PAEDIATRIC EAR, NOSE, AND THROAT SURGERY: INCIDENCE PATTERNS AND PARENTAL EXPERIENCES

Jacqueline Heather Stephens

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For Mitchell & James

The first was my inspiration to start;

The second, my courage to continue;

Both were my motivation to finish.

Table of Contents

List of Tables

List of Figures

List of Maps

List of Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AMWAC	Australian Medical Workforce Advisory Committee
AR-DRG	Australian Refined Diagnosis Related Groups
ASOHNS	Australian Society of Otolaryngology Head and Neck Surgery
cf.	*conferre* (Latin), 'compared to'
CI	confidence interval
DoHA	Department of Health and Ageing
ENT	ear, nose, and throat
ERP	Estimated resident population
GIS	geographic information system
ICD	International Classification of Diseases
ICD-10-AM	International Classification of Diseases, Australian Modification, Version 10
ICD-10-CA	ICD-10 with Canadian Enhancement
ICD-10-CM	ICD-10 with Clinical Modifications
ICD-10-GM	ICD-10 German Modification
IRSD	Index of Relative Socio-economic Disadvantage
ISAAC	Integrated South Australian Activity Collection
NCCH	National Centre for Classification Health
NHMD	National Hospital Morbidity Database
NSW	New South Wales
OR	odds ratio
SA	South Australia
SEIFA	Socio-Economic Indexes for Areas
SAR	standardised admission ratio
SD	standard deviation
TTI	tympanostomy tube insertion
USA	United States of America
vs.	versus

Abstract

Background

Surgery on the ears, nose, and throat (ENT) is amongst the most frequently performed on children driven by the propensity of children to contract infectious diseases as their immature immune systems develop. Previously epidemiological reports presented incidence of surgical intervention in age-bands, typically in 5-year age groups, which when reporting on paediatric conditions, can obscure the reporting of those children most likely to undergo surgery. Reports also suggested that the geographical distribution of the children who undergo surgery may follow specific patterns reflecting socio-economic status or geographical locale. The purpose of the thesis was to gain a clear and in-depth understanding of the incidence of tonsillectomy, adenoidectomy, and myringotomy within South Australia; to investigate how these incidences compared to other states and territories within Australia, and to identify and understand the factors that underpin and influence these incidences.

Method

In order to address the aims of the thesis, a mixed methods approach was adopted. Three retrospective cross-sectional quantitative studies were conducted to 1) describe the epidemiology of the procedures within the South Australian paediatric population; 2) describe and compare the epidemiology of the procedures across the Australian paediatric population; and 3) to describe and compare the geographical distribution of the surgical incidences across the South Australia. A prospective cross-sectional qualitative study was conducted that utilised semi-structured interviews with parents/caregivers of children undergoing ENT surgical intervention to understand their experiences, perspectives, and expectations.

Results

This thesis has shown that South Australian children have a higher than expected incidence of these ENT surgical procedures as compared to other Australian states and territories. There are definitive disparities across Australia in the frequency and age at which children undergo the procedures, with the state in which a child lives clearly associated with the likelihood of undergoing the surgery. Specifically, within South Australia, the children who most often underwent tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion were very young, more commonly were boys, and with private health insurance. Disruptions to the financial security and wellbeing of the child's household - through school and childcare absences, parental work absences, cost of repeat doctors' visits and medications, and the household's overall quality of life - were identified as key factors influencing the decision of parents and caregivers to proceed with surgery.

Conclusion

Clearly, there are geographical disparities in the ENT surgical incidences in South Australia and these are influenced by the child's age, gender and state in which they lived, with South Australian children undergoing these surgical interventions at a somewhat earlier age than the other states and territories examined in this thesis. These variations are most likely underpinned by difficulties in the affordability of healthcare and the financial pressures linked to lower socioeconomic status. This was further reinforced by the experiences described by parents and caregivers of children undergoing the surgeries; with financial security and disruptions to the family's quality of life being key factors driving surgical intervention. These broader implications of childhood illness should be considered when planning improvements in the access to appropriate health services, and may have important implications for reducing the burden on the Australian healthcare system.

Thesis Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

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Signed: Dated: 23 February 2017

Grants and Awards

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ARCNSISS Summer School Scholarship 2009, *Airfares, Fees and Accommodation*
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Australian Epidemiological Association Student Travel Award 2012, *$450*

Presentations

An exploration of the large variations in the epidemiology of childhood grommet insertion across Australia. Population Health Congress 2012, Adelaide Convention Centre. Wednesday, 12 September 2012. [Snapshot Presentation]

Childhood middle ear infections impact the social and financial health of families. Population Health Congress 2012, Adelaide Convention Centre. Monday, 10 September 2012. [Poster]

Paediatric ear, nose, and throat surgery: who, where, why and when? The University of Adelaide's Faculty of Health Sciences Postgraduate Research Expo. National Wine Centre, Adelaide. Friday, 31 August 2012. [Poster]

Paediatric ear, nose, and throat surgery: who, where and when? Spatial Information Day 2012, Adelaide Convention Centre, Adelaide. Friday, 3 August 2012 [Podium Presentation]

Research Update. School of Paediatrics & Reproductive Health Higher Degree Research Seminar, Women's & Children's Hospital, North Adelaide. Wednesday, 11 July 2012. [Presentation]

An investigation into the variations in the Australian epidemiology of paediatric tympanostomy tube insertion. Australian Society for Medical Research SA Scientific Meeting, Adelaide Convention Centre. Wednesday,6 June 2012. [Presentation]

Large variations in the epidemiology of paediatric otorhinolaryngological surgery across Australia. Head and Neck Surgery Section, Royal Australasian College of Surgeons Annual Scientific Congress. Kuala Lumpur, Malaysia. Monday, 7 May 2012. [Poster]

Stephens J, Baghurst P, O'Keefe M, Schembri M. Large variations in the epidemiology of paediatric otorhinolaryngological surgery across Australia. HN32P. ANZ J Surg. 2012; 82 (S1): 82. Head and Neck Surgery Section, Royal Australasian College of Surgeons Annual Scientific Congress. Kuala Lumpur, Malaysia. Monday, 7 May 2012 [Conference Proceedings Abstract]

Epidemiology of Paediatric Myringotomy and Tympanostomy Tube Insertion in South Australia: 1997 to 2007. Australian Epidemiological Association (SA Group) Conference – Epidemiology over the lifespan. The University of Adelaide. Friday, 14th August 2009. [Presentation]

Epidemiology of Paediatric Tonsillectomy and Adenoidectomy in South Australia: 1997 to 2007. State Population Health Conference - Public Health Research for the Real World. Education Development Centre, Hindmarsh. Saturday 18th October 2008. [Presentation]

Paediatric otorhinolaryngologic surgery in South Australia: 1997 to 2007. The University of Adelaide's Faculty of Health Sciences Postgraduate Research Expo. National Wine Centre, Adelaide. Tuesday, 22 July 2008. [Poster]

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The most worth-while thing is to try to put happiness into the lives of others.
Robert Baden-Powell

As I reflect on the course that this PhD candidature has taken, I realise that there are many people I must thank, but a few I must thank profusely. The six years that I have spent, firstly as a fulltime student and then as a part-time student, have been difficult and involved juggling multiple roles at once. Mother, wife, and student – usually in that order. I have had to navigate kindergarten and school routines and all that running a household entails. I had my laptop stolen – twice. And then, following the birth of my second child, I shifted from researcher to statistic as I dealt with a child who entered the health system. After three hospital stays – including all three surgical procedures examined in this thesis – and years of appointments and tests, my family finally has some resolution and my child has returned to good health. So it is that I know that my thesis is relevant, important, and provides an accurate account of the quality of life issues surrounding these conditions.

My family

So with those sentiments in mind, firstly, and most importantly, I would like to thank my family for their ongoing love, support, and encouragement. First and foremost, thank you Chris, for giving me the opportunity to undergo my candidature, for continually encouraging and supporting me, and for putting up with me throughout the process.

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SECTION I:

BACKGROUND AND

LITERATURE REVIEW

The work of epidemiology is related to unanswered questions,

but also to unquestioned answers.

Patricia Buffler

CHAPTER 1
An Overview

1.1 INTRODUCTION

The most common childhood ailments are related to the exposure of children to infectious diseases. Most common are infections involving the upper respiratory tract – more specifically, the ear, nose, and throat (ENT). These infections are typically short-lived and resolve spontaneously. Furthermore, these episodes of infection are important during childhood for the development of the immature immune system. However, it is not uncommon for medical intervention to be warranted. Antibiotics and analgesics are most commonly implemented. However, when these treatments are no longer efficacious and the infections become recurrent or irresolvable, surgical intervention is often recommended. In these cases, surgery involves either removing all or part of the infectious tissue, or draining the fluid from the infected organ.

ENT surgery is amongst the most historic and prevalent surgery performed. For example, the first recorded account of tonsillectomy (the surgical removal of the tonsils) is within the tome *De Medicina* written by the Roman surgeon Celsus in 30 AD,[1] while the first report of myringotomy was in 1649 by French anatomist, Jean Riolan the Younger.[2] In the centuries since, these surgeries have gone through periods of waxing and waning popularity. There have been allegations of overuse and misuse. Controversies and academic discussion on the method of surgical approach and appropriate patient selection have been rife. And the discussion continues. Despite the abundance of published literature on ENT surgery, there still continues to be questions on when, how and who to perform these procedures on. But resolving these questions is not the focus of this thesis. Rather, the aim of this thesis is to provide a clear and accurate description of the recent use of these surgeries, thereby providing a foundation that can be used by policy makers in devising clinical practice guidelines and intervention recommendations.

It is widely accepted that ENT surgeries persist as amongst the most common surgical interventions for children and one of the most common reasons for paediatric hospital admissions. Specifically, tonsillectomy, adenoidectomy, and myringotomy were amongst the five most common surgical procedures performed during paediatric hospital admissions in Australia for 2009-10 in children aged 0 to 14-years-old.[3] Specifically, in the state of South Australia, tonsillectomy and myringotomy are historically the two most common surgical procedures performed during hospital admissions for both adults[4] and children.[5] Previous reports show that in the late 1990s, South Australia had a higher standardised admission ratio (SAR) when compared to the remainder of Australia.[5] In South Australia, the incidence of tonsillectomy was 18% higher than the other states and territories, while myringotomy was 28% higher.

Unfortunately, the epidemiological evidence describing these surgical procedures for South Australia is sparse. However, the evidence that is published would seem to suggest that South Australia has maintained a higher than expected surgical incidence of these ENT procedures.[4] Given this limited evidence, the possibility that a disparity may continue to exist in the incidence of these procedures within Australia provided the impetus for this study.

1.2 PURPOSE OF THE THESIS

The overarching aim of this thesis was to understand the epidemiology of the three most common ENT surgeries – tonsillectomy, adenoidectomy, and myringotomy – amongst the South Australian paediatric population. The purpose is to gain a clear and in-depth understanding of the paediatric population that underwent these surgeries throughout the study period. A further examination of how these South Australian incidences compare to other states and territories within Australia will provide another layer of information. The thesis will extend the available knowledge by providing a detailed account within the South Australian setting which has not been previously conducted. In order to understand the epidemiology of the surgical procedures, it is also pertinent to understand how these children come to undergo surgery. Therefore, the thesis will explore a number of potential influences that may drive the increased incidence of these procedures within the South Australian paediatric population. In order to identify and understand these potential factors, qualitative research will be presented that aims to understand the experiences and expectations of parents and caregivers who are responsible for their child's healthcare decisions.

1.2.1 Key Aims

There were three key aims for the thesis. These aims were as follows:

1. To provide a detailed description of the epidemiology of tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion within the South Australian paediatric population.
2. To understand how the epidemiology within the South Australian population compares to the wider Australian population by describing and comparing the epidemiology of tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion across the Australian states and territories.

3. To understand the motivators and cues to action that drive parents/caregivers to seek surgical intervention for their child's ENT condition.

1.2.2 Key Objectives

There were numerous objectives set throughout the course of the thesis development. The key objectives are outlined as follows:

1. To accurately describe the age- and sex-specific incidence of tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion in the South Australian paediatric population.
2. To determine whether the incidence of these surgical procedures changed over the course of the study period within the South Australian paediatric population.
3. To determine the influence of admission status (public system *vs*. private insurance) and hospital location (metropolitan *vs*. country) on the incidence of these surgical procedures within the South Australian paediatric population.
4. To accurately describe the underlying medical conditions listed as the indication for surgery and whether the indications for surgery changed over time within the South Australian paediatric population.
5. To accurately describe how these incidences for South Australia compare to other Australian states and territories.
6. To accurately describe and illustrate the geographical variation of the incidences of these surgical procedures across South Australia.
7. To understand how the experiences of parents/caregivers of children with ENT conditions influence their decision to seek a referral for surgical intervention by an ENT specialist clinic.

1.2.3 Research Questions

The aims and objectives outlined above were developed in order to answer the following research questions that emerged throughout the development phase of this thesis. These questions are the foundation for each results chapter within the thesis.

1. What is the epidemiology of paediatric tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion within South Australia?
2. How does the epidemiology of these surgical procedures within South Australia compare to other Australian states and territories? Can any incidence differences across Australia be explained by otorhinolaryngology workforce density?
3. Within South Australia, where do children who undergo these procedures reside, and can these spatial variations provide insight into factors that influence incidence?
4. What are the experiences of parents, caregivers and families of children who require these surgical procedures, and do these experiences influence the decision to pursue surgery?

1.3 THESIS STRUCTURE

This thesis comprises five sections, with nine chapters in total. The first section of the thesis is comprised of the first three chapters of this thesis, providing a foundation for the research, and includes the introduction, background and literature review. The second and third sections includes the five results chapters - each chapter reporting on one of a series of research studies conducted to address each of the research questions previously outlined. The fourth section incorporates the discussion, while the fifth section includes the references and appendices.

Chapter one provides an introduction to the thesis, introduces the aims and objectives, and the format and structure of the thesis. The ethical approvals sought and given for this thesis are provided in this chapter.

Chapter two provides a brief background on the anatomy involved in, and the symptomatology and risk factors associated with, the ENT ailments that preclude surgical intervention. There is also a brief explanation of the surgical procedures that are the focus of this body of research.

Chapter three constitutes a critical review of the literature examining the epidemiology of the surgical procedures studied herein. Two separate reviews were performed – one examined the available epidemiological literature for tonsillectomy with/without adenoidectomy, while another examined the same for myringotomy with/without tympanostomy tube insertion. A final section of this chapter provides an examination of previously published research on the quality of life and lived experiences of children who have the underlying medical conditions, and their parents/caregivers.

Within the following three chapters, the results of three epidemiological research studies conducted within the framework of this thesis are presented. **Chapter four** provides a detailed description of the age and sex-specific incidences of paediatric ENT surgery in South Australia. This chapter provides a level of detail that has not been previously reported for an Australian population and expands upon previously-reported Australian data published by the Australian Institute of Health and Welfare (AIHW)[6, 7] and Rob *et al.*[8]

Chapter five situates the South Australian epidemiology presented in Chapter 3 into an Australian context. The epidemiology of paediatric ENT surgery of five of the eight Australian states and territories is compared and examined. The results presented in this chapter indicate that there is undoubtedly strong evidence that South Australia persistently had the highest frequency of paediatric ENT surgery in Australia throughout the study period. This chapter also outlines the surgical workforce present in Australia during the study period and relates it to the data presented. The results highlight a number of disparities between the five Australian jurisdictions studied herein, particularly relating to the theory that a higher frequency of surgical procedures must be perpetrated by a higher proportion of surgeons.

Chapter six presents the epidemiology of these procedures geographically so that the spatial distribution of the children that undergo these procedures within South Australia can be appreciated. Higher-than-expected frequencies of the procedures are performed on children from some rural and regional centres, while some areas of metropolitan Adelaide have a clustering of higher-than-expected frequencies which are closely aligned with the geography of socioeconomic status.

The final two results chapters present the findings of the qualitative components of research conducted as part of this thesis. Directly preceding these chapters is a **reflexivity statement** that outlines this author's professional position within the health arena, and personal experience of the research material. While the topic of research was devised purely on the academic relevance of the subject matter, the author moved from researcher to the researched during the thesis timeline. Within a qualitative research design, it is important to understand the researcher's social position and personal experience. Reflexivity is crucial in taking account of the effect of the researcher in the qualitative research process. Outlined in **chapter seven** is the report of the pilot study conducted to develop the research approach and protocol used in the following chapter.

In **chapter eight**, the results of a qualitative cohort study are presented and discussed. The results highlight the impact that the underlying medical condition has on, not only the child, but the parents, carers and household members who live with the child. There is evidence of a patient-preference demand for surgical intervention, particularly when the child's medical condition begins to impact on the social, financial and emotional wellbeing of other members of the household.

Finally, **chapter nine**, being the last chapter of this thesis, summarises the results presented within the thesis and provides an interpretation of these findings. The validity of the work is reviewed and opportunities for potential future research identified. Results conclusions are drawn and the policy implications of the research are explored.

1.4 ETHICAL APPROVALS

Research conducted for, and presented within, this thesis was approved by the Children, Youth and Women's Health Service Human Research Ethics Committee and the AIHW Research Ethics Committee. The application numbers and approval dates are listed in Table 1-1. Notifications of the ethical approvals by these institutions were made to the University of Adelaide Human Research Ethics Committee. Copies of all approval letters are included in Appendix B.

Table 1-1: List of Human Research Ethics Committee Applications and Approvals.

Application Title	Application ID	Date of Approval
Children, Youth and Women's Health Service		
Understanding the rates of myringotomy and tonsillectomy/adenoidectomy in South Australian children with special reference to the Northern Communities of Adelaide: An Audit.	Audit 17	1 June 2007
	Addendum	29 January 2010
Understanding the rates of myringotomy, tonsillectomy, and adenoidectomy in South Australian children with special reference to the Northern Communities of Adelaide: Referral Patterns and Waiting Lists	REC2061/5/11	12 August 2008
Australia Institute of Health and Welfare		
Understanding the incidence of myringotomy, adenoidectomy and tonsillectomy in Australian children.	2010-035	26 August 2011

CHAPTER 2
A Background to the Surgical Procedures

2.1 ANATOMY OVERVIEW

2.1.1 Adenoid and Tonsils

The adenoid and tonsils are lymphoid structures of the nose and throat that are similar in histology and function. The pharyngeal tonsil, commonly called the "adenoid", is situated in the nasopharynx on the posterior wall of the nasal cavity (Figure 2-1).

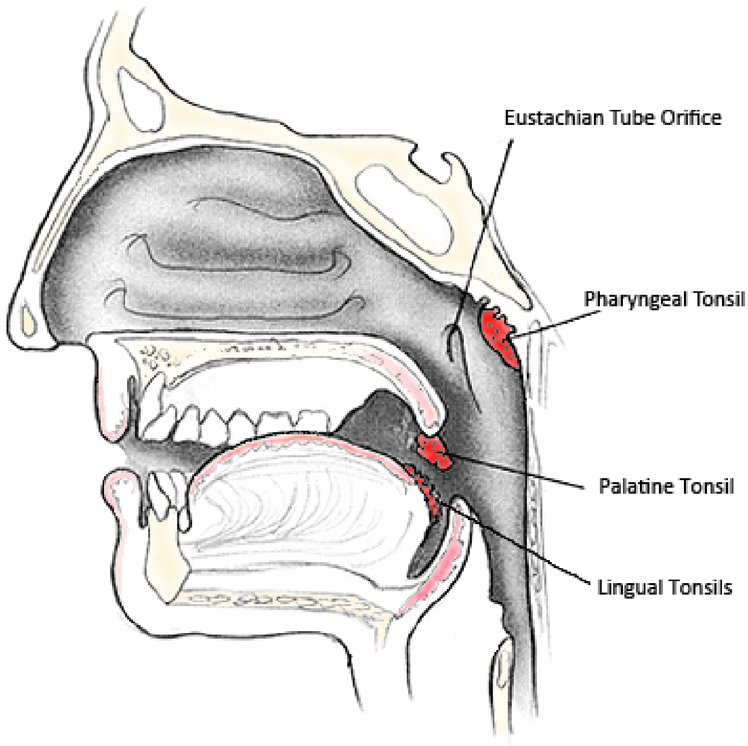


Figure 2-1: Anatomy of the ear, nose, and throat: pharyngeal and palatine tonsil.

Modified image. Original image sourced from: Bailey BJ, Johnson JT, editors. Head & Neck Surgery - Otolaryngology. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.[9]

Located in the confined space behind the opening of the Eustachian tube and above the level of the soft palate, the adenoid can become obstructive. The palatine tonsils, commonly called the "tonsils", are those involved in tonsillitis. They are oval-shaped masses located on the lateral walls of the oropharynx between the two palatine arches.[9] While much of the palatine tonsil is embedded, a large proportion visibly projects out from the surrounding tissues. In some children, this visible portion of the tonsils can be large enough to cause obstruction. While the lingual tonsils can become infected or can obstruct, the term "tonsillectomy" typically refers to the removal of the palatine tonsils. Both the palatine tonsils and adenoids are larger in children than in adults. After puberty, the tonsils reduce in size and assume a flattened, disc-shape, while the adenoids start to regress at the age of 5-years and typically finished regressing by age 10-years.

2.1.2 Middle Ear and Eustachian Tube

The middle ear is comprised of the tympanic membrane (ear-drum), the tympanic cavity and the ossicles (Figure 2-2). The middle ear plays an important role in hearing. The ossicles are bony structures that transmit acoustic vibrations from the ear-drum to the cochlea within the inner ear. The middle ear cavity is connected to the nasopharynx by the Eustachian tube. The Eustachian tube has two main functions: 1) to provide drainage of secretions produced by the middle ear mucosa, and 2) to allow pressure equalisation of the middle ear.[10] A simplistic explanation is that due to its close proximity to the adenoids, the nasopharyngeal opening of the Eustachian tube can be obstructed by adenoids that are inflamed or enlarged. This can result in a build-up of fluid in the middle ear, leading to otitis media with effusion ("glue ear"). However, recent literature has shown that the proximity of the infected adenoids to Eustachian tube, particularly in the presence of an upper respiratory tract infection, facilitates the introduction of the infection into the passage-way.[11-13] The established presence of a bacterial biofilm on the adenoid and in the middle ear has been shown to cause chronicity and recalcitrance to antibiotic treatment and antibody response.[14, 15] Furthermore, because of the developing skull anatomy of young children, the Eustachian tube may not drain effectively and this can also lead to otitis media ("ear infection").

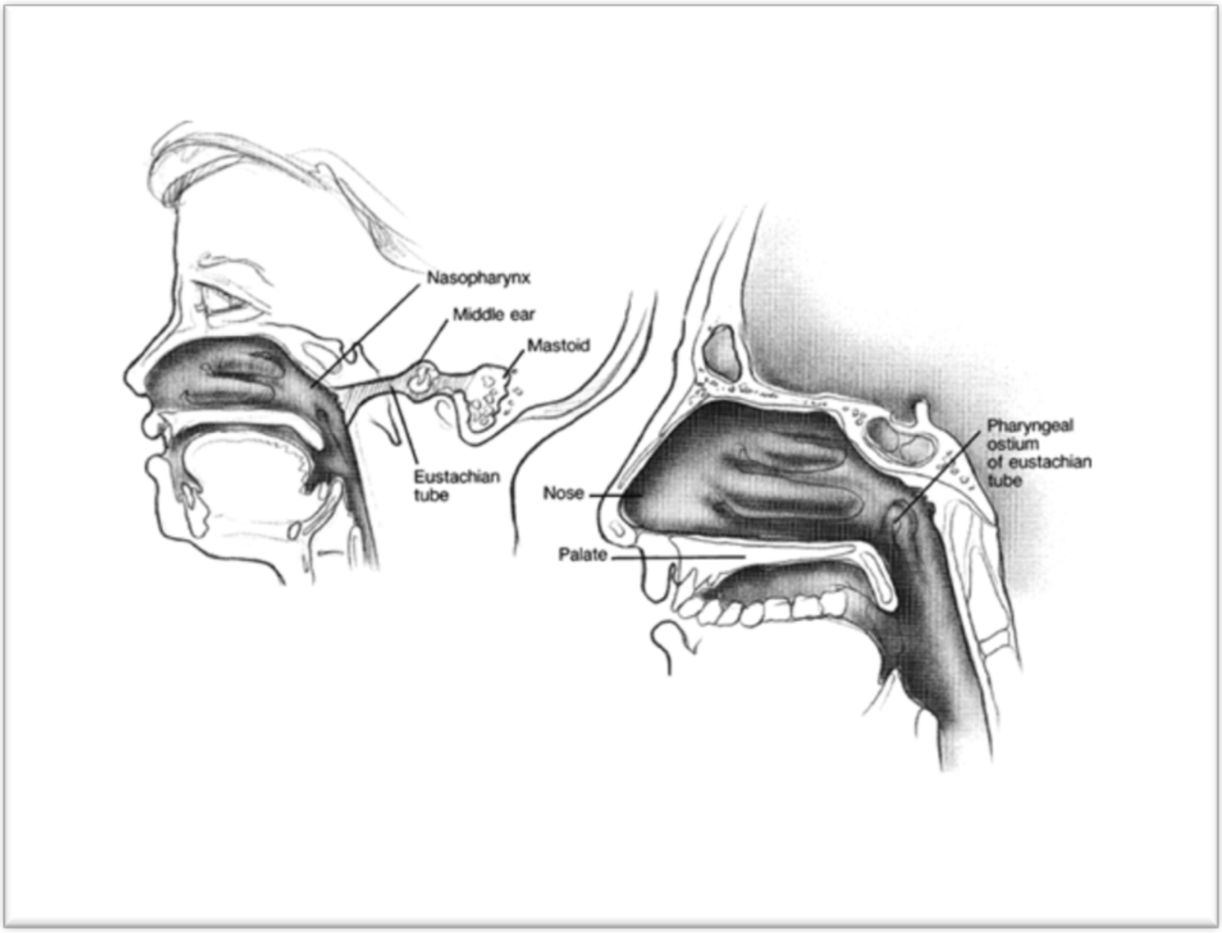


Figure 2-2: Anatomy of the ear, nose, and throat: tympanic membrane and Eustachian tube.

Source: Bailey BJ, Johnson JT, editors. Head & Neck Surgery - Otolaryngology. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.[10]

2.2 SURGICAL OVERVIEW: INDICATIONS AND GUIDELINES

2.2.1 Tonsillectomy

Tonsillectomy is the surgical excision of the palatine tonsils and is usually performed under general anaesthesia.[9] The tonsils may be excised for a number of reasons, however most commonly they are excised if they become recurrently acutely or chronically infected ("tonsillitis"), or if they are enlarged, obstructing inhalation and causing sleep disordered breathing (including snoring and obstructive sleep apnoea syndrome).[9, 16, 17] Tonsillectomy has also been shown to be of benefit for children who have a history of recurrent severe pharyngotonsillitis ("sore throat").[18 19]

Tonsillitis

Tonsillitis is the viral or bacterial infection of the tonsils resulting in inflammation and pain, making it difficult to swallow, and often resulting in a fever and malaise. Criteria, first set by Paradise *et al.* in 1984,[20] describe the number of episodes of sore throat (including tonsillitis) required before the consideration of surgical intervention (Table 2-1). These guidelines are often the basis of clinical practice guidelines, including in the United States of America (USA)[21] and Scotland,[21, 22] although some countries have developed their own criteria.[23, 24] Until recently there were no Australian consensus guidelines outlining when intervention with tonsillectomy should occur. However, in 2008 an Australian position paper was published that recommended adopting these same Paradise criteria.[25] Prior to this, a review published in 1992 suggesting using modified criteria.[26] Despite wide acceptance of the Paradise criteria as the mainstay of surgical intervention, research has shown that they are not always adhered to,[27] that some children will have their symptoms resolve without surgical intervention,[18] and that for children with moderate throat infections there may not be any cost benefit.[28]

Table 2-1: Paradise Criteria for Tonsillectomy

Criterion	Definition
Minimum frequency of sore throat episodes	7 or more episodes in the preceding year, OR 5 or more episodes in each of the preceding 2 years, OR 3 or more episodes in each of the preceding 3 years.
Clinical features (sore throat plus the presence of one or more qualifies as a counting episode)	Temperature > 38.3°C, OR Cervical lymphadenopathy (tender lymph nodes or >2 cm), OR Tonsillar exudate, OR Positive culture for group A b-haemolytic streptococcus.
Treatment	Antibiotics had been administered in conventional dosage for proved or suspected streptococcal episodes.
Documentation	Each episode and its qualifying features had been substantiated by contemporaneous notation in a clinical record, OR If not fully documents, subsequent observance by the clinician of 2 episodes of throat infection with patterns of frequency and clinical features consistent with the initial history.

Source: Paradise *et al.* (1984) [20]

Sleep Disordered Breathing

The term "sleep disordered breathing" encompasses a range of breathing disorders, including upper airway resistance syndrome, primary snoring, and obstructive sleep apnoea syndrome.[16] These conditions all cause a lack of adequate oxygenation and/or repetitive arousals to resume breathing throughout sleep. While the mechanisms remain poorly understood, enlarged ("hypertrophic") tonsils undoubtedly play a role in the causation by obstructing the airways. Although other factors, such as mandibular posture,[29-31] airway collapsibility,[32] hyoid bone position,[31] and soft palate shape,[31] also play a role. Most commonly, sleep disordered breathing results in daytime somnolence ("sleepiness")[16] and poor cognition.[33, 34] However, in children the prolonged impact of sleep disordered breathing includes a range of behavioural and developmental outcomes, such as hyperactivity,[35-37] inattention,[38] aggression,[35-37] depression,[35-38] difficulties with learning,[39] developmental delay,[40] and failure to thrive.[41] Children with sleep disordered breathing are also more likely to have associated enuresis ("bed wetting").[42-45] There may also be long-term consequences, since autonomic nervous system regulation is altered in children with sleep disordered breathing.[46] Furthermore, the impact varies depending on the form of sleep disorder. Snoring is associated with deficits in intelligence and attention, while behavioural sleep problems result in memory and behavioural issues.[47]

The extent of the impact of sleep disordered breathing on quality of life is typically measured using validated questionnaires. These questionnaires include a range of questions to measure sleep disturbance, behavioural and intellectual impact, and parental concerns to produce a quantified score.[38, 48] However, a key deficiency of using validated questionnaires to understand disease burden is that some components of quality of life are subjective. Furthermore, often these subjective impacts, such as on school performance, have been shown to not correlate well with quantifiable impacts, such as tonsil size or the respiratory distress index (a measure used in polysomnography –

also known as a sleep study – is a test used to diagnose sleep disorders).[39] The sole use of validated questionnaires may, therefore, miss other important aspects of the consequences of this condition.

Within Australia, the current recommendation is that children with a diagnosis of moderate to severe sleep disordered breathing should undergo adenotonsillectomy as the preferential treatment.[25, 49] However, there is a lack of evidence to support this recommendation.[50] Furthermore, for children who have milder forms of sleep disordered breathing, such as primary snoring, conservative management has been recommended.[25] However, this recommendation is problematic since a high proportion of children that snore also have undiagnosed hypoxic respiratory events.[51] Compounding this is the difficulty to distinguish between primary snoring and obstructive sleep apnoea syndrome on clinical history alone.[52-55] Instead, polysomnography is recommended for all children with snoring,[49, 52] which may not be feasible or practical due to the complexity, cost, and overnight duration of the testing. In fact, the procedure is performed so infrequently, that it is estimated that only 12% of children that undergo adenotonsillectomy for the treatment of obstructive sleep apnoea syndrome, have polysomnography performed prior to surgery.[56]

2.2.2 Adenoidectomy

Adenoidectomy is the surgical removal of the "adenoid", under a general anaesthetic, and with the operation performed through the mouth.[9] The operation is performed using a mirror and articulated surgical instruments which the surgeon manoeuvres into the confined space of the nasopharynx. If chronically infected ("adenoiditis") or enlarged ("hypertophic"), the adenoid can obstruct breathing through the nose, causing mouth breathing, snoring and sleep disordered breathing. As previously described in Section 2.1.2, the infected adenoids can spread infection to the Eustachian tube, with the resultant Eustachian tube infection and inflammation causing obstruction of the passage-way. The obstruction of the Eustachian tube causes fluid to collect in the middle ear, resulting in recurrent acute or chronic ear infections. Recurrent sinusitis is also a common indication for adenoidectomy. Due to the pathology of the adenoid and the aetiology of these conditions, adenoidectomy is often performed in conjunction with tonsillectomy, for the treatment of sleep disordered breathing,[25, 50] or in conjunction with myringotomy, for otitis media.[57, 58]

When adenoidectomy is performed for otitis media, there are only modest reductions in the number of episodes per year.[59-62] Furthermore, conflicting evidence exists regarding when adenoidectomy should be used in the treatment of otitis media. Research suggests that for children who have adenoidectomy in conjunction with their first tympanostomy tube insertion, the probability of requiring further tube insertions is greatly reduced (0.08 vs. 0.24, $p<0.001$).[58, 63] However, other evidence suggests that adenoidectomy is most efficacious for children who have had previous unsuccessful treatment with tympanostomy tube insertion.[60, 64] Furthermore, the benefits of adenoidectomy are most noticeable during the initial 12-month postoperative period.[62, 64] Given the lack of substantial evidence, adenoidectomy is not recommended as first-line treatment for otitis media.[65-67]

2.2.3 Myringotomy with/without Tympanostomy Tube Insertion

A myringotomy involves creating a surgical incision in the tympanic membrane ("eardrum") to allow the drainage of middle ear fluid.[68] This incision usually heals quickly; therefore, typically a tympanostomy tube ("grommet") is inserted to ensure the opening remains patent. This small plastic tube provides ventilation and drainage to the middle ear for several months. The procedure is used to treat otitis media ("ear infection") – long recognised as a continuum of middle ear infections,[69] ranging from acute otitis media through to chronic otitis media with effusion. To clarify, an effusion is the build-up of the fluid produced by the middle ear that usually drains through the Eustachian tube in the nasopharyngeal cavity. Chronic otitis media with effusion does not have the signs or symptoms of acute inflammation and can persist for many weeks. However, the main clinical sign that discriminates acute otitis media from otitis media with effusion has been shown to be the bulging of the tympanic membrane.[70]

Acute Otitis Media

Acute otitis media is typically viral in origin and associated with an upper respiratory tract infection.[71, 72] Usually acute otitis media is self-limited, resolving spontaneously with the resolution of the respiratory illness,[61] although some children with recurrent acute otitis media will develop otitis media with effusion.[73] The symptoms of acute otitis media usually include pain, fever, and irritability.[74] Guidelines recommend that a diagnosis of acute otitis media requires “a history of acute onset of signs and symptoms, the presence of middle ear effusion, and signs and symptoms of middle-ear inflammation” (Table 2-2).[74]

There is general consensus that, for children with uncomplicated acute otitis media, a period of observation is appropriate,[74-77] but should be supplemented with analgesic pain management.[78] This approach may, in fact, reduce the usage of antibiotics,[79 80] however there is evidence to suggest that there is poor adherence to these prescribing guidelines.[81-83] Nonetheless, when antibiotic prescription is necessary, amoxicillin is the recommended first-line therapy,[22, 74, 84] with other antibacterial agents used when amoxicillin does not resolve the infection.[74, 85, 86] Antibiotics have been shown to be most beneficial for children aged under two-years-old.[61] Furthermore, for children at risk of recurrent infections, antibiotics have been shown to reduce the probability, and the number of episodes, of acute otitis media.[87] Current guidelines typically make no mention of or recommendation for or against surgical intervention. Research has shown that myringotomy in the treatment of acute otitis media was of little benefit,[88] and may actually delay disease resolution.[89] However, more recently, tympanostomy tube insertion has been shown to be beneficial in the prevention of recurrent episodes in very young children.[90]

Table 2-2: A Definition of Acute Otitis Media

Acute otitis media
1. Recent, usually abrupt, onset of signs and symptoms of middle-ear inflammation and middle ear effusion.
2. The presence of middle ear effusion, as indicated by any of the following: ▪ Bulging of the tympanic membrane, ▪ Limited or absent mobility of the tympanic membrane, ▪ Air-fluid level behind the tympanic membrane, or ▪ Otorrhea.
3. Signs or symptoms of middle-ear inflammation, as indicated by: ▪ Distinct erythema of the tympanic membrane, or ▪ Distinct otalgia (discomfort clearly referable to the ear[s] that results in interference with or precludes normal activity or sleep).

Source: American Academy of Pediatrics Subcommittee (2004)[74]

Otitis Media with Effusion

In contrast, otitis media with effusion ("glue ear") usually does not involve pain or fever,[67, 91] being instead characterised by a build-up of non-purulent mucoid or serous fluid in the middle ear space.[67] Children with otitis media with effusion typically present with hearing loss,[67] caused by aural fullness[67, 92] and decreased mobility of the tympanic membrane.[67] Children with delayed diagnosis may also experience balance impairment,[93] and/or speech and language delays.[67] Evidence from animal models suggests that the long-term impact of delayed diagnosis includes impairment of the central auditory functioning (the way that sounds are processed by the cochlea into neural impulses), binaural hearing (the ability to localise and differentiate sounds), and temporal hearing (the ability to separate and integrate sounds over time).[94] However, while these impacts can be long-term, they were reversible in animal models and required between 6 and 24 months of training and testing to resolve.[94] Despite this, it has been highlighted that conclusive evidence is lacking on the impact of otitis media with effusion on quality of life.[95]

Otitis media with effusion should be diagnosed with pneumatic otoscopy (an examination that visually assesses the mobility of the tympanic membrane in response to pressure),[66, 67, 76, 96] and can be confirmed with tympanometry (an examination that quantifies the mobility of the tympanic membrane and the ear canal volume).[67, 96, 97] However, there may be no benefit to screening of otitis media with effusion. A systematic review of research studies that identified children for treatment via screening programs, concluded that there was no clinically significant improvement in language development gained by screening and treating children for otitis media with effusion.[91] Although, the review authors acknowledged that these findings may not be translatable to screening in developing countries, and that the studies reviewed may have included younger children and those with milder disease, thus impacting on the research findings.[91]

Current guidelines recommend that for children with otitis media with effusion, a three-month period of “watchful waiting” is observed.[66, 67, 76, 98-100] This “watchful waiting” allows for natural resolution to occur. However, the successful implementation of “watchful waiting” may depend on the technical skill of the general practitioner and the availability of appropriate audiometry equipment in the clinic, resulting in potential workload increases.[98] Furthermore, debate continues on the appropriate duration of “watchful waiting” for low-risk children, with recent suggestions of observational periods of up to 18 months.[67, 101] There are also variations in the recommendation for the treatment during, and beyond this, "watchful waiting" period. There are recommendations that after a three-month period of observation, a two to four-week antibiotic course may be prescribed;[99] while other guidelines expressly do not recommend the use of antibiotics in otitis media with effusion treatment.[100] Guidelines published by the American Academy of Pediatrics advise that antibiotic use is not effective in the long-term resolution of otitis media with effusion, but that a two-week course of antibiotics may be used when parents have an aversion to surgical intervention.[67] Surgical intervention (tympanostomy tube insertion) is recommended for children with significant hearing loss at risk of developmental delays,[67, 76] with intervention dependent on the amount of hearing loss.[66, 76, 100, 102] There is, however, general consensus that there is no evidence to support the use of antihistamines, decongestants or corticosteroids for the treatment of otitis media with effusion.[67, 91, 100]

2.3 INDICATIONS FOR SURGERY: INCIDENCE, PREVALENCE AND BURDEN OF DISEASE

2.3.1 Acute Otitis Media and Otitis Media with Effusion

Population-wide incidence and prevalence are difficult to estimate for otitis media. This is due in part to the use of differing classification systems and definitions, and because those affected with otitis media do not always seek, or require, medical attention. Therefore, incidence and prevalence estimates are typically formulated using the results of cohort studies. However, this often results in estimates that are greatly varied. For example, a recent systematic review estimates the annual incidence of acute otitis media is anywhere from 11.7 to 360 per 1,000 children aged under 5-years-old.[103] In the Netherlands, the incidence of otitis media has recently increased for children aged under 4-years-old,[104] a trend that has also previously been observed in the USA.[105] The increasing incidence of otitis media in the Netherlands was accompanied by an increasing trend in antibiotic prescription.[104] The recently observed increases in incidence and prevalence are most likely associated with an increasing exposure to risk factors,[105] particularly the greater than ever attendance at childcare by very young children.[106, 107] It has been estimated that by the age of three-years, up to 83% of children have had at least one episode of acute otitis media.[108]

In Australia, otitis media is one of the most common paediatric problems managed by general practitioners.[109] In fact, in Australia, ear ache is the most frequent reason infants visit a general practitioner.[110] And while typically otitis media is more prevalent in male children, it was reported that in 2003, otitis media was a leading cause of burden of disease for Australian girls aged 0 to 14-years-old (ranked 9th leading cause of disease burden for girls, whereas otitis media was not in the top ten causes of disease burden for boys).[111] Furthermore, the condition is most prevalent amongst Indigenous children, who are also more likely to have more severe presentations of the condition.[109] In some regions of Australia, such as the Northern Territory with its large Indigenous population, otitis media is the most prevalent diagnosis made during paediatric general practitioner consultations.[112] In comparison to other populations worldwide, Australian indigenous children have the highest prevalence of acute otitis media - 84% have otitis media.[113] Historically, otitis media has been amongst the most common problems observed amongst children living in Adelaide, South Australia. In 1980, it was reported that 6.6% children aged 4-years-old had otitis media, with 44% having had a history of ear infections.[114] More recently, in 2008, it was estimated that during the first 5-years of life, the incidence of acute otitis media in Australia is 1.74 cases per child per year.[110] This has been estimated to equate to an economic burden on the Australian health system of between AUS$100 and 400 million per year.[115] However, this estimate focussed on treatment costs, including antibiotics and doctor visits, and did not account for any costs associated with complications and comorbidities caused by otitis media. Another report estimated the impact of otitis media on other financial factors, such as lost income by carers, with a estimation of AUD$189.2 million for time lost for caring for children during their first 5-years of life.[110]

2.3.2 Tonsillitis

Despite tonsillitis being one of the most common infectious conditions affecting the upper respiratory tract, epidemiological data for children remains largely unreported. A recent epidemiological report from the Netherlands showed that from 2002-2008 the incidence of tonsillitis remained relatively stable, however, for older children aged 11 to 17-years-old there was a decreasing trend in incidence.[104] A recent Australian study of paediatricians did not report incidence or prevalence data on upper respiratory tract infections, since this diagnosis was not among the top 10 reasons for consultation in the study cohort.[112] However, insight of widespread impact of tonsillitis on the Australian population can be gained from reports on the *Better the Evaluation and Care of Health* (BEACH) program.[116] The BEACH program examined the workloads of general practitioners across the Australian population and assessed that reasons for patient visits to general practices. The study was population-wide and was not focused specifically on children. The BEACH program showed that tonsillitis was a commonly managed medical problem in 1998. Furthermore, that it was a problem managed across all regions of Australia, but in a greater frequency in remote regions of Australia.

2.3.3 Sleep Disordered Breathing

The prevalence of sleep disordered breathing is difficult to measure without conducting population-wide screening because it is largely unrecognised and underdiagnosed. Of course, accurate prevalence is not possible given the cost, both in time and financially, that data collection would require. However, several authors have estimated the prevalence of sleep disordered breathing, ranging from 1.8% (Italy),[117] to 2.9% (Iceland),[51] while the prevalence of habitual snoring has been reported as from 5.6% (Italy),[118] to 22.9% (USA).[119]

Evidence suggests that paediatric sleep disordered breathing remains under-diagnosed. Research has shown that parents often fail to report their child's sleep problems despite the presence of chronic symptoms.[51, 120] Furthermore, when children do have sleep disturbances identified by parents or general practitioners, they may not have the issues adequately addressed, diagnosed, or treated.[121] The current stance of the peak Australian otolaryngology organisations is that it is likely that a large proportion of the paediatric population would benefit from surgical intervention for what is currently undiagnosed sleep disordered breathing.[25] Importantly, this was driven by a group of South Australian sleep medicine physicians and otolaryngologists who pushed for a change in the paradigm for tonsillectomy in Australia, precipitating an potential increase in adenotonsillectomy for sleep disordered breathing, and a decrease in tonsillectomy alone for tonsillitis. Identification, and treatment, of these children may provide economic benefit, since research suggests that in the year preceding diagnosis and treatment, children with obstructive sleep apnoea have a two-fold increased utilisation of the healthcare system.[122] In 1980, a survey of 4-year-old children living across metropolitan Adelaide reported that 19% slept with their mouths open and 20% snored, suggesting that many children in this age-group had undiagnosed obstructive symptoms.[114]

2.3.4 Conclusion

As described in this section, the reported prevalence of these ear, nose, and throat (ENT) conditions in children is most likely underestimated. Despite this potential underestimation, a large body of research exists that identifies which children are more at risk of these conditions. The following section provides a detailed account of the potential risk factors that put children at risk of developing these medical conditions.

2.4 INDICATIONS FOR SURGERY: RISK FACTORS

The risk of undergoing surgery is directly related to the presence or absence of the clinical indications for surgery. As such, the risk factors for developing these surgical indications are also related to the risk of requiring surgical intervention. In the following sections, the risk factors for the development of one of the ENT conditions that are commonly used as indications for surgery are presented and discussed.

2.4.1 Acute Otitis Media

An extensive number of social and biological factors have been identified as potential risk factors for acute otitis media. These risk factors include parental smoking,[123-130] childcare attendance,[105, 123, 130-135] shorter duration of breastfeeding,[123, 130, 132, 134] dummy use,[136, 137] younger gestational age,[138, 139] lower birth weight,[130, 135, 138] maternal age and family structure,[126, 130, 132-134] ethnicity,[105, 126, 132, 135, 140] and male gender.[105, 126, 131, 132, 141, 142] Other potential risk factors identified include genetic predisposition,[143] allergy,[105] family history,[144, 145] air pollution,[130] socioeconomic status,[130, 135] and urban address.[131] However, the main risk factor for requiring surgical intervention is disease duration. Children who have otitis media for longer than four months duration have a very high risk of having tympanostomy tube insertion (odds ratio 16.8, 95% CI [11.7, 24.3]).[135] Furthermore, many of these risk factors also contribute towards an increased risk of subsequent re-insertion of tympanostomy tubes, particularly being a younger age (less than 18-months) at time of first tube insertion procedure and younger gestational age.[63]

In 1996, it was suggested that by removing children from childcare and family day care, up to 14% of acute otitis media cases during the first two-years of life could be prevented.[123] The population attributable fractions were calculated for each of these risk factors, suggesting that 19% (95% CI [15, 24]) of children would have avoided experiencing an episode of otitis media if they did not attend childcare, with 16% (95% CI [11, 20]) children avoiding otitis media if they did not attend family day care.[123] However, the authors rightly quantify these estimates by stating that the figures are hypothetical as childcare is necessary and unavoidable.[123] Research has debated the potential population attributable fractions of a variety of risk factors with otitis media.[146-149] More recently, in 2010, a review reiterated the importance of large-scale research to better determine causative factors, including aetiology and pathogenesis, genetics, and prenatal and environmental factors.[150]

Parental smoking

Research has shown both no relationship,[142, 151, 152] and definitive associations,[124, 125, 128] between second-hand exposure to cigarette smoke and otitis media. Despite this equivocal evidence, it is generally accepted that children with parents that smoke have an increased likelihood of acute otitis media.[113, 127] Research suggests that the odds ratio for otitis media in these children, compared to children of non-smoking parents, is between 1.2 and 1.6.[123, 124] Furthermore, children exposed to parental smoking and who have one episode of otitis media are more likely to become prone to repeated episodes than children who have an episode of otitis media but are not exposed to parental smoking.[123] This risk is up to double that for children of non-smokers who have had one episode.[124, 125] Research suggests that children of parents that smoke 20 or more cigarettes per day have a higher risk of having four or more episodes of acute otitis media over a four year period than children of non-smokers (odds ratio 1.8, 95% CI [1.1, 3.0])[153] Potential causal mechanisms include the impairment of ciliary function within the nasal cavity,[154] and the increased pathogenic colonisation of the nasopharynx, both shown to result from cigarette smoke inhalation.[155, 156] As an example, children exposed to cigarette smoke have been shown to have a higher *Streptococcus pneumoniae* carriage rate.[157] Although there is a strong association between parental cigarette smoking and otitis media, as shown in the Kalgoorlie Otitis Media Study,[158] the regularity of the exposure, proximity to exposure and the amount of cigarettes smoked by the parents are most likely critical to the impact that this risk factor has on otitis media incidence.

Childcare attendance

Childcare attendance increases the risk of otitis media.[132] This is likely due to the increased incidence of respiratory infections amongst childcare attendees and children in this age-group,[159-161] with the spread attributable to large numbers of children being in frequent close person-to-person contact as is can occur in the childcare setting.[162] In addition, because of the wide use of antimicrobial medication, children who attend childcare often harbour antibiotic resistant pathogens which further complicate medical treatment.[163] It has been estimated that children attending childcare are twice as likely to get acute otitis media compared to children cared for at home.[123] Reported estimates of the OR range from 1.5 to 3.7 for childcare exposure.[105, 123, 132, 135, 164] Other reports suggest that the relative risk is 1.7.[133] However, the size of the risk is dependent on the size of the childcare centre. It has been reported that children in centres caring for only 1 to 3 children have an OR of 1.5, compared to an OR of 3.7 for children in centres caring for over 12 children.[132] Furthermore, it may be possible that one of every five children attending childcare could avoid acute otitis media if they were cared for in the home.[123]

Breastfeeding

Breastfeeding has been shown to be protective against acute otitis media,[123, 132, 134] although there are reports that the association is weak.[141] Children who were breastfed for three to six-months have a lower likelihood of having otitis media compared to those that were formula-fed.[108, 150] The odds ratio for the protective effects of breastfeeding has been estimated at between 0.69 and 0.9.[123, 132, 164] While a reduction in the nasopharyngeal colonisation may be a potential mechanism of this protective effect,[71] the supine feeding position of breastfeeding may increase otitis media risk.[165] However, the overall evidence suggests a weak benefit associated with breastfeeding past 3-months-old.[123]

Dummy Use

Dummy use has been shown to be a preventable risk factor for acute otitis media. Children who use a dummy have nearly twice the risk of develop recurrent acute otitis media compared to those that do not (odds ratio 1.9, 95% CI [1.1, 3.2]).[137] This is much greater than a previous estimate of the impact of dummy use (relative risk 1.24, 95% CI [1.06, 1.46]).[164] The incidence of acute otitis media is 33% less amongst children who did not use a pacifier compared to those who did, suggesting that otitis media can be reduced when parents limit the use of a dummy for children aged less than 18-months.[136] While one report found no association between dummy use and acute otitis media,[132] the age group under review were children under 6-months-old and it may be that any association is not yet apparent for this age-group of children.

Gestational Age and Birth Weight

There may be an increased risk of acute otitis media for children born preterm or born with a low birth weight; however, the evidence is limited.[71, 166] One study suggests that children with a birth weight less than 1500g have nearly three times the risk of tympanostomy tube insertion (odds ratio 2.64, 95% CI [1.99, 3.50]) compared with children born with a birth weight greater than 2500g.[135] While one report did not find an association between birth prior to 37-weeks gestation and acute otitis media,[167] recent evidence suggests that the risk of having an episode of acute otitis media is greater for children born prematurely.[139, 166] These recent research reports focus on very premature children born earlier than 33-weeks' gestation, which may make these children more susceptible to ear infections.

Maternal Age and Family Structure

Children born to older mothers have a lower risk of otitis media.[126, 132, 133] Children of mothers aged over 34-years-old at the time of the child's birth have been shown to have an odds ratio of 0.81 compared to children of mothers aged 25 to 34-years.[132] One report stated that hospitalisation was more frequent for children with younger mothers.[134] Family structure has also been reported as impacting on otitis media risk. Children with older siblings,[126, 133, 134] parents with low educational levels,[132, 134] or a family history of otitis media,[133] have a greater likelihood of contracting otitis media. The number of children living in the home is important, with the size of the risk increasing as the number of children increases: two children living in the household (odds ratio 1.5, 95% CI [1.3, 1.6]) compared to three children (odds ratio 1.5, 95% CI [1.3, 1.7]), or more than four children (odds ratio 1.9, 95% CI [1.6, 2.3]).[132] Children of single mothers also have an increased risk.[132]

Ethnicity

A systematic review showed that there are racial/ethnic variations in the incidence of otitis media.[140] African-American and Hispanic children are less likely to have acute otitis media,[105, 132] and tympanostomy tube insertion,[135] than their Caucasian counterparts. The odds ratio for African-American children has been reported as between 0.6 (95% CI [0.5, 0.7])[105] and 0.75 (, 95% CI [0.62, 0.90]).[132] While for Hispanic children the odds ratio has been reported as between 0.8 (95% CI [0.6, 0.9]),[105] and 0.90 (95% CI [0.73, 1.1]).[132] Children with an Asian ethnicity have also been shown to have a reduced risk.[132, 141] The odds ratio for Asian-American children has been reported as 0.80 (95% CI [0.59-1.1])[132] In contrast, Indigenous children, including Australian aboriginals,[109] Canadian aboriginals, including Inuit and First Nations,[126, 145] and Native Americans,[168, 169] have been shown to have much greater incidence of otitis media. Of note, Australian indigenous children have been reported to be five times more likely of being diagnosed with otitis media by a general practitioner, compared to non-indigenous children.[109]

Boys

There is a plethora of research confirming male gender as a risk factor for otitis media.[105, 126, 131, 132, 141, 142] However, the size of the association varies widely in the literature, with odds ratios ranging from 1.1 to 2.6.[131, 132] Despite the variations in the reported size of any potential association, the large body of evidence showing that males have a higher incidence of otitis media than females outweighs the one report that male gender is not associated with increased risk.[113]

2.4.2 Otitis Media with Effusion

Unlike for acute otitis media, the literature identifying potential risk factors associated with otitis media with effusion is more limited. However, from the limited research available, there is some evidence to suggest that the risk factors are similar for both.[144] Potential risk factors identified for otitis media with effusion are parental smoking,[170, 171] exposure to other children, especially via childcare attendance,[171-173] shorter breastfeeding duration,[170, 174] lower gestational age and birth weight,[138] larger family size,[170, 172] genetic predisposition,[143] lower socioeconomic status,[170, 173, 174] medical history,[129, 142, 170, 172, 174] and allergy.[170, 175] Other risk factors that have also been identified include male gender,[138, 173] young age,[170] and winter season.[129, 142]

Parental Smoking

As with acute otitis media, second-hand smoke has been shown to be associated with a greater prevalence of otitis media with effusion.[170, 171] One report of a cohort of 2,097 Italian children aged 5 to 14 years found no association between parental smoking and otitis media with effusion (odds ratio 1.06, 95% CI [0.74, 1.50]).[174] A case-control study found no significant difference in the prevalence of parental smoking between 53 children aged 2 to 12-years who had otitis media and 34 children aged 2 to 10-years that had no history of ear infection.[152] Parental smoking has also been shown not to be associated with the likelihood of persistent disease.[129]

Childcare Attendance

Early commencement of child care (starting attendance prior to 12-months-old) has been shown to result in an earlier onset of otitis media with effusion.[171] Furthermore, increased hours of childcare attendance result in a longer duration of otitis media with effusion.[171] Exposure to other children, such as occurs by attending childcare, has been shown to be the most prominent risk factor for persistent otitis media with effusion.[172, 173]

Breastfeeding

A lack of breast-feeding,[170, 174] but not the duration of breastfeeding,[170] has been reported as associated with an increased risk of otitis media with effusion. However, a shorter duration of breastfeeding has been shown to increase the duration of otitis media, as has feeding in a supine position.[171]

Gestational Age and Birth Weight

As with acute otitis media, the association between gestational age, birth weight and otitis media with effusion remains unclear. While persistence of otitis media with effusion has been linked to low birth weight (<2500g) and premature gestational age (<37-

weeks),[138] other studies showed no significant association between birth history and otitis media with effusion.[170, 174]

Family Structure and Medical History

The number of people living in the household may,[170] or may not,[174] increase the risk of otitis media with effusion. Similarly, there are contradictory reports on the role of family history of otitis media, with evidence suggesting that sibling history of otitis media increases risk,[142, 172] and other reports suggesting that it does not.[174] A family history of allergy and asthma has also been associated with children with otitis media with effusion.[144] While there is evidence that a genetic predisposition exists, the specifics of this remain poorly understood.[143]

Socioeconomic Status

The socioeconomic status of children has been shown to be associated with increased risk, with otitis media with effusion occurring at a higher proportion in children attending school in a lower socioeconomic area compared to school in a higher socioeconomic area (12.44% vs. 8.56%, $p<0.001$).[170] Other research has found that the mothers education to be important, and not the family's socioeconomic status (odds ratio 0.99, 95% CI [0.99, 1.00]) or the mother's employment status (odds ratio 0.93, 95% CI [0.66, 1.32]).[174] Specifically, the lack of maternal education was found to be associated with an increased risk, with children of illiterate mothers having 2.26 times the risk of developing otitis media compared to children of mothers with any education (95% CI [1.13, 4.50]).[174]

Medical history

Medical history has been shown to predispose children to otitis media with effusion. The presence of an upper respiratory tract infection,[170, 172, 174] previous episodes of acute otitis media,[129, 142, 174] and a history of snoring,[170, 174] have been shown to increase the likelihood of persistent middle ear effusions. However, a history of previous otolaryngological operations does not appear to be important.[170] Research has shown that the mother's use of medication during pregnancy may result in a five-fold increase of the risk of otitis media with effusion.[138]

Allergy

Atopy, that is, a predisposition toward developing certain allergic conditions, has been shown to be associated with increased incidence of otitis media.[170, 175, 176] However, the relationship between atopy to otitis media remains unclear. Allergy has been identified as a causative factor for Eustachian tube dysfunction,[176] which may in turn precipitate otitis media with effusion. It has been proposed that patients identified as being atopic may benefit from treatment of their allergies in the resolution of the middle ear disease.[176] But an alternative hypothesis is that that frequent otitis media in infancy may in turn predispose children to allergic conditions later in life.[177]

2.4.3 Tonsillitis

There is scant research specifically focussed on the risk factors for tonsillitis. However, evidence suggests that genetic predisposition, including differences in anatomical and immunological defence mechanisms, may play a role in the risk for recurrent tonsillitis,[178] accounting for 62% of the variation in risk for recurrent tonsillitis.[179] The remaining risk has been attributed to individual environmental effects which are most likely similar for both tonsillitis and other upper respiratory tract infections. Therefore, it is not surprising that there is some evidence to suggest that the risk factors for tonsillitis include exposure to pathogens by attending childcare,[180] family history of tonsillectomy,[181] atopy,[180, 181] environmental pollution,[182] exposure to passive smoking,[180, 182, 183] and low socioeconomic status.[180] However, it is remains unclear whether exposure to passive smoking, or low socioeconomic status, play a role in increasing the number of tonsillitis episodes since there are reports to the contrary.[181]

2.4.4 Sleep Disordered Breathing

Due to the distinct implication of the airway anatomy in the pathophysiology of sleep disordered breathing, children with craniofacial abnormalities, such as Down Syndrome, are most at risk of the condition.[184] In addition, children with neuromuscular diseases may also be at increased risk due to upper airway muscle dysfunction.[184] Other potential risk factors include premature birth,[184, 185] complications while in utero,[40] childhood obesity,[184, 186] other childhood illness, such as upper respiratory tract infections,[40, 119, 186, 187] regular mouth breathing,[186] African heritage,[118, 185] low socioeconomic status,[188] and low maternal education.[186] Evidence suggests that familial predisposition may also play a role.[189] Furthermore, children who have previously undergone an adenoidectomy are at risk of being habitual snorers,[51, 190] due to the narrowing of the pharyngeal airway after surgery.[190] Also at risk of becoming habitual snorers are those children with septal deviation, decreased nasal patency, and nasal obstruction.[190] Children with habitual snoring may have resolution of this over time, however, if they are exposed to parental smoking, have a mother with low education, and have prior otolaryngological surgery are more likely to continue snoring for a duration greater than 12-months.[186] In contrast, there is evidence to suggest that children with asymptomatic asthma have a decreased risk of sleep disordered breathing.[118] Furthermore, the variants of sleep disordered breathing have been shown to be gender specific. Research suggests that adolescent girls have more difficulty initiating and maintaining sleep,[119] while preschool aged boys are more likely to be habitual snorers.[117, 119]

2.4.5 Conclusion

After reviewing the literature, it becomes clear that a wide range of risk factors have been linked to the ENT conditions of interest in this thesis. The evidence shows that socioeconomic status is a risk factor for all four conditions: acute otitis media,[130, 135] otitis media with effusion,[170, 173, 174] tonsillitis,[180] and sleep disordered breathing.[188] Genetic predisposition has been identified as a risk factor for both acute otitis media and otitis media with effusion,[143] as well as tonsillitis,[181] and sleep disordered breathing.[184] However, more compelling is the evidence that parental smoking is implicated in these conditions,[123-130, 170, 171, 180, 182, 183] as is childcare attendance.[105, 123, 130-135, 171-173, 180]

2.5 SURGICAL OVERVIEW: OUTCOMES FOLLOWING SURGERY

2.5.1 Tonsillitis

Following the removal of the tonsils, children who have had a history of tonsillitis have improved quality of life. Research has shown that following surgical intervention, children have improved ability to eat, swallow and breathe,[191] along with a reduction in health care utilisation and the number of upper respiratory tract infections.[191] Additional improvements have been noted in the general overall health of children and in the impact on parents and family activities.[191, 192] Children have been shown to have less days absent from school and an increase in their energy levels.[192] These improvements in paediatric quality of life following tonsillectomy for chronic tonsillitis mirror the quality of life improvements seen for adults following the procedure.[193]

There are a number of different surgical techniques for the removal of the tonsils. A large body of research has been conducted into the safety and efficacy of the techniques, with a focus on post-operative complications, recovery time, and length of stay.[194-199] In fact, some surgeons perform a partial tonsillectomy, thus leaving behind some of the tonsillar tissue. Therefore, a relapse in tonsillitis is a theoretical possibility. Indeed, regrowth has been shown to occur in 6.1% children that undergo partial tonsillectomy.[199] However, evidence suggests that following a partial tonsillectomy, there is no recurrence in tonsillitis symptoms in the short-term (20-months postoperatively),[197] or long-term (5-years postoperatively).[199] In spite of this, a review of tonsillectomy malpractice cases found that symptom recurrence was implicated in 5.8% cases,[200] indicating that recurrence of symptoms may occur.

2.5.2 Sleep Disordered Breathing

Adenotonsillectomy performed for sleep disordered breathing has been shown to improve respiratory function,[201] oxygen saturation,[201, 202] and to reduce the number of obstructive events that occur during sleep.[201, 203, 204] However, while the number of apnoeic events has been shown to reduce after adenotonsillectomy, a meta-analysis concluded that 'cure' (defined as a reduction in the apnoea-hypopnea index to less than 1) was only achieved in 59.8% paediatric cases.[205] Despite this, following surgery, children with sleep disordered breathing have improved overall quality of life,[204, 206] including resolution of diurnal incontinence and nocturnal enuresis,[44] a reduction in inattentive[207] and impulsive behaviours,[35, 38, 204] a reduction in hyperactivity,[207] improved emotional difficulties,[38] and increased height, weight and growth hormone levels.[41] School results have also been shown to improve following surgical intervention with adenotonsillectomy, including improvements in school report card grades,[39] and standardised testing (such as the Raven's Colored Progressive Matrices Test and the School Performance Test).[208]

Despite evidence that there are improvements following surgery, some consequences of sleep disordered breathing may be irreversible. Research suggests that the neurocognitive impact of sleep disordered breathing can continue postoperatively despite the improvements in respiratory function following surgery.[202] A recent meta-analysis further supports this, and as discussed above, the evidence shows that while there are improvements in the number of apnoeic episodes, obstructive sleep apnoea is often not cured by surgery.[205, 209] Furthermore, obese children are more likely to continue to experience obstructive symptoms and poor quality of life despite surgical intervention.[204] The reason for ongoing sleep disruption may be due to underlying anatomical abnormalities. In fact, there are anatomical similarities between with children with obstructive sleep apnoea and adults with the same condition, that is, obesity.[210] However, despite this evidence, currently available clinical practice guidelines do not provide specific recommendations for obese and non-obese subgroups of the paediatric population, such as recommending pre-surgical weight loss.[49, 211]

2.5.3 Otitis Media

When “watchful waiting”, analgesics, and antibiotics fail to provide a resolution, the first line surgical intervention for otitis media is tympanostomy tube insertion. Evidence suggests that tympanostomy tube insertion improves quality of life.[60, 212, 213] Meta-analyses suggest that tympanostomy tube insertion results in a reduction of acute otitis media by one episode per child-year.[60] Furthermore, tympanostomy tube insertion is a cost effective treatment, resulting in a reduction in the number of both annual clinic visits and antibiotic prescriptions.[213] Reading difficulties caused by otitis media induced hearing loss are rectified once hearing is restored by surgical intervention.[214] For children with otitis media with effusion, those being observed within a “watchful waiting” regimen are approximately three-months delayed in verbal comprehension and language skills when compared to their surgical counterparts nine-months following surgical intervention.[215] However, there is evidence that suggests up to 4% of children may actually have worse symptoms following tube insertion.[60] Children that had a worsening of their quality of life were identified as having those with three or more days of otorrhea after the tube insertion, or with parents who were unhappy with the decision for surgical intervention.[60] Furthermore, if hearing is not restored by tube insertion, and otitis media persists, reading problems can continue.[214] However, evidence suggests that over a four-year period, those children that continued to have otitis media and hearing deficits after the insertion of tympanostomy tubes did improve in their reading scores, but not to the same degree as those children who were rid of the infections.[214] Furthermore, evidence suggests that the benefits of surgery may be transient, with improvements in quality of life most noticeable during the first six to 12-months postoperatively.[60, 212] Despite this, most children experience some improvement following surgery, with more than 80% of parents/caregivers indicating satisfaction with surgical outcomes at 6-months postoperatively.[212] In addition to the individual improvement to the quality of life, there may be a population-wide benefit to surgical intervention. The total Australian healthcare expenditure for treating otitis media in 2008 was estimated at between $85.6 million to $163.2 million.[110, 216] The majority of these costs are attributed to general practitioner visits (estimated cost between $31.7 million to $77.9 million dollars) and the cost of prescribed medicines (estimated cost between $14.8 million to $36.4 million).[110] Another estimate is that burden on the Australian healthcare system is between $100 to $400 million, with the majority of this attributable to general practitioner visits and prescribed medicines.[115] While these are very broad estimations, it is clear that the burden of otitis media on the healthcare system is great and that improvements in treatment may decrease this expenditure. However, the condition is inherently difficult to cost assess since data on incidence and prevalence of otitis media are sparse. Furthermore, cost estimates need to consider general practitioner visits, antibiotic use, pathology and radiology, emergency department presentations, and hospital admissions and this data can be difficult to obtain Another difficulty in measuring the financial burden of the disease on the healthcare system is that cost estimates are often developed with the assumption that the cost of healthcare services are the same across jurisdictions. [110]

CHAPTER 3
A Literature Review of the Surgical Procedures

3.1 INTRODUCTION

Ever since John Snow first identified infected households to determine the source of a cholera outbreak in 19th century London, geographical location has been inherently part of epidemiology. However, it was not until 1936 when Dr Alison Glover wrote of the potential for over-treatment, that the first small area analysis of tonsillectomy was performed.[217] With the development of more sophisticated analytical techniques and approaches, medical geography has emerged as its own research field during the past 20 years.[218]

Access to medical care directly influences how, and whether, healthcare is utilised and there is a growing body of literature that examines this phenomenon. The multi-factorial interplay of geography,[219, 220] socioeconomic status,[219-224] ethnicity,[224] family structure,[222] patient perception,[219, 223, 225] and health status[219] influences the uptake of medical care by the individuals within a community. While some of these factors are difficult to influence, geographical access to healthcare is directly within the scope of healthcare policy and planning. Research has shown that geographical variations exist in the utilisation of hospitals,[226] emergency departments,[220] general practitioners,[219] and nuclear medicine imaging.[227] While small area geographical analysis has been predominantly used in the planning of services and infrastructure, such as in town planning, variations have been increasingly observed for many health conditions and can prove vital in the development of public health policy. Furthermore, the application of this analytical approach for research conducted in the Australian setting is increasing. Recent examples include an analysis of the geographical variations of Ross River virus infections in Western Australia,[228] and geographical variations in myocardial infarction admissions in Melbourne.[229] An understanding of the public health and political implications of small area geographical analysis can be provided using, as an example, a recent report of melanoma within South Australia. The report showed that within South Australia there is an increased risk of melanoma diagnosis for those persons living in coastal or riverside locations.[230] These findings have direct implications for primary prevention (e.g. provision of education about, and access to, sun protection); early detection (e.g. provision and location of skin check clinics); and treatment (e.g. the location of cancer services) of melanoma.

Internationally, there is an increase in the application of small area geographical analyses for paediatric conditions. Recent examples include investigations into the geographical distribution of childhood diabetes mellitus in Yorkshire, United Kingdom,[231] and hospital utilisation by children in California, USA.[226] These studies have shown that geography is a factor in both child health and health service use. However, the utilisation of health services, particularly for surgical intervention, can be directly influenced by the geographical distribution of the underlying medical condition. These conditions can be influenced by factors such as season,[232] altitude,[232] and humidity.[232]

The geographical distribution of the ear, nose, and throat (ENT) conditions that are the most common indications for surgical intervention are not the subject of this chapter, nor are they the focus of this thesis. The limited published findings on this topic have already been discussed in Section 2. As discussed previously, the limited epidemiological data is most likely due to the difficulties in identifying cases within the population.

Similarly, published reports regarding the focus of this thesis – that is, small area geographical analyses of ENT surgery, particularly in paediatric populations - are limited. Predominantly, geographical comparisons are made on a larger scale by making comparisons of incidences between entire countries or, less frequently, between states within a country. Such large scale comparisons foster discussion on the international or national variations in surgical procedures and their underlying medical indications. However, past research fails to identify smaller scale variations where intervention at a local level may have the potential to reduce the number of surgical procedures performed or the incidence of the underlying medical indications.

In the following sections of this chapter, the published literature detailing the epidemiology of the three surgical interventions that are the subject of this thesis will be presented. A detailed examination will be made of the incidence of tonsillectomy (the surgical removal of the tonsils), adenotonsillectomy (the surgical removal of the tonsils and adenoids), and myringotomy with tympanostomy tube insertion (the surgical incision of the tympanic membrane with the insertion of a tympanostomy tube into the incision). In addition, there will be discussion on how the incidence of these procedures has changed over time, and whether there is evidence to suggest that insurance status or residential locale influences the incidence of the procedures. In addition, the available literature discussing small scale geographical variations for these procedures will be presented. However, it must be noted that it is difficult to report the incidence of adenoidectomy since this procedure is typically performed with either concomitant tonsillectomy or tympanostomy tube insertions and, hence, reported thus. Finally, a systematic literature review will be presented which details parental experiences and expectations of treatment.

3.2 EPIDEMIOLOGY: TONSILLECTOMY WITH/WITHOUT ADENOIDECTOMY

As data from the United Kingdom and western Europe would suggest, the incidence of tonsillectomy has changed over time going through periods of both waxing and waning use. Initially, the incidence of the procedure amongst the general population was low until the beginning of the twentieth century. In the United Kingdom, there was a rapid rise from 1902 to the beginning of World War 1, with a peak in 1931.[217] After a sharp decline, a second peak occurred in 1936.[217] The popularity of the procedure was remarked upon in 1947 by eminent physician James Alison Glover CBE, when he was stated that it was his opinion that the incidence of tonsillectomy "remains excessive", particularly in five to seven-year-old children, stating that often the surgery was being performed for 'trifling reasons'.[233] This is perhaps the earliest report of a perceived over-use of the procedure in the paediatric population. After World War 2, a decline in the incidence of tonsillectomy occurred. In the United Kingdom, from 1967 to 1980 the incidence of tonsillectomy (with concomitant adenoidectomy) decreased by 46%, stabilising to 60-70 cases per 10,000 population aged 0 to 14-years-old between 1975 to 1980.[234] The cumulative risk of tonsillectomy increased over the following 21-year period in Denmark, from 6.0 to 7.9% in 1980, to 7.5 to 9.7% in 2001.[235] However, making longitudinal observations and comparisons on the incidence of surgical procedures are difficult given changing surgical techniques and methods for collecting and reporting the data. Furthermore, published reports are from the United Kingdom and western Europe, with no published data from other European countries, thus making comparisons difficult.

With literature from across the globe, and from over an extended period of time, it is unsurprising that there are differences in the methods used for data extraction and reporting. Incidences are reported inconsistently, with data collated on a national,[236-238] regional,[4, 8, 236, 239-246] and or age-group level.[5, 235, 240, 247-249] Reports that collated on age-group did so in five- or one-year age brackets.[5, 235, 240, 247-249] However, the age range of the population included in the incidences also varied, with some reports including all ages[235, 241-243, 245-247] and other reports including children only.[4, 8, 236-240, 249] Furthermore, the definition of the paediatric population varied between reports, although the most common definition was children being specified as being up to age of 14-years-old.[8, 237-239, 249] The coding methods used were varied, which is not entirely unexpected since countries can use different coding nomenclature and these definitions change and evolve over time. On reviewing the literature, it becomes evident that the reported incidence of tonsillectomy varies widely between populations. For example, an international report published in 1998 examined the annual incidence of tonsillectomy in children aged up to 14-years-old, with results summarised in Table 3-1, below. The annual incidence estimates ranged from 19 per 100,000 children in Canada, to up to 118 per 100,000 children in Northern Ireland.[250] Data presented in the report were extracted in a similar method from national healthcare databases, using consistent definitions for children and surgical procedures, which makes drawing comparisons between countries more meaningful. That there is a six-fold difference between the lowest and the highest incidence in the report is surprising. By examining the most common indicators of health for Canada and Ireland it is apparent that both countries have similar overall populations. Specifically, both countries have life expectancies of 81-years,[251, 252] and the infant mortality rates are not dissimilar for the two countries (Canada 4.9 vs. Ireland 3.5 per 1,000 live births).[252] However, there are differences in the private health insurance usage between the two countries, with 68% of Canadians having private health insurance compared to only 47.5% of the Irish population.[252] Furthermore, the health expenditure per capita is greater in Canada than in Ireland (Canada US$4522 vs. Ireland US$3700). These differences in the way the healthcare systems are funded may contribute to the wide variations in access to healthcare and surgical interventions. In addition, the incidences presented in Table 3-1 utilised data collected within the national databases from each country. This, as discussed in Section 0, inherently has problems of different coding practices, variations in surgical practices, and differences in the underlying incidences of the diseases.

Such extreme differences in the incidence of the surgical procedures must be explained by either a widely variable incidence of the underlying medical conditions between international populations, or variations in the diagnosis and treatment of these conditions by clinicians across the globe. With no international consensus on clinical practice guidelines, the definitions of the medical conditions that warrant surgical intervention with tonsillectomy, and the different clinical history deemed necessary before surgical intervention is warranted, vary between nations. Complicating the interpretation of the data are the varied methods of analysis and reporting, including the previously stated differences in age-groups studied, study periods, classification schema, and whether reported for tonsillectomy alone or in combination with adenoidectomy. Therefore, it is difficult to conclude whether the variations seen are true differences in the incidence of the procedure across the study populations, or whether the differences are an artefact of the differences in data extraction, definition, and analysis.

The following sections provide an in-depth summary of the incidence data for three continental regions – Europe and the United Kingdom, the North American Continent, and Australia. Data for these continents are presented based on the publications available and not for any academic reason. Literature searches failed to identify reports of incidence data for other continents such as Asia, Africa, or South America.

Table 3-1: International incidences of tonsillectomy with/without adenoidectomy.

Country	Incidence (per 10,000 children)
Northern Ireland	118
The Netherlands	115
Belgium	101
Australia	75
England	65
USA	50
Scotland	47
Finland	45
Canada	19

Source: van den Akker *et al*. (2004) [250]

3.2.1 Europe and the United Kingdom

An examination of a region, such as Europe and the United Kingdom, reveals that incidence continues to vary widely between countries of similar geography. Eight research studies from across the region report the incidence of tonsillectomy with/without adenoidectomy as between 2.02 per 1,000 children in Oxford, England[241] up to 14.4 per 1,000 children in Veneto, Italy (Table 3-2).[240] Such large variations, such as this seven-fold difference between a province of England and one in Italy, may be explained by regional variations in disease prevalence or surgeon preferences. Of course, the literature has been published over a wide timespan (from 1978 to 2009), so the variations may indeed be a reflection of changes to surgical practice over time. Furthermore, the literature reporting these surgical incidences varies widely in analytical methods. Reports utilise both prospective[239] and retrospective[235, 236, 240-242, 253] analyses of patient registry databases. The inclusion criteria vary, particularly for defining the population age. Most reports include children aged from birth,[235, 236, 239, 253] but most vary in the upper age limit, with this ranging from nine-years-old[240] to 27-years-old[253] (Table 3-2). One study included all age groups,[241] while another only included children aged between two and nine-years-old.[240]

3.2.2 The North American Continent

There have been five reports from the north American continent detailing the incidence of tonsillectomy with/without adenoidectomy. Reports from Canada suggest that the incidence of tonsillectomy with/without adenoidectomy is between 4.5 and 5.0 per 1,000 persons.[237, 243, 244] However, the populations examined in these reports are varied. One report includes all ages within the population,[243] while another report includes only children up to the age of 14-years-old.[237] The incidence estimates for tonsillectomies with/without adenoidectomy performed in America are lower than in Canada. Specifically, the incidence of tonsillectomy alone has been reported at between 1.02 to 1.84 per 1,000 persons, while the incidence of adenotonsillectomy is estimated at between 1.89 and 2.66 per 1,000 persons.[247, 248]

3.2.3 Australia, including South Australia

Seven studies have been published that outline the incidence of tonsillectomy with/without adenoidectomy in Australia. In the past, the published SAR for tonsillectomy has been higher for South Australia when compared to the rest of Australia.[4] This measurement – the SAR – is a summary statistic calculated relative to the national pattern of hospital admissions, taking into account differences in the age and sex of the population.[254] On average, the SAR for South Australia has been 18% higher than the other states,[5] a longstanding pattern first seen in the late 1980s.[246, 254] When tonsillectomy and/or adenoidectomy was examined for 1995/96, the highest SAR was 137 for South Australia, a statistically significant greater ratio compared to the national average (Figure 3-1).[4] Similarly, in 1996/7, the SAR for tonsillectomy in South Australia was 133.9.[4] The only other states above the national average in 1996/97 were Victoria, at 116.2, and Queensland, at 100.5.[254] The remaining Australian jurisdictions were below the national average.

Table 6.47: Admissions[1] with a principal procedure of tonsillectomy and/or adenoidectomy, State/Territory, 1995/96
Standardised admission ratios

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Total
Capital city	89**	109**	101	136**	95*	71**	71**	65**	100
Other major urban centres[2]	100	147**	106	..	..	..	..	..	106**
Rest of State/Territory	101	115**	84**	141**	92*	67**	35**	–[3]	99
Whole of State/Territory	94**	112**	94**	137**	94**	68**	50**	66**	100

[1]Includes admissions to public acute hospitals, private hospitals and day surgery facilities, including admissions of same day patients
[2]Includes Newcastle and Wollongong (NSW); Geelong (Vic); and Gold Coast-Tweed Heads and Townsville-Thuringowa (Qld)
[3]Data unreliable: included with ACT total
Source: See *Data sources*, Appendix 1.3
Statistical significance: * significance at 5 per cent; ** significance at 1 per cent

Figure 3-1: Standardised Admission Ratios for Australia States and Territories, 1995/96, Tonsillectomy and/or Adenoidectomy.

Source: Glover J, Harris K, Tennant S. A social health atlas of Australia. Volume 5: South Australia. Second ed. Adelaide: Public Health Information Development Unit, University of Adelaide; 1999. [4]

The SAR for the rural and remote regions of South Australia have been demonstrated to be even higher. Within these rural and remote regions, the Port Augusta region in the north of the state (SAR of 178), the Fleurieu Peninsula to the south of Adelaide (SAR of 146), and Mount Gambier region in the south-east of the state (SAR of 143), have been highlighted as having some of the highest occurrences of tonsillectomy and/or adenoidectomy in Australia.[4] Furthermore, when the spatial epidemiology has been previously examined, distinct patterns of raised SAR have been seen for metropolitan Adelaide (Figure 3-2). Standardised admission ratios were higher in the northeast and the inner southwest of the metropolitan region. However, it is important to note that these geographical patterns were not specific for the paediatric population and included all age groups across South Australia.

The elevated incidence of ENT procedures in South Australia is also apparent for children. Specifically, in 1998/98, the SAR for children and youth aged 0-24-years-old was 118 in South Australia, which was 20.3% higher than for the remainder of Australia.[5] Children aged five to nine-years-old living in metropolitan Adelaide have been reported to have the highest incidence of tonsillectomy hospitalisations in Australia (953 admissions per 100,000 children).[5] Higher still is the incidence of hospital admissions for children of the same age-group living in rural and remote South Australia (1025 admissions per 100,000 children).[5] More recently, for the period 2003/4 the incidence of tonsillectomy admissions for all South Australians was 202.7 per 100,000 persons.[245]

In summary, the previously reported data clearly indicate that within South Australia the surgical removal of tonsils and/or adenoids occurs more frequently than in other Australian states or territories. Despite this well documented pattern, no explanation has been provided in the literature thus far – a deficiency that will be addressed in this thesis.

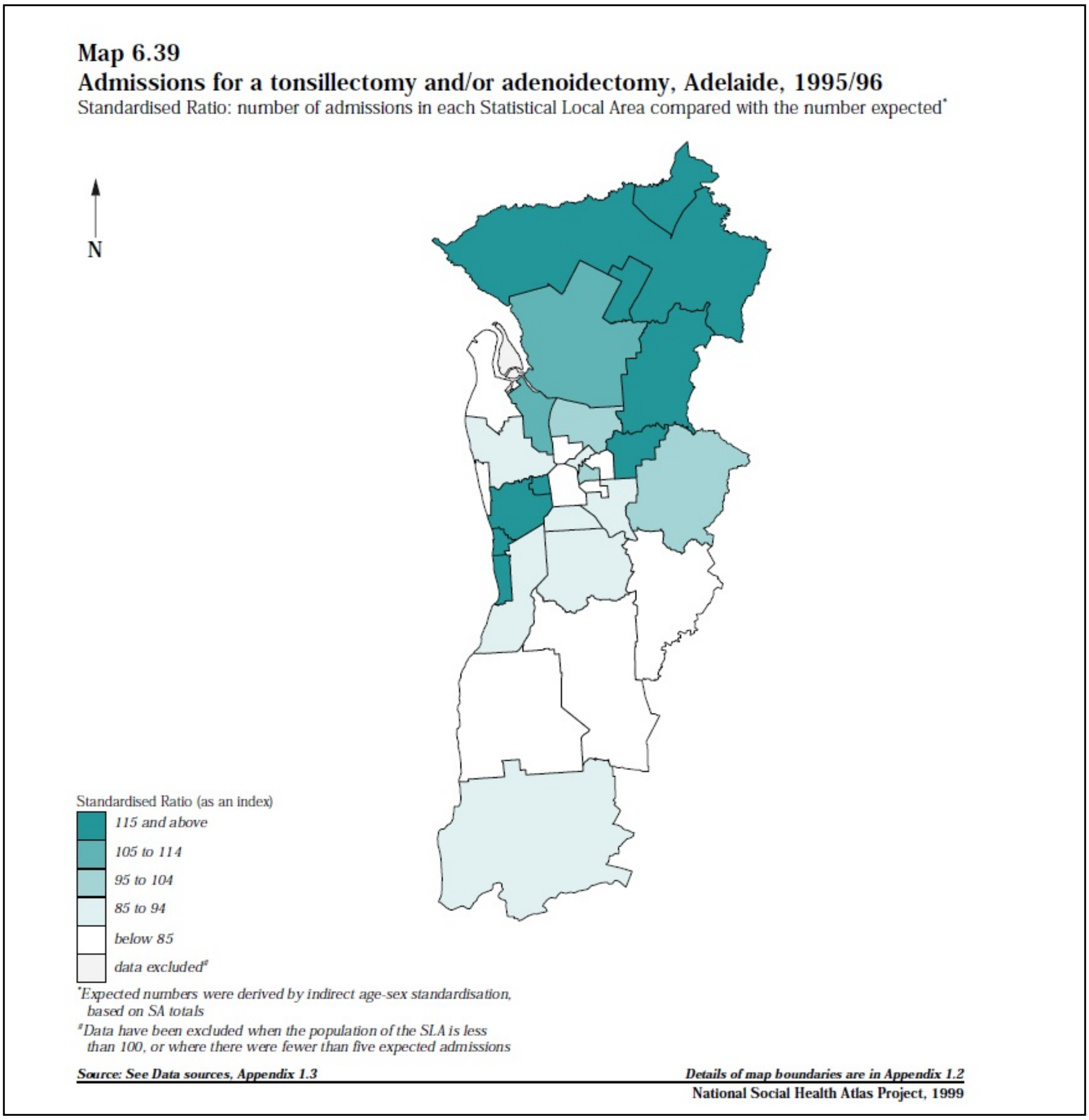


Figure 3-2: Spatial epidemiology of tonsillectomy and/or adenoidectomy across metropolitan Adelaide, 1995/96.

Source: Glover J, Harris K, Tennant S. A social health atlas of Australia. Volume 5: South Australia. Second ed. Adelaide: Public Health Information Development Unit, University of Adelaide; 1999. [4]

Table 3-2: Literature Reporting Epidemiology of Tonsillectomy with/without Adenoidectomy.

Author, Year	Region/ Country	Design, data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000)
Europe and the United Kingdom							
Bisset, 1994 [236]	Scotland	Population-wide, NHS and GRO databases	National, Regional, Annual	1990	0-15	Tonsillectomy Coding system not stated	6.0
Bloor, 1978 [239]	Scotland	Primary data, new referrals to ENT clinic in two regions	Regional	1970	0-14	Tonsillectomy ± Adenoidectomy Coding system not stated	11.9
Fedeli, 2009 [240]	Veneto, Italy	Person-years, regional archive of hospital discharge records	Regional, Annual 1-year age-bands	2004-2006	2-9	Tonsillectomy ± Adenoidectomy ICD-9-CM	14.4
Glover, 1936 [217]	England, Wales	School data	Regional	1936-1938	School-aged, not defined	Tonsillectomy Coding system not stated	18.0
Mattila, 2001 [253]	Helsinki, Finland	Helsinki University Central Hospital patient registry, retrospective survey	Cumulative incidence	1997-8	0-27	Tonsillectomy ± Adenoidectomy ICD-10	Proportions presented. Female 45% 0-9-year-olds 49% 10-19-year-olds

Author, Year	Region/ Country	Design, data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000)
Motta, 2008 [242]	Italy	Cross-sectional data from clinical units across Italy	Regional	1999-2004	All	Tonsillectomy ± Adenoidectomy Coding system not stated	Absolute numbers only 26,915 surgeries in the study period.
Newton, 1994 [241]	Oxford England	Oxford Record Linkage Study Indirectly age and sex-standardised admission rates per 10,000 residents per year	Regional	1979-1986	All ages	Tonsillectomy and Adenoidectomy ICD-9	2.02
Vestergaard, 2007 [235]	Denmark	Danish National Patient Registry, person-years at risk	Age-specific	1980-2001	All 0-20	Tonsillectomy ± Adenoidectomy ICD-8, ICD-10	Age-specific incidences reported. No overall incidence given.
North American Continent							
Black, 1999 [243]	Manitoba, Canada	Population-wide, data sources not stated	Regional	1989/90 to 1993/4	All	Tonsillectomy ± Adenoidectomy Coding system not stated	4.5 (1996/97)
Brownell, 2002 [244]	Manitoba, Canada	Population-wide, Manitoba Population Health Research Data Repository	Regional	1994/5 to 1998/9	0-19	Tonsillectomy + Adenoidectomy ICD-9-CM	5.0 (1998/99)

Author, Year	Region/ Country	Design, data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000)
Croxford, 2004 [237]	Ontario, Canada	Central registry	Total	1996-2000	0-14	Tonsillectomy ± Adenoidectomy Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	4.6
Erickson, 2009 [248]	Olmsted County, Minnesota	Retrospective, population cohort, Rochester Epidemiology Project	Annual, 5-year age-bands	1970-2005	0-29	Tonsillectomy ± Adenoidectomy ICD-9	Adenotonsillectomy: 2.66 Tonsillectomy: 1.84
Freeman, 1982 [247]	USA	Hospital Discharge Survey, age/sex-specific surgical rates	5-year age-bands	1970-1977	All	Tonsillectomy ± Adenoidectomy Coding system not stated	Adenotonsillectomy: 1.89 Tonsillectomy: 1.02
Australia							
Close, 1993 [249]	New South Wales	Population-wide hospital separation data, Standardised separation rates	5-year age-bands	1986, 1989/90	0-14	Tonsillectomy + Adenoidectomy ICPM-9, ICD-9-CM	Tonsillectomy only: 1.4 Adenoidectomy only: 2.4 Adenotonsillectomy: 3.9
Glover, 1999 [4]	South Australia	Population-wide	Regional	1995/96	0-9	Tonsillectomy + Adenoidectomy Coding system not stated	No incidences given. Standardised admission ratios reported.

Author, Year	Region/ Country	Design, data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000)
Glover, 2006 [245]	South Australia	Population-wide	Regional	2003/4	All	Tonsillectomy ± Adenoidectomy Coding system not stated	2.03
Ford, 2004 [238]	Australia	AIHW, NHMD ǂ	National	1996/7-97/8	0-14	Adenotonsillectomy ICD-9	Adenotonsillectomy 39.4 local vs. 24.8 nonlocal per 1000 hospitalisations
Renwick, 1991 [246]	South Australia	Population-wide	Regional	1986	All	Tonsillectomy Coding system not stated	No incidences given. Standardised admission ratios reported.
Rob, 2004 [8]	New South Wales	New South Wales Inpatient Statistics Collection	Regional, Annual	1998/99	0-14	Tonsillectomy ± Adenoidectomy ICD-9-CM	Tonsillectomy: 8.9 per 100 Adenoidectomy: 9.6 per 100
Tennant, 2003 [5]	South Australia	Population-wide	5-year age-bands	1996/97-1998/99	0-24	Tonsillectomy ± Adenoidectomy ICD-9	No incidences given. Standardised admission ratios reported.

ǂ AIHW = Australian Institute of Health and Welfare, NHMD = National Health and Medical Database

3.3 EPIDEMIOLOGY: MYRINGOTOMY WITH/WITHOUT TYMPANOSTOMY TUBE INSERTION

As with many surgical procedures, the use of myringotomy has waxed and waned since it was first described in 1649 by a French anatomist.[2] Despite the procedure having gained popularity by the early 1800s across England and Europe, its inappropriate overuse resulted in a lack of benefit to most patients and led to a decline in its use by the mid-nineteenth century.[2] However, by the late-1800s surgeons had recognised that the procedure was most successful for those patients with “fluid collections in the middle ear”.[2] The medical profession was once again interested in the procedure and it was during this period that attempts were made to keep the myringotomy perforation patent and, therein, the first grommets were devised.[2] But again the surgery lost popularity by the early 1900s due to the high complication rate, particularly due to post-operative infections, and a shift in interest to the now popular adenotonsillectomy.[2] It wasn’t until after World War 2 that the use of myringotomy regained momentum.

With the advent of antibiotics, the risk of postoperative infection was now reduced, and coupled with the invention of the modern plastic ventilation tube in 1954, the use of the procedure quickly gained popularity as the standard treatment for otitis media.[2] However, the modern literature again questioned the application of the procedure, with recent research concluding that the benefits appear small.[255-257] Despite this, the recent epidemiology of the procedure indicates that it remains a popular procedure, although the incidence of myringotomy with/without tympanostomy tube insertion is widely varied across geographical locale. Internationally, the current incidence of myringotomy with/without tympanostomy tube insertion has been reported to range from 4.3 to 11.1 per 1,000 children.[249, 258-262] These variations are not only between countries but also across regions within the same county. As an example, in Ontario county in Canada, the reported national incidence of the procedure is between 5.2 and 8.4 per 1,000 children,[237, 259] compared to 11.1 per 1,000 children in Calgary, Canada.[260] These reports are for similar time periods and the timeframes overlap through 1996 to 2000, making these reports comparable.

Children who undergo tympanostomy tube insertion are predominantly male. Research suggests that between 58 to 66% of these procedures are performed on boys.[213, 234, 249] Other reports state that the male to female ratio is 4:3.[263] Furthermore, the paediatric population that undergoes this procedure is younger than the paediatric population undergoing tonsillectomy, as discussed in the previous section. It has been reported that children undergoing surgery are as young as 9.75 to 11.75 months old.[264] Finally, the epidemiology of the procedure is influenced by the insurance status of the children requiring surgical intervention. Children with health insurance are more likely to receive surgical treatment.[135, 265]

3.3.1 Europe and the United Kingdom

Within the United Kingdom, the incidence of myringotomy with/without tympanostomy tube insertion has been reported to vary between 2.0 to 6.8 per 1,000 persons. Of course, variations in reporting periods and geographical locations are evident (Table 3.3). The low incidence of 2.0 per 1,000 persons was reported for Oxford data from 1979-1986.[241] Similarly, the incidence of 2.1 per 1,000 persons reported for the entirety of England was for the year 1992.[266] In contrast, Scottish data for 1990 revealed an incidence of 4.7 per 1,000 persons.[236]

3.3.2 The North American Continent

Across the North American continent, the incidence of myringotomy with/without tympanostomy tube insertion is reported to vary from 5.2 per 1,000 Canadian children aged 0 to 14-years-old,[237] to 13.0 per 1,000 American children aged 0-17-years-old.[267] Again, differences in the age range of the cases included in the data sets reported and the method for coding surgical procedures is evident.

3.3.3 Australia, South Australia

Within Australia the incidence of myringotomy has changed over time. Research has shown that in New South Wales, the overall incidence of myringotomy was 5.6 per 1,000 persons in 1986, but that this steadily increased over the next four years to 6.3 per 1,000 persons by 1990.[249] In comparison, a report from Western Australia indicates that the incidence of the procedure reduced from 6.7 per 1,000 persons in 1997 to 5.6 per 1,000 persons in 2004.[262] Both reports included children aged 14-years and under. More recent data shows that in 2004-5, the majority of tympanostomy tube insertions occurred in Australian children under 10-years-old.[7] More specifically, that 49.53% of the procedures were performed in children aged 1 to 4-years-old, while 28.95% of the procedures were performed in those aged 5 to 9-years-old.[7] The higher incidence of the procedure amongst these age groups reflects the epidemiology of the underlying medical conditions, as previously discussed in Section 2.

As with international data, the incidence of myringotomy varies across Australian regions. In rural areas of New South Wales the incidence of the procedure is the lowest within the state, while outer metropolitan areas of the major cities in New South Wales have the highest incidence.[249] Furthermore, the incidence of this procedure varies between indigenous and non-indigenous Australians. In Western Australia between 1981 to 2004, Indigenous children were 37% less likely to undergo myringotomy with tympanostomy tube insertion.[262] More recently in New South Wales, during the years 2000 to 2008 Indigenous children were 28% less likely to have the procedure.[268] However, this difference did not exist once the analysis was adjusted for geographical remoteness, private insurance status, and socioeconomic status. Regardless, there is no doubt that Indigenous children have high incidence of otitis media. In the Northern Territory, in 2001, up to 91% of Indigenous children were affected by otitis media.[269] Furthermore, research has shown that when the surgery is performed on Indigenous children they are older than their non-Indigenous counterparts.[262] Despite this being a high risk group within Australia where further research and intervention would be of benefit, this is outside the scope of this thesis and will not be explored further.

South Australia

South Australia has the highest Australian SAR of this procedure compared to the other Australian states and territories. In fact, in 1996/7, the direct-standardised admission rate for myringotomy in South Australia was 3.83 compared to 2.17 for the remainder of Australia.[254] The standardised admission rates for the other states and territories for the same time period were 2.74 in Victoria, 2.21 in Queensland, 2.11 in Western Australia, 1.91 in the Australian Capital Territory, 1.84 in New South Wales, 1.89 in Tasmania, and the 0.84 in Northern Territory.[254]

For children and youth aged 0 to 24-years-old, the SAR in South Australia in 1998/99 was 28% higher than the other states and territories.[5] More specifically, South Australian children aged 0 to 4-years-old have previously had the highest incidence of myringotomy (2,181 admissions per 100,000 population) in the country.[5] The SAR for South Australian children aged 0 to 9-years-old have also previously been the highest in the nation for both metropolitan Adelaide and the rural and remote regions of South Australia (Figure 3-3). [4] In 1995/6, the SAR for South Australia was 192, nearly twice the national average. While the SAR for Victoria and Western Australia were also elevated, the rest of the states and territories were below the national average. Furthermore, Adelaide has been reported as having had the highest SAR (SAR of 205) for 0 to 9-year-olds compared to any other Australian capital city.[254]

Table 6.49: Admissions[1] of children aged 0 to 9 years with a principal procedure of myringotomy, State/Territory, 1995/96
Standardised admission ratios

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Total
Capital city	78**	125**	103	205**	130**	119**	84	59**	112**
Other major urban centres[2]	70**	133**	91*	..	..	..	..	..	85**
Rest of State/Territory	64**	116**	59**	163**	82**	68**	44**	–[3]	82**
Whole of State/Territory	73**	123**	82**	192**	114**	88*	60**	61**	100

[1]Includes admissions to public acute hospitals, private hospitals and day surgery facilities, including admissions of same day patients
[2]Includes Newcastle and Wollongong (NSW); Geelong (Vic); and Gold Coast-Tweed Heads and Townsville-Thuringowa (Qld)
[3]Data unreliable: included with ACT total
Source: See *Data sources*, Appendix 1.3
Statistical significance: * significance at 5 per cent; ** significance at 1 per cent

Figure 3-3: Standardised Admission Ratios for Australian States and Territories, 1995/96, Myringotomy in Children aged 0 to 9-years-old.

Source: Glover J, Harris K, Tennant S. A social health atlas of Australia. Volume 5: South Australia. Second ed. Adelaide: Public Health Information Development Unit, University of Adelaide; 1999. 4

When the spatial epidemiology was previously reported, raised SAR were identified across metropolitan Adelaide (Figure 3-4). Standardised admission ratios were higher primarily in the inner southern suburbs of the metropolitan region. However, previous reports have indicated that the remote regions of the state have had the highest frequency of the surgery, with the far west coast of the state having seven times more admissions than expected, that is, an SAR 712, in 1996/97 for children and youth aged 0 to 24-years-old. [5] Other regions within the state with more than twice the expected number of admissions were Lameroo (SAR 261), Port Broughton (SAR 254) and Burra (SAR 228), all located within the mid-north of the state.[5]

As with tonsillectomy and/or adenoidectomy, the previously reported data clearly indicate that within South Australia myringotomy occurs at a much greater frequency than in other Australian states or territories. Again, while this has been previously described, no hypotheses have been proposed to explain why the procedure is performed nearly twice as often when compared to the rest of the country. Potential explanations will be proposed and explored in this thesis.

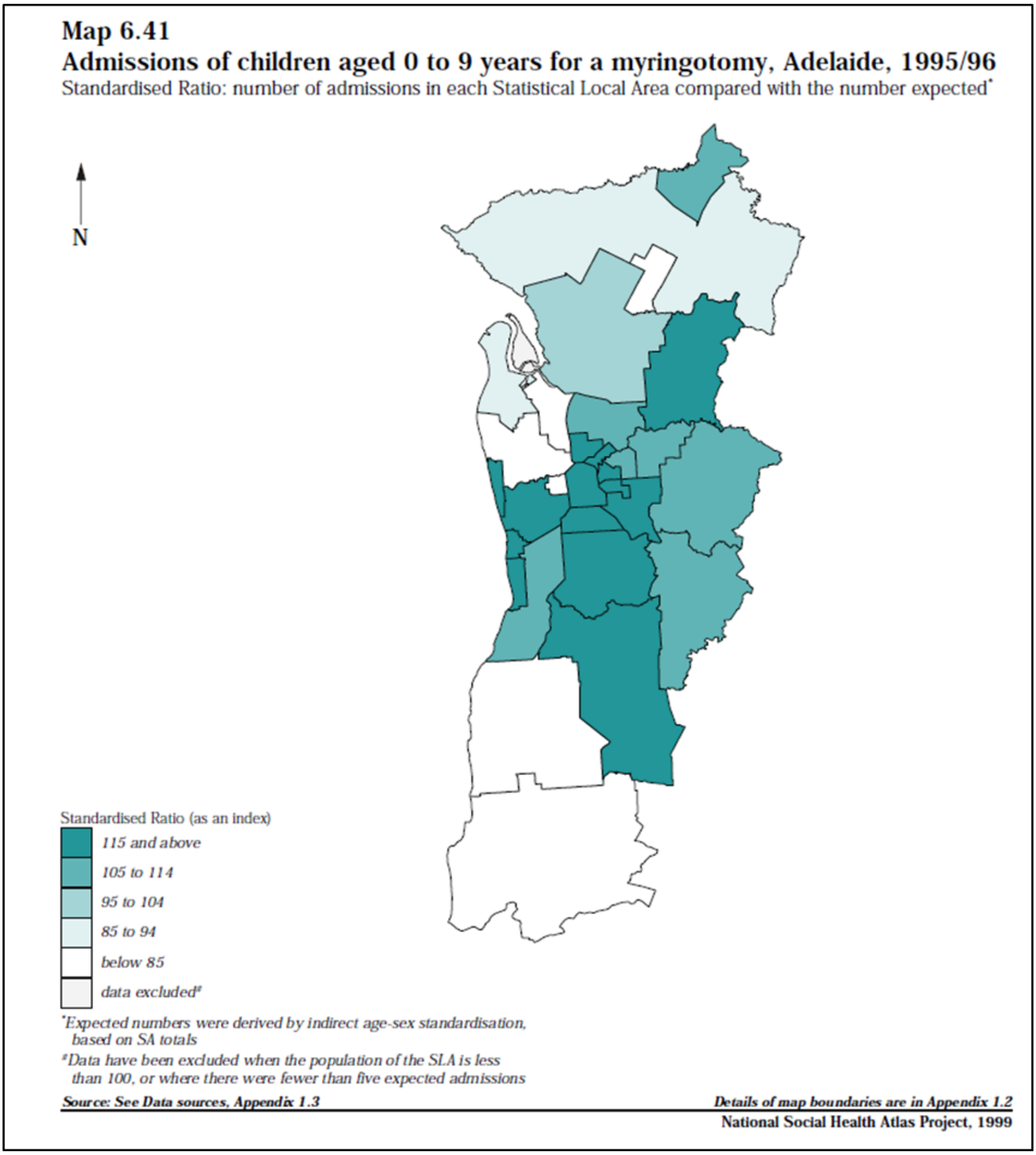


Figure 3-4: Spatial epidemiology of myringotomy with/without tympanostomy tube insertion for children aged 0 to 9-years-old across metropolitan Adelaide, 1995/96.

Source: Glover J, Harris K, Tennant S. A social health atlas of Australia. Volume 5: South Australia. Second ed. Adelaide: Public Health Information Development Unit, University of Adelaide; 1999. 4

Table 3-3: Literature Reporting Epidemiology of Myringotomy with/without Tympanostomy Tube Insertion and/or Adenoidectomy.

Author, Year	Country	Data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000 persons)
Europe and United Kingdom							
Bisset, 1994 [236]	Scotland	Population-wide, NHS and GRO databases	National, Regional, Annual	1990	0-15	Grommet insertion Coding system not stated	4.7
Black, 2002 [258]	Oxford, East Anglia	United Kingdom NHS database	Regional, Annual	1975-1997/98	0-9	Myringotomy ±TTI ±TA OPCS 3rd revision	6.84 (1997/8)
Haapkyla, 2006 [270]	Finland	Finnish National Research and Development Centre for Welfare and Health (STAKES)	Regional, 1-year age-bands	1987-2002	0-15	Adenoidectomy ± TTI NOMESCO	Western Finland: A: 13.9 TTI: 7.7
Haapkyla, 2008 [271]	Finland, Norway	STAKES, Norwegian Patient Registry	Annual, 1-year age-bands	1999-2005	0-7	Adenoidectomy ± TTI NOMESCO	In 2005, Finland: A: 13.3 TTI: 14.7 In 2005, Norway: A: 4.4 TTI: 12.3
Karevold, 2007 [272]	Norway	Population-wide national database	Regional	2002	0-16	Myringotomy ±TTI ±Adenoidectomy NOMESCO, ICD-10	TTI: 4.1 M: 0.8 A+TTI: 1.6 A+M: 0.7
Karevold, 2007 [261]	Finland, Norway	Population-wide national databases	1-year-age bands	2002	0-16	Adenoidectomy, TTI NOMESCO, ICD-10	TTI Finland 5.13 Norway 4.32

Author, Year	Country	Data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000 persons)
							A Finland 9.52 Norway 3.93
Mason, 2001 [266]	England	Hospital episodes system	Annual, Quarterly	1989-1996	0-14	TTI D151	Trend graphs presented. 1992 quarterly: 2.1 per 1,000
Newton, 1994 [241]	Oxford England	Oxford Record Linkage Study Indirectly age & sex-standardised admission rates per 10,000 residents per year	Regional	1979-1986	All ages	Myringotomy ICD-9	M: 2.01
Northern American Continent							
Bright, 1993 [267]	United States	National Health Survey, parent recall	National	1988	0-17	TTI Coding system not stated	13
Coyte, 2001 [259]	Ontario, Canada	Hospital discharge records	Regional, 1-year age-bands	1996-1999	0-14	Myringotomy with TTI Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	8.35
Croxford, 2004 [237]	Ontario, Canada	Central registry	Total	1996-2000	0-14	Myringotomy with TTI Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures	5.2
Desai, 2002 [260]	Calgary, Canada	Calgary Health Region hospital database	1-year age-bands to 5-years-old,	1997-2000	0-15	Myringotomy with TTI ICD-9-CM	11.1

Author, Year	Country	Data sources	Reporting	Study Period	Age Range	Surgical Procedure, Coding System	Findings (per 1,000 persons)
			Regional				
Kogan, 2000 [135]	USA	National Maternal and Infant Health Survey	Proportion	1991	0-3	Maternal report of surgery, coding system not stated	68.0
Australia							
Close, 1993 [249]	NSW, Australia	Population-wide hospital separation data, Standardised separation rates	5-year age-bands	1986, 1989/90	0-14	Myringotomy ICPM-9 ICD-9-CM	Adenoidectomy only: 2.4 Myringotomy + TTI: 7.6
Glover, 1999 [4]	South Australia	Population-wide	Regional	1995/96	0-9	Tonsillectomy, Adenoidectomy Coding system not stated	No incidences given. Standardised admission ratios reported.
Rob, 2004 [8]	New South Wales, Australia	New South Wales Inpatient Statistics Collection	Regional, Annual	1981-1998/99	0-14	Myringotomy ICD-9-CM	M + TTI: 7.36
Spilsbury, 2006 [262]	Western Australia, Australia	Western Australian Data Linkage System, person-years	Annual	1981-2004	0-14	Myringotomy with TTI ICD	1997: 6.7 2004: 5.6
Tennant, 2003 [5]	South Australia	Population-wide	5-year age-bands	1996/97-1998/99	0-24	Myringotomy ICD-9	No incidences given. Standardised admission ratios reported.

TTI – Tympanstomy tube insertion. AT – Adenotonsillectomy. NOMESCO - Nordic Medico-Statistical Committee. ICD – International Classification of Diseases

3.4 THE DEFICIENCIES OF THE CURRENT EPIDEMIOLOGICAL LITERATURE

Global comparisons of the epidemiology of ENT surgery are complicated by the varied mechanisms of data collection, analysis and reporting. First, a variety of classification and coding conventions are used internationally. The main coding convention used internationally is the World Health Organisation (WHO) endorsed International Classification of Diseases (ICD) system. The purpose of the ICD coding convention is to aid countries with resource allocation and reimbursement decision-making.[273] However, it has been widely adopted amongst the international public health community as a means of making comparisons amongst and between communities. This coding convention has been through a number of major revisions since its conception in the late 1800s,[274] with the most recent revision, Version 10 (ICD-10), endorsed by the WHO in 1990.[273] These revisions result in changes to disease and procedural definitions, including the addition, deletion, and merging of codes as new diagnoses and treatments emerge and others become obsolete. The main downfall of the ICD system is that emergent diseases are not easily incorporated into the system without a major revision and, due to the major changes that can occur during a revision, the interpretation and comparison of epidemiological trend data can be problematic. Further to this, many countries have made modifications to the coding system prior to adopting it for use, with Australia being one country to do so. The *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (ICD-10-AM) was first released and implemented in 1998.[275] Since then it has been adopted by a number of countries, including New Zealand, Ireland, and Singapore.[276] Other countries use their own modified versions of the ICD system, for example, the Canadian Institute for Health Information endorse *ICD-10 with Canadian Enhancement* (ICD-10-CA), the American Centers for Disease control and Prevention endorse *ICD-10 with Clinical Modifications* (ICD-10-CM), and the *ICD-10 German Modification* (ICD-10-GM) is used in Germany.

Second, epidemiological comparisons are further complicated by the use in some countries of coding conventions entirely separate to the ICD system. For example, a coding convention developed and endorsed by the Nordic Medico-Statistical Committee (NOMESCO)[277] is utilised in Nordic countries, while in America a number of coding systems are utilised by healthcare providers in addition to the ICD-10-CM, including the Healthcare Common Procedure Coding System,[278] the Current Procedural Terminology, and the Centers for Medicare and Medicaid Services created ICD-10 Procedure Coding System.[279] Even within Australia other coding systems are in use. The Medicare Benefits Schedule (MBS), while similar, is different from the ICD-10-AM codes and is used by many healthcare providers for determining billing fees with the coding used for research purposes.[280, 281] The variety of coding systems used in the literature that describes paediatric ENT surgery has been presented in Tables 3.2 and 3.3. It is evident that different nomenclature has been used across both geographic locations reported and throughout time. Therefore, in making comparisons between reports, certain assumptions are made that the basic definition of a surgical procedure has not changed dramatically over time or between surgical communities internationally. For example, that a tonsillectomy continues to involve the partial or entire surgical removal of the tonsils, or that a myringotomy continues to mean the surgical incision of the ear drum, regardless of time or geographic location. With this assumption, comparisons can be made on the changing epidemiology across geography and time. Several reports in the literature did not state the classification system used to identify the surgical procedures, which further obscures the interpretation of the reported data. Given this, the method used for classifying surgical procedures and their underlying conditions needs to be clearly described in order to allow meaningful interpretation of the data within the context of the known literature.

Third, methodological issues exist in the analysis and reporting of procedural data. Conventions adopted throughout the epidemiological community include mechanisms for the reporting of age. One common convention is to report medical conditions, diseases and surgical procedures in five-year age groups. This is a practice that is widely accepted and used throughout the health literature including by prominent public health agencies, such as the World Health Organisation,[282] Center for Disease Control,[283] and the Australian Institute of Health and Welfare (AIHW).[284, 285] However, this analytical practice is problematic when reporting paediatric conditions. Within the literature, the incidence and prevalence of paediatric medical conditions and their corresponding surgical procedures are commonly only available for the five-year age-bands: 0 – 4 years, 5 – 9 years and 10 – 14 years. However, these age groupings may not be appropriate, particularly as there are large developmental discrepancies within the age groupings themselves. For example, the age grouping zero to four-years-old covers the most exponential period of growth that humans go through.[286] It would seem nonsensical to most to say that a six-month-old infant and a four-year-old pre-schooler are equivalent in developmental stage or that they should be included within the same categorisation. However, it is a common practice in epidemiological research. Generally, this poses no issue as most conditions described in the wider public health literature are chronic medical conditions affecting older populations. However, in research that is specifically describing medical conditions and the related surgical procedures that predominantly affect children, the coarseness of this aggregation clearly conceals the detail necessary for accurate comparisons of management practices across different communities.

Fourth, there are international disparities in the demarcation between childhood and adulthood. However, in 1989, the United Nations General Assembly adopted the Convention on the Rights of the Child which defines

> *"a 'child' as a person below the age of 18, unless the laws of a particular country set the legal age for adulthood younger."*[287]

In line with this definition, many countries, including Australia, define the legal age of majority as 18-years-old, but internationally it does vary from between 15 to 21-years of age.[287-290] Therefore, it is unsurprising that international epidemiological reports use differing criteria to define their paediatric cohorts. Within the published literature, many reports focus on the epidemiology for paediatric populations aged less than 16 or 18-years of age. However, a number of published reports include not only children and adolescents in the cohort examined, but the portion of the population in early adulthood. A number of reports examine the incidence of these ENT surgical procedures in the whole population with the paediatric-specific incidences extractable from within the body of the publication. Of course, these differences in criteria used to define the study populations leads to difficulties in the comparison of the reports. Each needs to be carefully reviewed in order to extract the incidence of the surgical procedures for only the paediatric populations. And in those reports where the cohort inclusion age criterion is less than 18-years of age, important epidemiological inferences in the adolescent cohort may be overlooked or missed entirely. Consistency in the inclusion criteria across reports would allow for more meaningful conclusions to be made on the epidemiological differences reported.

The problematic differences in the definition of data for inclusion in the analyses are not the only methodological issues of note. The reporting nomenclature in the literature varies widely and is often dependent on the preferences of the authors, the public health community, and the journal in which the paper is published. The way in which the epidemiological data are presented and reported can lead to misinformation. Preferences and opinions abound as to the terminology to be used and the reporting conventions to be followed. In the literature reported herein, the incidence of ENT surgery has been reported using a variety of analytical methods and terminology, including ‘rates’, ‘incidences’, ‘proportions’, and ‘frequencies’. Each of these methods of analysis and reporting varies slightly from each other in their accepted use, validity, and rigor. Generally, the most accepted analytical technique is to examine and report incidences with an age and sex-standardisation.[284, 285] Age and sex-standardisation is an adjustment applied to incidences in order to enhance the comparability of data from different populations. The adjustment minimises the effect on the incidence caused by the compositional differences in the age structure of a populations.[285] An additional disparity is the use of divergent denominators, for example, published results have been presented as per ‘person-year’, ‘hospitalisations’, or ‘resident’ and expressed as anywhere from 1,000 to 100,000 population. These differences in reporting conventions make comparison of the results time consuming as results need to be extracted from reports and modified so consistency is obtained, thereby allowing for sensible and meaningful comparisons to be made.

Finally, as expected, the literature has been published over many years, and from a wide variety of countries. This in itself leads to difficulties in comparing reports and drawing conclusions. Surgical practices inevitably vary over time and between surgeons. As surgical techniques improve, change, or wax and wane in popularity the ability to make comparisons longitudinally over time becomes complex. This is further complicated by variations in surgical techniques, both across the globe and within countries, making true comparisons near impossible. The adoption of case definitions and clinical practice guidelines helps to ensure consistency in the application of surgical procedures within a community and many countries have clinical practice guidelines in use. Clinical practice guidelines for the treatment of otitis media have been developed and endorsed for use within a number of countries, including the *American Academy of Pediatrics* and *American Academy of Family Physicians* in the USA,[67, 82] the *National Collaborating Centre* *for Women's and Children's Health* in the United Kingdom,[66] and the *Korean Otologic Society*.[76] Within Australia, a nation-wide clinical practice guideline for the treatment of otitis media does not exist, however, some hospitals have developed and implemented their own.[65] Likewise, clinical practice guidelines exist for the application of tonsillectomy in children in a number of countries including the USA,[21, 49] Scotland,[22] and South Africa,[24], but unlike for otitis media, there are Australian developed and endorsed guidelines for the application of tonsillectomy in Australia.[25]

Therefore, it is clear that there are deficiencies and discrepancies in the previously available literature reporting the epidemiology of ENT surgical procedures in children. These inconsistencies in the analysis and reporting of data limit the ability to make international comparisons, as well as, temporal comparisons within countries. With these shortcomings of the previous literature in mind, the data presented in this thesis will be rigorously analysed with a sound methodological approach to ensure that the data are meaningful not only to the current author, but to public health practitioners that may utilise the analyses in the years to come.

3.5 PARENTAL EXPECTATIONS AND EXPERIENCES: A SYSTEMATIC REVIEW

3.5.1 Introduction

As discussed in earlier chapters, ENT conditions are ubiquitous in childhood. Exposure to pathogens during the early years of life induces the immune responses that protect the individual throughout life. To reiterate, along with infections, including tonsillitis and otitis media, children often have obstructive sleep apnoea due to enlarged tonsils resulting in sleep disturbances,[42, 44] social and educational disruptions,[35, 38, 204, 206, 207] and delayed growth.[41] While these conditions affect the child, as a general rule, children have little say in their medical care. Their inability to care for themselves results in caregivers being responsible for decision-making on their behalf. Parents, guardians, doctors and nurses decide the best course of medical treatment and are responsible for decisions regarding antibiotic use, surgical intervention, or a 'watchful waiting' approach. While medical practitioners provide their learned opinion on the best treatment approach, the child's caregivers make the final decision on whether treatment is instigated. Therefore, it follows that the opinions, experiences, and expectations of parents and caregivers are pivotal in the decision-making process for surgical intervention. This was also suggested from anecdotal evidence acquired through discussions with clinician and allied health colleagues. Therefore, the following component of work was conducted to explore the currently published literature on the topic. A systematic literature review was undertaken to examine the currently published literature reporting on the parental experiences and expectations associated with caring for a child with ENT conditions. The results of this literature review analysis are presented in this section of the thesis.

Research Question

The research question was:

What are the reported experiences and expectations of parents and caregivers of a child with an ear, nose and/or throat condition?

Aims

The aims of this section are to:

1) Critically review the currently published literature; and
2) Identify and discuss the strengths and weaknesses of the published literature.

3.5.2 Research Protocol

Search Strategy

The following databases were searched: PubMed (1966-2012), Scopus (1960-2012), Web of Knowledge (1864-2012), CINAHL (1983-2012), and Embase (2009-2012). The search strategy used MeSH headings, free text words, and wildcard symbols (*). Publications were identified using combinations of the following search terms: *parent*, father*, mother*, guardian*, legal guardian, sleep apn*ea, tonsillectomy*, *adenoidectomy*, *middle ear ventilation*, *tympanostomy*, *otitis media with effusion*, *middle ear effusion*, *ear inflammation*, *tonsillitis, referral, consultation, second opinion, decision making,* and *expectation*. The search strategy was tailored for each database to maximise the success of each search. The detailed search strategy used for each database is included in Appendix A.1. The reference lists of articles were also reviewed to identify any potential additional articles, however, none were identified using this method. The search was limited to parents and caregivers of children aged under 18 years of age. Searches were limited to studies published in English and conducted on human subjects.

Inclusion and Exclusion Criteria

Articles were included if they reported research investigating parental and/or caregiver experience and expectations of caring for children with tonsillitis, sleep disordered breathing and/or otitis media. The 'care' of children with these conditions included experiences and expectations related to the diagnosis, treatment, and specialist referrals for this population of children. Articles were excluded if they reported case studies, were Clinical Practice Guidelines, or examined postoperative outcomes only (Table 3-4). Articles were excluded if they only reported the medical practitioners' experiences and expectations, or the medical practitioners' perception of the parents' experience and expectations regarding the care of children with tonsillitis, sleep disordered breathing and/or otitis media.

Table 3-4: Exclusion criteria for the systematic literature review.

Exclusion Criteria
Reviews, Editorials
Clinical case studies
Treatment Guidelines
Research examining postoperative surgical outcomes
Research not involving tonsillitis, sleep disordered breathing, or otitis media
Research involving high risk patients, such as Down Syndrome

Study Selection and Data Extraction

The search identified 391 articles: Embase (123), CINAHL (16), Pubmed (78), Scopus (98), and Web of Knowledge (76). After removing duplicates, there were 166 original articles that contained the search terms (Figure 3-5). These were reviewed for title and abstract content which resulted in a further 130 journal articles being excluded from analysis.

There were 31 articles that appeared to report parental experiences of caring for a child with these conditions and the subsequent referral experience. However, after review of the published papers, 23 were excluded: six reported the medical practitioner's perception of the parent experience, two were medical record reviews, 14 were irrelevant to the research question, and one was not published in English. The final selection consisted of eight journal publications.

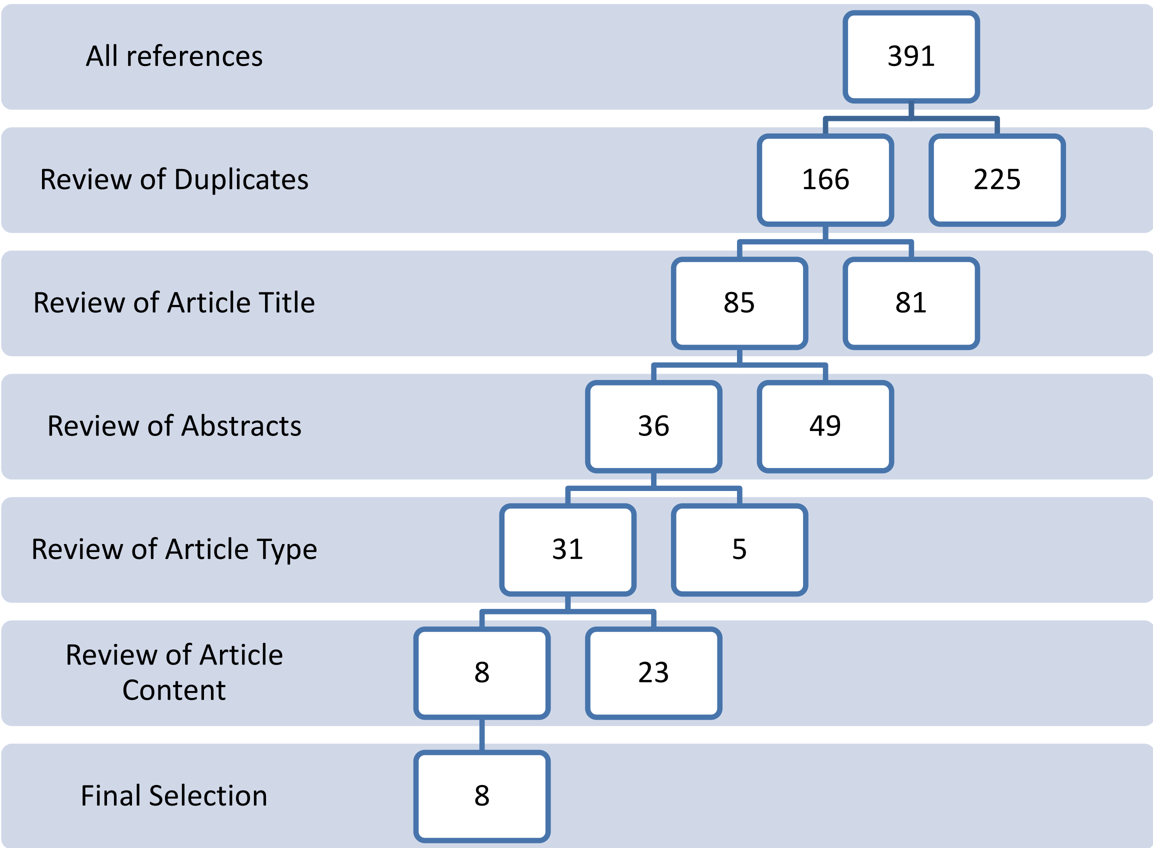


Figure 3-5: Study Selection Profile.

3.5.3 Quality Appraisal

Eight papers were included in the review (Table 3-5). These papers reported research that used cross-sectional, cohort, or qualitative study designs. The methodologies used were surveys or interviews. The study sample sizes ranged from 12 parent-child dyads through to data from surveys completed by 2,619 parents. All articles were published in peer-reviewed journals.

These papers reported aspects of the parental experience associated with caring for a child with an ear, nose, and/or throat condition. This included the experience of caring for the child; the expectations of referral; and the understanding and/or expectation of treatment for children with ENT conditions. The data collected on parental concerns and expectations was often embedded within a larger quantitative study and not the primary aim of the reported research project.

3.5.4 Data Analysis and Interpretation

There is limited in-depth research on the views and understandings of parents who care for children with an ear, nose, and/or throat condition. The majority of the published research is from surveys without a detailed focus on the parental stance.

Table 3-5 provides a summary of the literature that reports on some aspect of parental opinion and/or expectation. Six studies used surveys to gather this data. Only two studies used interviews to explore parental experiences in detail. These eight studies are summarised and critiqued.

Research published in 1990 by Wuest and Stern[291] was the first study that utilised interviews to explore the experiences of parents and families of children with otitis media. Thirty Canadian individuals from 12 families participated in interviews that were analysed using grounded theory. Grounded theory was first described in 1967 by Glaser and Strauss[292] as a method for "*discovery of theory from data systematically obtained from social research*". Using this method, Wuest and Stern[291] identified that the families' relationship with the healthcare system was the constant theme throughout the interviews. Each family's relationship with the healthcare system fluctuated through a number of phases. The phases were identified as entrusting, disillusionment, learning the rules, and negotiation.[291] The authors concluded that the way the families perceived their physician was important in decision-making. Physician credibility was linked to the physician behaving in a way that the family expected. Furthermore, the families' experiences could be improved by providing more information about the healthcare system and the disease to increase the families' understanding and improve the family-physician relationship. The research provides some important insight into the familial experience of otitis media health care, however, there are some important flaws in the article. Firstly, the timeframe for data collection is not stated and the study sample is not defined. While it is made clear that there were 30 individuals from 12 families interviewed in the research, the authors fail to state who exactly was interviewed. There is no information about the questions or prompts used during the interview or who conducted the interviews. The method for analysing the interview transcripts is not outlined, so it is not clear whether only one or both of the authors reviewed themes. Also not clearly stated is how themes were revised or refined throughout the interviewing process or whether the final analysis was conducted only after all interviews were conducted. Therefore, while this research paper provides one of only two detailed accounts, the methodology is unclear.

The second noteworthy paper reported experiences of English families with a child with recurrent sore throat. Issues affecting these families were explored in research conducted in 2002 by Lock *et al.*[293] Semi-structured interviews were conducted with 12 parent-child pairs. Children were aged between four and 16 years-old. Three key parental concerns were identified. These were the physical and emotional effects of the condition on the child; the impact on the child's education, social life and family; and the management of recurrent sore throat. The physical effects were discussed in more detail than the social effects. Parents focussed on the child's temperature and tonsil abnormalities, energy levels, voice problems and lack of sleep, whereas children only focussed on pain and voice problems. The child's moodiness, lethargy, withdrawal and clinginess were social effects highlighted during parent interviews. Recurrent sore throats impacted on the child's education, social life, and family relationships according to parents. All parents were concerned about absences from school. In contrast, children had mixed views about missing school but many did complain about having to catch up on missed school work. Parents reported that children would remain indoors during an episode and spend their time resting and participating in sedentary activities because they were unable to participate in other activities. In addition to impacting the children, the illness would impact on the family resulting in sleep disturbances, disruptions to holidays, and loss of employment both in needing to take time off to care for their child and also in losing or leaving jobs. Parents managed recurrent throat infections by requesting repeat antibiotic prescriptions and insisting on surgical intervention, including insisting on prophylactic tonsillectomy to prevent future episodes of illness. Parents also used the time on the waiting list to see whether there was resolution of the illness and based their decisions regarding treatment on the prior experience of themselves or others.

The remainder of the studies identified in this systematic literature review reported structured survey data. These surveys were limited in scope, often only focussing on one aspect of the parental/caregiver experience, or incorporating the survey into a broader research project. For example, within the framework of a health technology assessment study of adenotonsillectomy for children with recurrent sore throat, Lock *et al.*[294] explored parental treatment preferences among parents from across northern England and west-central Scotland. A total of 729 parents were given the choice between enrolling their child in a randomised controlled trial and opting for their child to be included in a parallel patient preference study. Two-thirds of the study parents chose for their child to participate in the patient preference study, with 83.9% parents choosing surgical intervention and only 16.1% choosing medical management for their child with recurrent sore throat.[294] Also reported in this study, was that those parents choosing surgical intervention for their child stated that their child had a greater number of sore throats (3.6 *cf*. 2.7 episodes) in the preceding three months compared to those parents who chose medical management, and that these sore throat episodes were longer in duration (7.8 cf. 5.3 days).[294] Parents who chose surgical intervention for their child also reported that their child had more days absent from school (11.2 *cf*. 6.6 days).[294] A greater proportion of these parents also indicated that the child's condition had impacted on their school work (62% *cf*. 29%).[294] This research provides an important insight into the parental preference for surgical intervention for children with recurrent throat infections. The data provide evidence that when given the option, the majority of parents will choose surgical intervention. Furthermore, this choice is most likely influenced by the number and severity of episodes of illness that the child has had in the preceding months. However, while this research provides an insight into parental decision making and draws conclusions about those factors potentially influencing this decision making process, the research does not provide the deeper understanding gained by in-depth interviews.

Parental knowledge and expectations of antibiotic prescribing was the focus of four survey-based studies reported. Two research studies conducted by Arason *et al.*[295, 296] investigated factors that could influence antibiotic prescribing for acute otitis media, and the relationship between this antibiotic use and tympanostomy tube insertion. In both studies, parents of children aged one to six years-old from within four Icelandic regions were invited to complete a survey collecting a range of sociodemographic and medical data. It was within this research framework that the authors collected information on parental views of antibiotic usage. In both studies, parents answered closed-answer questions designed to elicit the parental understanding on whether antibiotic usage was appropriate to treat the common cold or acute otitis media. Questions were answered using a standardised Likert scale with three answer options - "always", "sometimes", and "never" - as well as a neutral "don't know" response. Despite the studies being conducted five years apart, the results were concordant. A large proportion of parents indicated it was always or sometimes appropriate to give antibiotics for acute otitis media (94.3% in 1998 cf. 94.9% in 2003).[295, 296] Surprisingly, nearly half of parents also felt it was always or sometimes appropriate to treat the common cold with antibiotics (43.5% in 1998 cf. 45.0% in 2003).[295, 296] In addition to these questions, in 1998 parents were also asked to indicate whether they believed pathogens were becoming antibiotic-resistant and if the inappropriate usage of antibiotics could contribute to this. The majority of parents (89.4%) believed that bacteria were becoming antibiotic resistant and, similarly, the majority (80.1%) agreed that the inappropriate use of antibiotics could lead to this development of resistance.[296] While there are other interesting results presented in both research papers - for example, that there was a correlation that parents who lived in regions of Iceland with low antibiotic usage were likewise less likely to agree that antibiotics were always necessary[295, 296] – the exploration of parental opinions is clearly limited and not the focus of either of these two studies.

A similar study conducted across Finland and the Netherlands by Tahtinen *et al.*[297] investigated the antibiotic knowledge of parents of children aged less than 4 years old who attended childcare. Closed-answer questions about the use of antibiotics in the treatment of acute otitis media were answered by 656 parents in Finland and 465 parents in the Netherlands.[297] A larger proportion of Finnish parents (85%) believed that antibiotics were necessary to treatment of acute otitis media compared to Dutch parents (55%).[297] Finnish parents were more likely to believe that antimicrobial resistance was an issue for the treatment of acute otitis media in children (20% Finnish parents cf. 2% Dutch parents).[297] Furthermore, more Finnish parents (88%) were worried that bacteria could develop antibiotic resistance compared to Dutch parents (65%). In comparison to both these Finnish parents and the Icelandic parents discussed previously, the proportion of Dutch parents who indicated concern over antibiotic resistance was much less. The differences in the knowledge and attitudes of the parents from Finland and the Netherlands were attributed by the authors to be due to differences in the national treatment guidelines of the two countries.[297] This is most likely the same explanation for the difference between Icelandic parent attitudes and knowledge and those of the Dutch parents.

A fourth study investigated the knowledge and expectations of Italian parents regarding antibiotic prescription for the treatment of their child's upper respiratory tract infections.[298] This study surveyed 1029 parents with a questionnaire that used closed-answer and Likert scale questions. The authors report that 37% of parents thought that antibiotics were useful in treating viruses, while 41% parents believed that bacteria were the potential cause of the common cold.[298] This is clear evidence that a large proportion of parents do not have a good understanding of the aetiology of upper respiratory tract infections. Despite this, a large proportion of parents (47%) indicated that in most cases the infection would resolve without treatment and a third of parents (35%) indicated that medical practitioners often prescribed antibiotics unnecessarily.[298] Within this research study, a subset of 359 parents who were opportunistically selected were interviewed with a second questionnaire that used a series of closed-answer and Likert scale questions to collect data on parental expectations and satisfaction. Prior to a consultation, only 17% of parents expected the doctor to prescribe antibiotics, however, after the consultation 32.5% of parents had received a prescription for the treatment of their child's upper respiratory tract infection.[298] There was an association between the parents' expectation to receive antibiotics and the receipt of an antibiotic prescription.[298] Regardless of the outcome of the medical consultation, nearly all parents reported being satisfied with the outcome: 98% of those with and 99.5% of those without a prescription reported being satisfied.[298]

Parental concern over the impact on themselves and their families was explored in research by Howel *et al.*[299] A cohort of 1190 north England parents of children aged under 14-years with a history of recurrent throat infections were surveyed. The questionnaire construct included sociodemographic and medical questions, including a five-point Likert scale to examine parental concerns. However, the authors did not disclose all the parental concerns included in the questionnaire, or the way that the questions were posed, and a copy of the questionnaire was not included as an appendix. Only three of the parental concerns included in the questionnaire were reported in the paper. These were the level of disruption cause by the child's condition, the extent of parent/caregiver worry, and their eagerness for surgical intervention.[299] These were the three concerns determined by the authors to be the most significant for parents/caregivers. The majority of parents (63%) stated that they were worried or very worried about their child's illness. Furthermore, the majority of parents/caregivers (66%) were eager for surgical intervention to be performed. Fifty-eight percent of parents indicated that the level of disruption that the child's illness had on the family was severe or very severe. In addition to these outcomes, the authors also reported on disruptions to employment. Nearly half (49%) of parents had to take time off work at some stage to care for their child, with 17% citing difficulties in taking this time off.[299] When the child was unwell, 96% of mothers provided care for the child compared to only 39% of fathers.[299] In addition, the authors examined the associations between the parents' level of concern, social disruption, and eagerness for surgery with the number of episodes of the child's illness, episode duration, and absences from school. The likelihood that parents were very worried about their child's illness or considered the disruption to the family to be considerable was greater if the child had more absences from school, more severe and more regular episodes of infection, or the parent had to regularly take time off work. However, the parent/caregivers eagerness for surgery was only associated with the number of episodes of illness that the child had per year. The authors also report that parents and caregivers often had to leave the workforce due to inflexible working hours and difficulties in getting leave to care for their sick child. However, there is no information on how this information was collected and the proportion of parents/caregivers quoting these reasons is not presented. Another criticism of the study was that the authors used a structured questionnaire to elicit their findings, which constrained answers to a five-point scale or brief responses to closed-answer questions. The authors stated that they piloted the questionnaires to ensure ease of use prior to the commencement of the study, but they did not provide access to a copy of the survey so that all the questions posed can be reviewed. The number of questions included in the survey is also undisclosed. However, the sample size surveyed was large (1190 parents) which allows some certainty that these results are a true reflection of the issues facing adults responsible for the care of children with tonsillitis and recurrent throat infections in the north of England. Ultimately, the findings reported in this study are noteworthy and provide an important insight into the issues facing parents and caregivers.

Table 3-5: Parental expectations and understanding of treatment: Interviews with parents/caregivers.

	Reference	Country	Year	Study Design	Methods	Sample Size	Child's Condition	Interviewee Sample
1	Arason, 2002 [296]	Iceland	1998	Cross-sectional	Survey	804	AOM	Parents of 1-6 year-old children
2	Arason, 2005 [295]	Iceland	2003	Cross-sectional	Survey	889	AOM	Parents of 1-6 year-old children
3	Howel, 2002[299]	England	1994-5	Cross-sectional	Survey	959	Recurrent sore throat	Parents of 0-14 year-old children
4	Moro, 2009 [298]	Italy	2003	Cross-sectional	Survey	352	Recurrent sore throat	N.S.
5	Lock, 2010a [293]	United Kingdom	2002	Qualitative	Semi-structured Interview	12	Recurrent sore throat	Parent-child dyads
6	Lock, 2010b [294]	United Kingdom	2002-6	RCT with a preference parallel study	Survey	729	Recurrent sore throat	Parents of 4-15 year-old children
7	Tahtinen, 2009 [297]	Finland, Netherlands	2006-7	Cross-sectional	Survey	1151	AOM	Families of 0-4 year-old children
8	Wuest, 1990 [291]	Canada	NS	Qualitative	In-depth Interview	30	OME	N.S.

NS - Not Stated. RCT - Randomised Controlled Trial. AOM – Acute Otitis Media. OME – Otitis Media with Effusion

3.5.5 Discussion

The objective of this review was to identify report on, and critically examine the currently published literature that reports the experiences and expectations of parents and caregivers of a child with an ear, nose and/or throat condition. As a result of this review it is now clear that the literature is sparse. Just eight studies report on some aspect of parental/caregiver experience and expectations - four studies examined and reported on parental knowledge of antibiotic usage, three studies examined and reported on the impact of the condition on the family and their ability to navigate the healthcare system, and one study reported parental treatment preferences. Only two of the eight studies used qualitative research methods to elicit the study findings.

The research suggests that parents have limited knowledge regarding the appropriate use of antibiotics, with many surveyed parents incorrectly believing that antibiotics should be used in the treatment of viral upper respiratory tract infections. Furthermore, the research suggests that many parents expect to receive an antibiotic prescription following a medical practitioner consultation for their child's ENT condition. However, when given the option the research suggests that many parents prefer to choose surgical intervention for the treatment of the complications of their child's upper respiratory tract infection, rather than medical management. It can be assumed that in most instances parents/caregivers are the persons responsible for the final decision on whether a child will undergo surgical intervention. While general practitioners may refer a child for surgery, and specialists may recommend surgical intervention, if the parent/caregiver does not give consent, the treatment will not be performed. Since surgery is a potentially scary and painful experience for a child, it is reasonable to posit that parents would be reluctant to request surgical intervention unless they perceive clear benefits to outweigh these costs. And although there is just one paper addressing this subject, this research suggests otherwise.

The three studies that explored the impact the child's ENT condition had on the parent and family identified similar themes.[291, 293, 299] Disruptions to the parent's employment and their child's school absences were of greatest concern. Both of these issues, along with the severity and duration of each episode of illness and the interactions with the healthcare system were common themes. Unfortunately, there were flaws in the research methods used. As previously discussed, the paper by Wuest and Stern[291] did not clearly define who the study population included, nor was there any detail about the questions or themes used during the interview. The authors did not define who conducted the interviews, and while the methodological approach was grounded theory, there is not enough information on the analytical approach for the study to be reproducible. Typically, grounded theory follows an iterative process, with transcripts examined for key themes with consensus made by all researchers. While the authors explained their research process as a "constant comparative analysis", it is not clear whether only one or both of the authors analysed the interviews. Furthermore, there are no direct interviewee quotes included in the paper, so the reader is unable to see evidence of the raw data. Therefore, while this research paper provides one of only three detailed accounts, the methodology is unclear.

Howel *et al*.[299] concluded that the impact of recurrent throat infections and parental concerns was significant and that it would be important for clinicians to understand these issues in order to provide healthcare that balances the clinical requirements of treatment with the needs of the family. However, this paper used a cross-sectional study design with data collection via questionnaires completed by parents. While the benefits of using a survey are many - they are easy to administer, cost-effective and can collect data from a large number of respondents - there are also drawbacks.[30] While, the response rate can be low, especially when surveys are conducted via post or the internet,[30] the authors posting these surveys had an impressive response rate of 81.5%.[299] However, assuming that the survey was administered in English, it was not clear whether participants were excluded if they could not read or write in English. The survey was sent to families visiting ENT surgical departments in Northern England. While England remains a predominantly Caucasian country with 86.0% of the population identifying as 'white' in the 2011 census,[31] there is an ever increasing proportion of British subjects that identify belonging to other ethnic groups. In the 2011 Census, 7.7% of the British population stated that English was their second language, and 1.3% stated that they did not speak English well.[31] However, the authors of this research paper do not disclose whether non-English speaking participants were included or excluded in this research study. While it could be argued that only a small percentage of the population may have been excluded, ethnicity has been shown to be a risk factor for these ENT conditions, so including all ethnic groups is important to get a complete understanding of the impact of the disease in the population.[135, 145, 222, 300, 301] Further to this, while a survey can generate a large amount of data in a short timeframe, the data collected can lack depth of understanding. Certainly these authors focussed the papers on the results of three survey questions they felt were most significant. However, with data collected as five-point Likert scales, the reader must draw some of their own conclusions. The reader is told that parents are eager for surgery and that the family is severely disrupted by the child's illness, but more could be understood through in-depth interviews. What factors are driving the eagerness for surgery? Is the disruption only to the parent's employment and the child's education, as reported by the authors, or are other disruptions evident as well? Unfortunately, a survey constrains the level of understanding that is achieved. Also, as previously discussed, Howel *et al.*[299] fail to disclose the full scope of the survey or to include it as an appendix for the reader to consider.

The most comprehensive study was published by Lock *et al.,*[293] which examined the experiences of parent-child dyads with recurrent sore throat. The authors conducted semi-structured, in-depth, interviews and used a grounded theory approach to their data collection and analysis. The paper presented a clear explanation of their participant recruitment strategy, interview methods, and analytical approach. The methods have been reported such that the study would be reproducible – this being an important foundation of sound scientific method. Furthermore, the authors give details of who was interviewed and that an interpreter was used for those who had English as a second language. However, there is potential sampling bias. The study population was a convenience sample recruited through a hospital ENT clinic. While convenience sampling has its benefits, such as being easy, timely, and cost effective to perform, it does suffer some limitations, particularly systematic bias. This results from the over- or under-representation of a population in the sample. This results in a study population that may not be a true reflection of the wider population from which it is derived and, therefore, the results do not reflect the entire population. As a result, the generalisability of the study findings can be questioned. Unfortunately these biases are inherent in this study due to the unequal recruitment of more boys than girls (eight males *cf*. four females) and that the boys enrolled were considerably younger than the girls (mean age of boys was 7.63-years *cf*. mean age of girls was 13.25-years).[293] The issues and concerns raised by older girls during an interview are likely to be considerably different to those issues raised by younger boys. The interviewing methodology is also potentially problematic. The authors interviewed parent-child dyads and so the data collected was jointly created through the interaction between parent and child, as opposed to one individual's version of events. The issues surrounding the use of dyads for research have been recently examined in the literature.[96, 97] Specifically, individual interviews allow a participant to share information they may otherwise have withheld. In contrast, interviewing a pair may have resulted in a less detailed account given by either, or both, the parent and child.

Indeed, a power differential exists between the parent and child which would also impact on the potential contribution to the interview. In fact, the authors state that the contribution of some children was very limited, with parents dominating the dyadic interviews.[293] There are also potential ethical issues associated with interviewing parent-child dyads, including potential impacts on the privacy of the two interviewees. However, proponents of dyadic interviews state that through interviewing a dyadic pair, ideas can be stimulated and discussion items remembered and expanded.[96, 97]

Limitations

First and foremost, a systematic literature review should have a clearly defined research question and use methods to identify and select publications relevant to the research question, and then critically appraise these publications. This certainly has been done here. However, the analysis of the data reported in the relevant publications and the subsequent reporting of the combined results posed some obstacles. Primarily, the nature of the research question meant that the publications identified would not necessarily include empirical or standardised data and, therefore, not be easily extracted, analysed, and reported. Therefore, the nature of the review did not align explicitly to the internationally recognised and widely published PRISMA standards for reporting systematic literature reviews.[302, 303] The challenges of performing a systematic literature review of qualitative data have been examined in the past.[29, 304] The methodology of performing a review of qualitative research is acknowledged as being complex. Within this current review, the process began with deciding what was relevant to the initial inclusion criteria. As studies were read and re-read through an iterative process, the relevant interpretations were developed and the key concepts extracted. The main aim of conducting a systematic literature review of qualitative data is to develop and explicate a theory.[32] The purpose of this being to use this to drive the expansion of the qualitative body of knowledge to inform research, practice, and policy. While a basic preliminary theory was developed - that a child's ENT condition adversely impacts on the family unit – this theory was incomplete and required further exploration in the Australian setting. The exploration and development of this theory formed a component of the thesis research.

Finally, with only eight published studies examining some aspect of the research question, and with these having study design and methodological flaws, there is clearly a paucity of literature currently available. The main concern was that most data examining parental/caregiver concerns were collected through structured surveys and, often within the confines of a larger study. While findings reported within the context of a larger study remain important, this method of data collection raises concerns about the depth of the understanding gained by these studies. Only two of the studies examined in this review used interviews in their study design – one study used in-depth interviews while the other used semi-structured interviews.

Conclusions

In conclusion, there is little currently known about the expectations and experiences of parents/caregivers who care for a child with an ear, nose, and/or throat condition. Only three studies explored in depth those issues facing parents and caregivers which may influence their opinion and lead to a preference to seek surgical intervention. Only one of these studies examined these issues for parents of children with otitis media, while the remaining two focussed on parents of children with recurrent sore throats. Despite this, the themes that can be drawn from these three studies focus on the impact of the child's condition on the family dynamics, financial security, and the child's and family's wellbeing. No study explored the expectations or experiences of parents of children with obstructive sleep apnoea. Clearly, there is a scarcity of published literature on this important influence on surgical intervention. An in-depth examination of those issues influencing Australian parents and caregivers to seek surgical intervention for their child with an ear, nose, and/or throat condition is warranted.

SECTION II:

THE EPIDEMIOLOGY OF EAR, NOSE, AND THROAT SURGERY IN CHILDREN

I am told there are people who do not care for maps,

and I find it hard to believe.

Robert Louis Stevenson, Treasure Island

CHAPTER 4
The South Australian Epidemiology

4.1 INTRODUCTION

As a result of the literature review, a study was conducted to describe the age and sex-specific incidence of ENT surgical procedures in the South Australian paediatric population. This study would provide a clearer understanding of the characteristics of children who undergo one or more of the following surgical procedures: adenoidectomy, tonsillectomy, and myringotomy with/without tympanostomy tube insertion. Furthermore, while these procedures can be performed individually, more often they are performed concomitantly. Determining the proportion of children who undergo multiple ENT surgeries simultaneously would provide further insight into the epidemiology of these procedures in South Australia and why South Australia has had a higher incidence of these procedures compared to elsewhere in Australia. In this chapter, the results of this study are presented and discussed.

The ear, nose, and throat (ENT) surgical procedures most commonly performed in children are adenoidectomy, tonsillectomy and myringotomy with/without tympanostomy tube insertion. As highlighted in the literature review, South Australia has previously been reported as having a higher incidence of paediatric ENT surgical procedures compared to other Australian states and territories. In fact, the incidence of these three surgeries in South Australia has been estimated as being up to twice that in other areas of Australia.[254]

An important first step toward understanding why South Australia has had a higher incidence of these procedures was to understand which children were more likely to undergo these procedures. However, there was a paucity of literature that provided detailed reports of age-specific incidence. Predominantly, incidence data has been reported for 5-year age-groups[5, 247-249] or entire regions,[8, 240, 241, 243, 250] and the literature that has reported age-specific incidence profiles has come from Scandinavian countries.[235, 261] There are no Australian reports that give sufficient detail and the descriptions provided were substantially out-dated. Furthermore, while reporting incidence in 5-year age-groups may be acceptable and sensible for adults, it is not sensible to do so for paediatric populations. For example, children aged one-year and four-years are developmentally different to each other and are exposed to different risk factors in relation to ENT disease. However, data for children aged below five-years are commonly combined together for reporting purposes. So, although there was literature that gave some insight into which children undergo these procedures, the level of detail was inadequate for the purpose of this investigation.

4.1.1 Aim and Objectives

The aim of this study was to provide a description of the epidemiology of adenoidectomy, tonsillectomy, and myringotomy with/without tympanostomy tube insertion within the South Australian paediatric population.

The following objectives were set for this study:

1. To describe the population of children that underwent these procedures.
2. To describe the age and sex-specific incidence of these procedures.
3. To determine whether the incidence of these procedures changed over the course of the study period.

4. To determine whether the incidence of these procedures varied between the publicly funded and privately insured cases.
5. To describe the proportion of these procedures performed in metropolitan or country locations.
6. To describe how often these procedures were performed simultaneously, and in which combinations.
7. To describe the underlying medical conditions listed as the indications for surgery.
8. To determine whether the distribution of the underlying medical indications for surgery changed over the course of the study period.

4.2 METHODS

4.2.1 Study Design

A retrospective cross-sectional study was used to assess the incidence of ENT surgical procedures within the South Australian paediatric population between 1 January 1997 and 31 December 2007. This study used existing data collected through the SA Health Integrated South Australian Activity Collection (ISAAC) and the Australian Bureau of Statistics (ABS) Census of Population and Housing (the "Census").

4.2.2 Research Setting

Within South Australia, the Women's and Children's Hospital is the main provider of public healthcare for children. However, within metropolitan Adelaide, public healthcare is also provided for children at Flinders Medical Centre, Lyell McEwin Hospital and Modbury Hospital. In rural South Australia, public paediatric healthcare is provided within the major regional centres, for example Mount Gambier and Port Augusta. While the majority of private hospitals offer paediatric care, there is not a dedicated private children's hospital in South Australia.

SA Health is the state government department responsible for the organisation, administration and funding of the public healthcare services across the state. In addition, SA Health records the service provision of both public and private hospitals. Data were obtained from SA Health for all paediatric hospital separations that occurred during the study period. All South Australian hospitals, both public and private, are required by law (Health Commission Act 1976) to submit information for every hospital separation to the ISAAC database.[305] Data can be submitted in both paper and electronic format, and there are penalties for not supplying data within the required timeframes. While the ISAAC database was initially designed to provide SA Health with the information necessary to reimburse hospitals for their services, it is being increasingly used by SA Health research units for research purposes. For each hospital separation the ISAAC database includes demographic data, hospital separation data, and up to 25 procedures and 30 diagnoses.

Population data from the 1996, 2001 and 2006 Census were accessed through the ABS website.[306] The Census aims "to accurately measure the number of people in Australia on Census Night, their key characteristics, and the dwellings in which they live".[307] As the Census is compulsory and is bound by the Census and Statistics Act (1905), it was assumed that it would provide a reliable estimation of the South Australian population during the study period. The Census data were used to estimate the size of the paediatric population and to calculate incidence, as described in Section 4.2.4.

4.2.3 Study Sample

All hospital separations recorded in the ISAAC database for the study period that met the inclusion criteria were included in the study (Table 4-1). Within the ISAAC, and therefore for the purposes of this study, hospital activity was measured by the number of *hospital separations* rather than the number of hospital admissions. A *hospital separation* was counted when a patient was discharged from a hospital, transferred to another hospital, or died. Records were excluded from the study for those children who, though they had their surgery in a South Australian hospital, usually resided outside South Australia at the time of their surgery. Reasons that children from other jurisdictions may have undergone a surgical procedure in a South Australian hospital include the necessity for emergency surgery while on holiday in South Australia or a transfer to South Australia due to a lack of surgical services at their local health service in western Victoria, far-western New South Wales or the Northern Territory.

Table 4-1: Inclusion Criteria for the Study Sample.

Criterion
1. The patient was aged less than 18 years at time of surgery.
2. At least one of the following procedures was performed during the hospital stay: a. tonsillectomy b. adenoidectomy c. myringotomy with/without tympanostomy tube insertion
3. The hospital separation was between 1 January 1997 and 31 December 2007.
4. The patient's usual place of residence was within a South Australian postal code area at the time of surgery.

Identification of Study Sample

Permission to access the ISAAC database was granted by SA Health, who provided the researcher with a de-identified subset of the ISAAC database. This subset included all paediatric hospital separations for the study period (children aged less than 18-years-old). Hospital separations that met the inclusion criteria were identified and extracted from this subset by searching all 25 procedural fields to ensure completeness of the study dataset. Following this, data were excluded from the dataset where the postcode was not a South Australian residential postcode, where the postcode of the child was unknown or where there was no corresponding denominator data (Table 4-2). Specifically, four children who were recorded as residing in Lonsdale (postcode 5160) were excluded because the 1997, 2001 and 2006 ABS Census recorded no residents in this postcode.

Table 4-2: Data excluded from the study.

Postcode	Reason for exclusion	Cases (n)
0800 – 0999	Northern Territory	204
1750, 1755, 1765	New South Wales	0
2000 – 2914	New South Wales, Australian Capital Territory	267
3000 – 3984	Victoria	520
4000 – 4885	Queensland	24
6000 – 6965	Western Australia	34
7000 – 7468	Tasmania	8
5160	No denominator	4
9999	Unknown	30
Total		**1,091**

Surgical Procedure Codes

The relevant surgical procedures were identified using the *International Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (ICD-10-AM) procedural codes. The ICD-10-AM was produced by the National Centre for Classification in Health (NCCH) and consisted of a tabular list of diseases and procedures.[275, 308] The ICD-10-AM was modelled on the World Health Organisation ICD-10,[273] but was modified by the NCCH, under contract from the Australian Department of

Health and Ageing (DoHA), to ensure that the classification system was appropriate for Australian clinical practice. The ICD-10-AM used an alphanumeric coding system that was structured into body system and aetiology classifications. The ICD-10-AM procedure codes used in this study are listed in Table 4-3. It should be noted here that in 2010 the DoHA contracted the National Casemix and Classification Centre, located at the University of Wollongong, to take over the management, development and implementation of the ICD-10-AM system.

The Australian Refined Diagnosis Related Groups (AR-DRG) Version 4.2 codes[309, 310] were used in this study to cross-reference sample identification. The AR-DRG is a patient classification system originally designed to assist in the allocation of hospital funding. The definitions used to identify diseases and procedures in the AR-DRG classification system vary slightly from the ICD-10-AM classification system. The two codes used for this study were for tonsillectomy and/or adenoidectomy (D11Z) and myringotomy with or without tympanostomy tube insertion (D13Z). After initial interrogation of the dataset it became clear that a more comprehensive dataset was obtained by utilising the ICD-10-AM coding to extract the dataset. Given this, the AR-DRG coding system was abandoned as a method of data identification.

Table 4-3: Surgical procedural codes from the International Classification of Diseases, Version 10, Australian Modified (ICD-10-AM).

Code	Description
41626-00	Myringotomy, unilateral
41626-01	Myringotomy, bilateral
41632-00	Myringotomy with tympanostomy tube insertion, unilateral
41632-01	Myringotomy with tympanostomy tube insertion, bilateral
41789-00	Tonsillectomy without adenoidectomy
41789-01	Tonsillectomy with adenoidectomy
41801-00	Adenoidectomy without tonsillectomy or removal of lingual tonsil

Diagnostic Codes

The ICD-10-AM diagnostic codes used to describe the indication for surgery are presented in Table 4-4. Where alternative diagnostic codes were used, the indication for surgery was designated as “other”. This occurred in instances when the principal diagnosis, that is, the reason for the hospital admission during which the surgery was conducted, was not an otorhinolaryngological diagnosis. For the purposes of this research study, obstructive sleep apnoea was defined as any case where the patient had a diagnosis of sleep apnoea (G4730-G4739), hypertrophic tonsils, and/or hypertrophic adenoids (J351-J353).

Table 4-4: Diagnostic codes from the International Classification of Diseases Version 10 Australian Modified (ICD-10-AM).

Code	Description
J350	Tonsillitis
Obstructive Sleep Apnoea	
G4730	Sleep apnoea, unspecified
G4731	Sleep apnoea, central sleep apnoea syndrome
G4732	Sleep apnoea, other sleep apnoea syndrome
G4739	Sleep apnoea, other sleep apnoea
J351	Hypertrophic tonsils
J352	Hypertrophic adenoids
J353	Hypertrophic tonsils and adenoids
Otitis media	
Acute otitis media	
H650	Acute serous otitis media: Acute and subacute secretory otitis media
H651	Other acute nonsuppurative otitis media: Otitis media, acute and subacute: allergic/mucoid/sanguinous/serous, mucoid, nonsuppurative NOS, nonsuppurative NOS, sanguinous, seromucinous
H660	Acute suppurative otitis media
Otitis media with effusion	
H652	Chronic serous otitis media: Chronic tubotympanal catarrh
H653	Chronic mucoid otitis media
H654	Other chronic nonsuppurative otitis media
H659	Nonsuppurative otitis media, unspecified
Chronic suppurative otitis media	
H661	Chronic tubotympanic suppurative otitis media
H662	Chronic atticoantral suppurative otitis media
H663	Other chronic suppurative otitis media
Other otitis media	
H664	Suppurative otitis media, unspecified
H669	Otitis media, unspecified

4.2.4 Dataset

The final study dataset contained demographic data, procedural data, and diagnostic data. The demographic data included age, sex, hospital sector (metropolitan vs. country), hospital type (public vs. private), insurance status (public vs. private), residential postcode, as well as information on the hospital stay, including the separation date, length of hospital stay. The procedural and diagnostic data included all ICD-10-AM codes included in the ISAAC database. Indigenous status was only recorded from 1 July 2001 and was not used in this study.

4.2.5 Data Analysis

Mean values are presented with one standard deviation (SD). Medians were calculated for length of hospital stay. Since the length of hospital stay data were skewed by a small percentage of outliers (generally patients with complex comorbidities), the 99th percentile is reported in place of a range. Differences in continuous data were tested for significance with analysis of variance or the Student's t-test, as appropriate. Proportions were calculated and tested using Pearson's chi-squared test.

Incidence estimates were calculated for each procedure using the ISAAC hospital separation data (the "*numerator*") and child population data taken from the ABS Census (the "*denominator*"). Linear interpolation between Census years (1996, 2001 and 2006) was performed to estimate the population size for each of the inter-Censual years. Linear extrapolation was performed to estimate the population size for 2007. Age and sex-specific incidence were calculated for the overall paediatric South Australian population, and also according to insurance status and the underlying surgical indications. These incidence estimates are presented graphically within this chapter, with the numerical incidences, and accompanying 95% confidence intervals, tabulated in Appendix E.

The incidence for tonsillectomy and adenoidectomy have been used to infer the prevalence of children operated on within the population, since both tonsillectomy and adenoidectomy are usually only performed once on an individual (in rare cases tonsil or adenoidal tissue may not be entirely resected and repeat surgery may be required). However, myringotomy with/without tympanostomy tube insertion can be performed more than once on a child so it is not possible to estimate prevalence from de-identified data. While incidence estimates reported herein for myringotomy with/without tympanostomy tube insertion for 1-year-old children can be assumed to be reflect prevalence, as it is unlikely that a child would have had multiple procedures prior to their second birthday, the procedure incidence estimates at older ages will be an over-estimation of the children that underwent surgery. Furthermore, the incidence may be influenced by children undergoing multiple episodes of surgery within one year. The size of this over-estimation was not determinable due to the de-identification of the ISAAC dataset. Access to an identifier within the dataset, such as Medicare number, would have allowed the number of children undergoing multiple procedures within one year to be tracked and accounted for. However, unique identifiers were not available.

Data were manipulated and analysed using R© (Version 2.13.0, 13 April 2011, The R Foundation for Statistical Computing, Vienna, Austria). This software utilises programming language for statistical analyses and graphics. The programming commands used to perform data manipulation and analyses for this study were compiled into R© scripts – small executable files – to record the analytical process. The scripts for this component of research are presented in Appendix C. Graphs were prepared using Microsoft® Excel® 2010, part of the Microsoft Office Professional Plus 2010 (Version 14.0.6112.5000, Microsoft Corporation).

4.3 RESULTS

4.3.1 Study Sample

Between January 1997 and December 2007, there were a total of 659,321 paediatric hospital separations in South Australia (Figure 4-1). Of these, 10.3% hospital separations included an adenoidectomy, tonsillectomy and/or myringotomy with/without tympanostomy tube insertion. The vast majority of these hospital separations were for children that resided within South Australian residential postcodes. The final study sample consisted of 66,612 hospital separation records. The mean age of the children was 5.8-years (± 4.05) and 54.5% (36,310) were boys. The median length of hospital stay was 9 hours (1 to 86.7hours, 99th percentile).

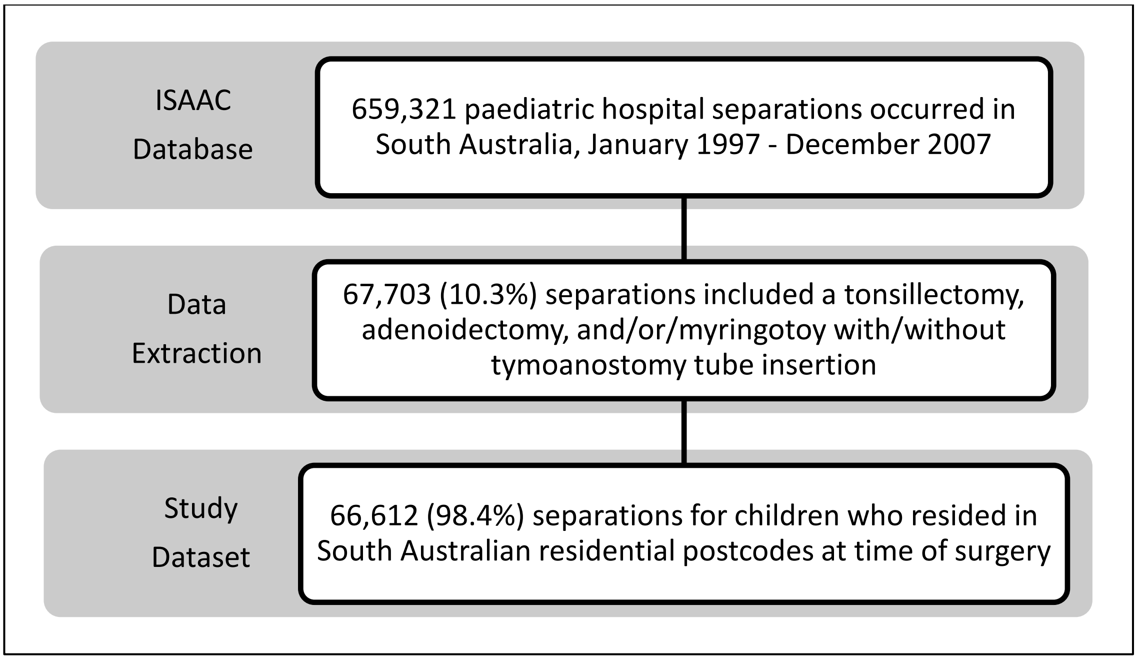


Figure 4-1: Study Sample

ISAAC – SA Health Integrated South Australian Activity Collection

Patient Demographics

There were marked differences in the demography of the children that underwent adenotonsillectomy, tonsillectomy, adenoidectomy, or myringotomy with/without tympanostomy tube insertion (Table 4-5). Firstly, children that underwent tonsillectomy alone were more likely to be girls, whereas the other three procedures were more commonly performed on boys. These differences were statistically significant for most procedures ($p<0.001$) - the exception being adenoidectomy alone and myringotomy with/without tympanostomy tube insertion that had proportions of boys and girls that were not statistically different ($p=0.058$).

Secondly, the mean ages of children that underwent each of the surgical procedures were statistically different ($p<0.001$). Specifically, the mean age of children that had tonsillectomy alone was quite dissimilar. The mean age for children that had this procedure was eleven-years-old, more than five-years older than those who underwent the other procedures. In contrast, children that underwent myringotomy with/without tympanostomy tube insertion were much younger – on average just four-years-old.

These results show that children who underwent adenoidectomy alone were not significantly different to those that underwent myringotomy with/without tympanostomy tube insertion. This is due to the regular concomitant performance of these two procedures – 60.3% of adenoidectomy alone were performed in combination with myringotomy with/without tympanostomy tube insertion. This will be reported in further detail in Section 3.3.2.

Overall, surgery was more likely to be privately funded than publicly funded. Depending on the procedure, the proportion ranged from 50.3% to 62.6% privately-funded. The proportion of adenoidectomy alone and myringotomy with/without tympanostomy tube insertion that were privately funded was not significantly different (p=0.105). However, there were statistically significant differences in the proportions of public and private funding between the other procedures (p<0.001). Generally, the procedures were performed in different proportions across the various hospital locations (p<0.001). Again, the only exception was adenoidectomy and myringotomy with/without tympanostomy tube insertion which were performed at proportions across the hospital localities that were not statistically different (p=0.279). The mean annual incidence estimates for the procedures were different for each of the surgical procedures. The overall incidence of tonsillectomy was 6.47 per 1000 child-years. However, as shown in Table 4-5, the overall incidence of tonsillectomy alone was 2.1 per 1000 child-years and adenotonsillectomy was 4.4 per 1000 child-years. The incidence of adenoidectomy alone was 2.3 per 1000 child-years, with myringotomy with/without tympanostomy tube insertion performed at an incidence of 11.3 per 1000 child-years. These incidences will be discussed in more depth in the following sections.

Table 4-5: Demographic Profile, South Australia, 1997-2007.

	Tonsillectomy Alone [48901-00]	Adenotonsillectomy [48901-01]	Adenoidectomy Alone [41801-00]	Myringotomy +/- TTI [31626-00/1, 31632-00/1]
N	7,903	16,705	8,699	43,158
Age (mean ± SD, years)	11.25 ± 4.77	6.19 ± 3.27	5.97 ± 3.36	4.44 ± 3.02
Sex (n, %)				
Girls	4,929 (62.4%)	7,985 (47.8%)	3,537 (40.7%)	18,021 (41.8%)
Boys	2,974 (37.6%)	8,720 (52.2%)	5,162 (59.3%)	25,137 (58.2%)
Separation Election (n, %)				
Publicly Funded	3,928 (49.7%)	6,945 (41.6%)	3,330 (38.3%)	16,123 (37.4%)
Privately Funded	3,975 (50.3%)	9,760 (58.4%)	5,369 (61.7%)	27,035 (62.6%)
Hospital Locality (n, %)				
Women's and Children's Hospital	1,127 (14.3%)	5,444 (32.6%)	1,941 (22.3%)	9,926 (23.0%)
Other metropolitan hospitals	4,420 (55.9%)	8,688 (52.0%)	5,328 (61.3%)	26,057 (60.4%)
Country hospitals	2,356 (29.8%)	2,573 (15.4%)	1,430 (16.4%)	7,175 (16.6%)

TTI – Tympanostomy Tube Insertion

Notes: Adenotonsillectomy, tonsillectomy and adenoidectomy are mutually exclusive. Myringtomy ±TTI is not mutually exclusive and may have been performed in combination with adenoidectomy (12.1%), adenotonsillectomy (8.9%) or tonsillectomy (1.7%). † Range reported is the shortest stay to the 99th percentile.

Table 4-5 - Demographic Profile, South Australia, 1997-2007. continued.

	Tonsillectomy Alone [48901-00]	Adenotonsillectomy [48901-01]	Adenoidectomy Alone [41801-00]	Myringotomy +/- TTI [31626-00/1, 31632-00/1]
Hospital Sector (n, %)				
Public Hospital	4,504 (56.7%)	9,800 (58.7%)	4,379 (50.3%)	20,777 (48.1%)
Private Hospital	3,399 (43.0%)	6,905 (41.3%)	4,320 (49.7%)	22,381 (51.9%)
Length of Stay (median [range], hours) †	27.0 [2.3-89.2]	26.4 [0.8-82.9]	23.0 [1.0-43.8]	4.65 [2.0-84.0]
Annual Incidence (mean, per 1,000 child-years)	2.1 ± 0.2	4.4 ± 0.4	2.3 ± 0.3	11.3 ± 1.5

Notes: Adenotonsillectomy, tonsillectomy and adenoidectomy are mutually exclusive. Myringotomy ±TTI is not mutually exclusive – Myringotomy ±TTI may have been performed in combination with adenoidectomy (12.1%), adenotonsillectomy (8.9%) or tonsillectomy (1.7%). † Range reported is the shortest stay to the 99th percentile.

4.3.2 Surgical Procedure Combinations

A Venn-Euler diagram[311] provides a visual representation of the combinations of surgical procedures within the dataset (Figure 4-2). This diagram illustrates the proportion of each combination of procedures; with the size of the proportion reflected by the size of the ellipse and subsequent overlapping areas. Nearly two-thirds of hospital separations (64.8%) involved a myringotomy with/without tympanostomy tube insertion either alone or in combination with the other procedures. One-third of hospital separations involved tonsillectomy, predominantly as tonsillectomy alone (10.7%) or in combination with adenoidectomy (19.3%). A small proportion of children (5.8%) underwent all three procedures within the one hospital stay.

4.3.3 Surgical Procedure Funding and Hospital Locality

About half (51.2%) of the hospital separations occurred at public hospitals (Table 4-6). Of these, 47.0% were performed at the one site - the Women's and Children's Hospital. However, the public or private status of the hospital did not necessarily reflect how the surgery was funded. Patients who had their surgery at a public hospital could elect for their hospital stay to be funded by private insurance. Within public hospitals, the ratio of public to private funding was 3:1, that is, almost a quarter of separations occurring in public hospitals were co-funded by private insurance. In private hospitals nearly 100% were funded by private insurance.

Across all of South Australia, nearly two-thirds (60.4%) patients had their hospital separation funded by private health insurance (Table 4-6). However, this was far more likely in metropolitan Adelaide. In fact, nearly three-quarters of all the hospital separations occurring in metropolitan Adelaide were funded by private insurance (72.1% privately insured *vs*. 27.9% publicly funded) compared to rural South Australia where the majority were publicly funded (94.3% publicly funded *vs*. 5.7% privately insured).

Within South Australia the majority of hospital separations (82.5%) were performed at metropolitan hospitals. In comparison, patients who underwent surgery in country hospitals were mainly funded by the public health system. Only a small proportion of country-based hospital separations were funded by private insurance (5.7%).

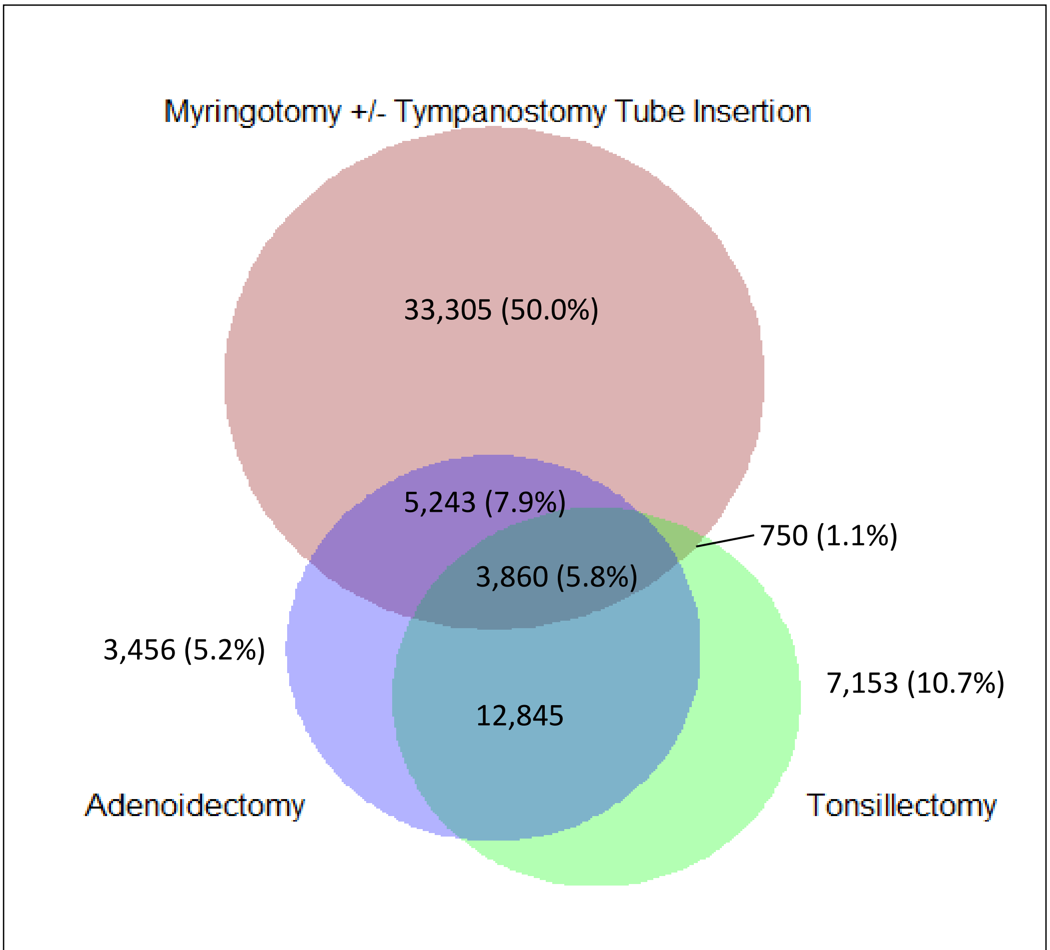


Figure 4-2: Euler Diagram of the Surgical Combinations, South Australia, 1997-2007.

Note: This diagram illustrates the proportions of procedures performed alone and concomitantly in the South Australian paediatric population during 1997 to 2007.

Table 4-6: Separation election status by hospital sector and locality.

	Separation Election Type (n, %)		
	Publicly funded	**Privately insured**	**Total**
Total (n, %)	26,367 (39.6%)	40,245 (60.4%)	66,612
Hospital Type (n, %)			
Public Hospital	26,060 (39.1%)	8,032 (12.1%)	34,092
Women's and Children's Hospital	8820 (33.8%)	7199 (89.6%)	16,019 (47.0%)
Other	17,240 (66.2%)	833 (10.4%)	18,073 (53.0%)
Private Hospital	307 (0.5%) ‡	32,213 (48.4%)	32,520
Hospital Locality (n, %)			
Metropolitan	15,351 (27.9%)	39,576 (72.1%)	54,927
Public †	15,045 (98.0%)	7,457 (18.8%)	22,502 (41.0%)
Private	306 (2.0%)	32,119 (81.2%)	32,425 (59.0%)
Country	11,016 (94.3%)	669 (5.7%)	11,685
Public †	11,015 (99.9%)	575 (85.9%)	11,590 (99.2%)
Private	1 (0.1%)	94 (14.1%)	95 (0.8%)

† includes the Women's and Children's Hospital
‡ this occurs rarely but usually as a means to reduce waiting times for patients who are in urgent need of intervention.
Notes:
Separation Election Type by Hospital Type, $\chi^2=39664.2$, df=1, $p<0.001$
Separation Election Type by Hospital Locality, $\chi^2=17721.6$, df=1, $p<0.001$

4.3.4 Annual Incidence

Over the study period, the annual incidence of ENT procedures was highest for myringotomy with/without tympanostomy tube insertion (Figure 4-3). The incidence of tonsillectomy and adenoidectomy were similar throughout the study period. By the end of the study period, the annual incidence had declined for all the procedures. However, while the annual incidence of adenotonsillectomy, tonsillectomy and adenoidectomy remained fairly stable throughout the study period and only underwent a very small decrease, the annual incidence of myringotomy with/without tympanostomy tube insertion dropped considerably from 14.7 to 8.5 per 1,000 child-years (although much of this was in the early part of the study period – during 1997 and 1998).

Tonsillectomy and Adenoidectomy

When the sex-specific annual incidence for tonsillectomy, adenoidectomy, and adenotonsillectomy were examined there were noticeable differences (Figure 4-4). The annual incidence of adenotonsillectomy was near identical for both boys and girls fluctuating around 4 per 1,000 child-years. In contrast, the annual incidence of tonsillectomy alone was consistently higher for girls than for boys – 2.6 per 1000 girls compared to 1.5 per 1000 boys. Conversely, for children who underwent adenoidectomy alone the annual incidence of boys was greater than for girls - 2.6 per 1000 boys compared to 1.9 per 1000 girls.

The annual incidence was also noticeably different for public and privately funded children. The proportion of privately funded cases was greater for adenotonsillectomies and adenoidectomies throughout the study period. In contrast, the proportion of privately or publically funded tonsillectomies did not fluctuate greatly during the initial years, only shifting to a greater proportion of privately funded cases towards the end of the study period.

Myringotomy with/without Tympanostomy Tube Insertion

The annual incidence of boys who underwent a myringotomy with/without tympanostomy tube insertion was greater than girls (Figure 4-5). The mean annual incidence for boys was 12.9 per 1,000 child-years compared to 9.7 per 1000 girls. Throughout the study period, a greater proportion of myringotomy with/without tympanostomy tube insertion were privately funded – a pattern that was consistent throughout the study period.

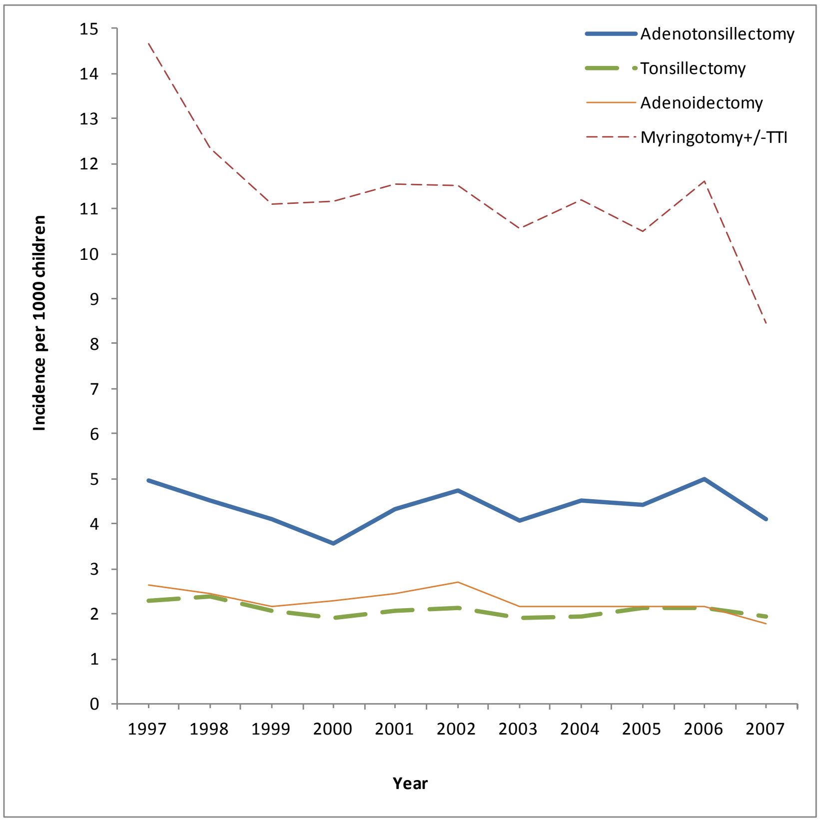


Figure 4-3: Annual Incidence for adenotonsillectomy, tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion, South Australia, 1997-2007.

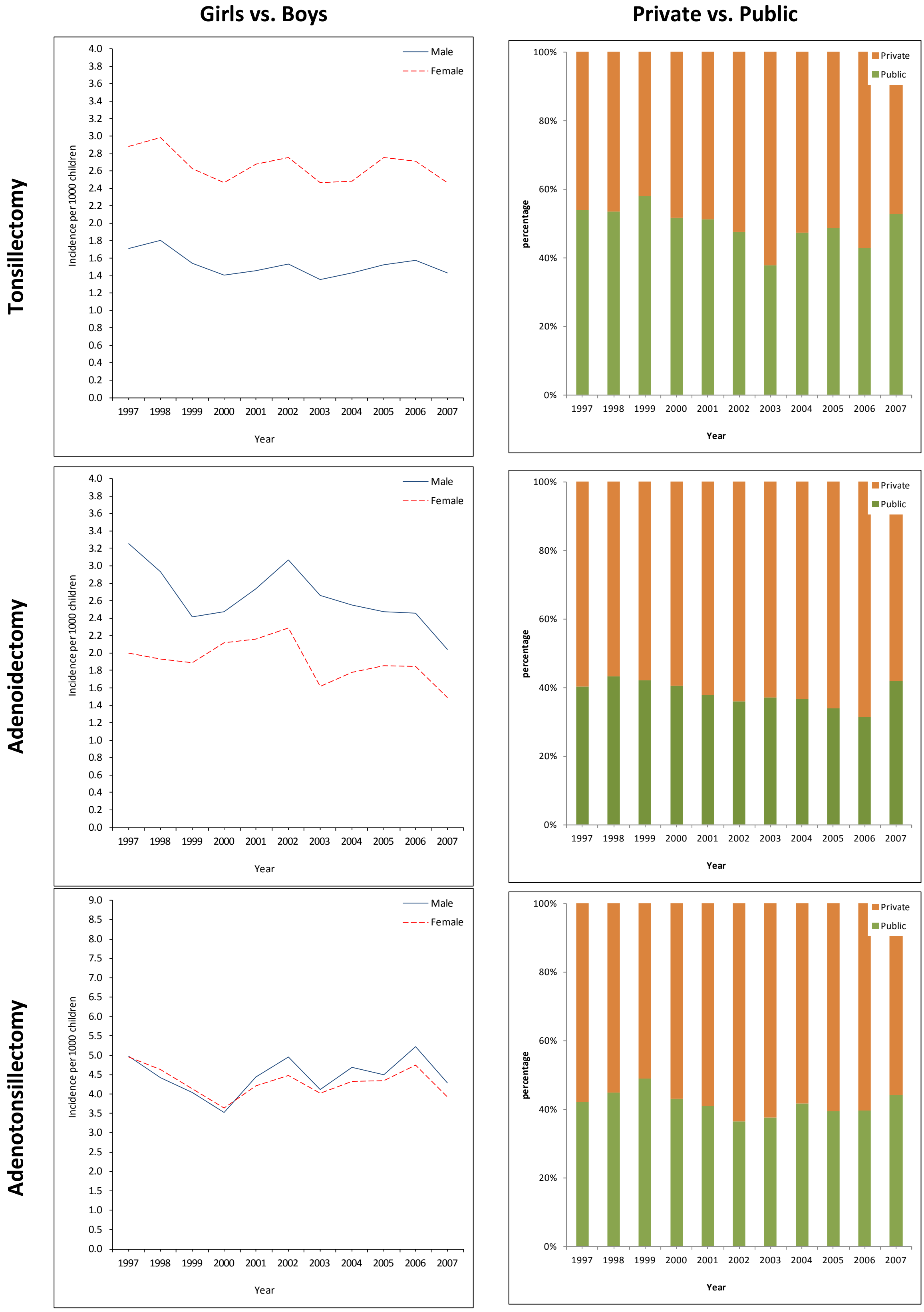


Figure 4-4: Annual incidence (per 1,000 child-years) of tonsillectomy, adenoidectomy, and adenotonsillectomy by sex (boys vs. girls) and the ratio of annual incidence by hospital election status (public vs. private funding), SA, 1997-2007.

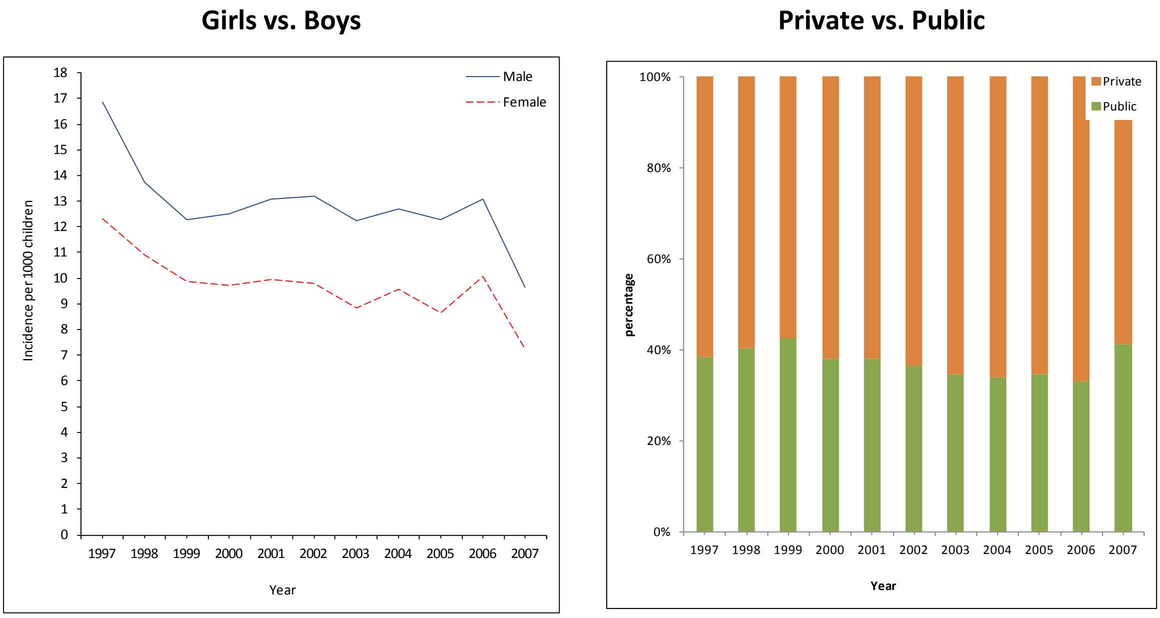


Figure 4-5: Annual incidence (per 1,000 child-years) of myringotomy with/without tympanostomy tube insertion by sex (boys vs. girls) and the ratio of annual incidence by hospital election status (public vs. private funding), SA, 1997-2007.

4.3.5 Age and Sex-Specific Incidence

The age-specific incidence profiles were noticeably different for each of the surgical procedures (Figure 4-6). The peak incidence of adenotonsillectomy (14.2 per 1,000 child-years) and adenoidectomy alone (7.0 per 1,000 child-years) occurred in 4-year-old children. In contrast, the peak incidence of tonsillectomy alone occurred in 16-year-olds (4.5 per 1,000 child-years). Most notably, the peak incidence of myringotomy with/without tympanostomy tube insertion was much greater than the other procedures and occurred in one-year-old children (48.9 per 1,000 child-years). Furthermore, the incidence of myringotomy with/without tympanostomy tube insertion had another small peak in 4-year-old children (30.0 per 1,000 child-years) prior to steadily declining thereafter.

Tonsillectomy and Adenoidectomy

When the sex-specific incidence of tonsillectomy, adenoidectomy, and adenotonsillectomy was examined, it was clear that there were differences in the incidence of each of the procedures between the sexes. The peak incidence of adenotonsillectomy was greater for boys than for girls and boys underwent the procedure at a younger age. However, the greatest frequency of adenotonsillectomy in both boys and girls occurred across ages 3 to 5-years-old. For adenoidectomy, boys and girl both had a peak in incidence at 4 to 5-years-old, only the magnitude varied (8.5 per 1,000 boys compared to 5.3 per 1,000 girls). The incidence profiles for the two sexes were very different for tonsillectomy. The peak incidence of tonsillectomy alone in 16-years-olds was driven by a high incidence of the procedure in 16-year-old girls. The incidence for 16-year-old girls was 7.1 per 1000 persons compared with only 2.0 per 1000 boys. For boys, the highest incidence of tonsillectomy alone was in 4-year-olds (2.8 per 1,000 child-years). The proportions of publically and privately funded procedures differed. Overall, children with private insurance underwent these ENT surgeries at a younger age than those children who were publicly funded. Tonsillectomy alone was performed at a greater frequency for privately funded children, particularly for those children who were very young and for those were in the older years of adolescence. Similarly, a greater proportion of adenoidectomies and adenotonsillectomies performed on very young children were privately funded. However, the size of the funding discrepancy reduced as child's age increased.

Myringotomy with/without Tympanostomy Tube Insertion

The incidence of myringotomy with/without tympanostomy tube insertion was greater in boys than in girls until around the age of 8-years when the incidence for both sexes became near identical (Figure 4-5). The peak incidence for both sexes occurred in one-year-old children. Specifically, the peak incidence for one-year-old boys (56.7 per 1,000 child-years) was much greater than the peak incidence for girls of the same age (40.5 per 1,000 child-years). However, at ages 3 and 4-years-old, there was another peak in incidence but the discrepancy between boys and girls was much less (35.0 per 1000 boys compared to 24.8 per 1000 girls). It is clear that for very young children, the large majority of myringotomy with/without tympanostomy tube insertion were privately funded. For children aged under one-year-old there was nearly three times as many privately funded procedures performed (public:private, 1:2.8). Similarly, for children aged one-year-old, the ratio of publicly to privately funded procedures was 1:2.5. However, by around 8 to 9-years of age the large discrepancy had nearly equalised with similar proportions of the procedure both privately and publically funded thereafter.

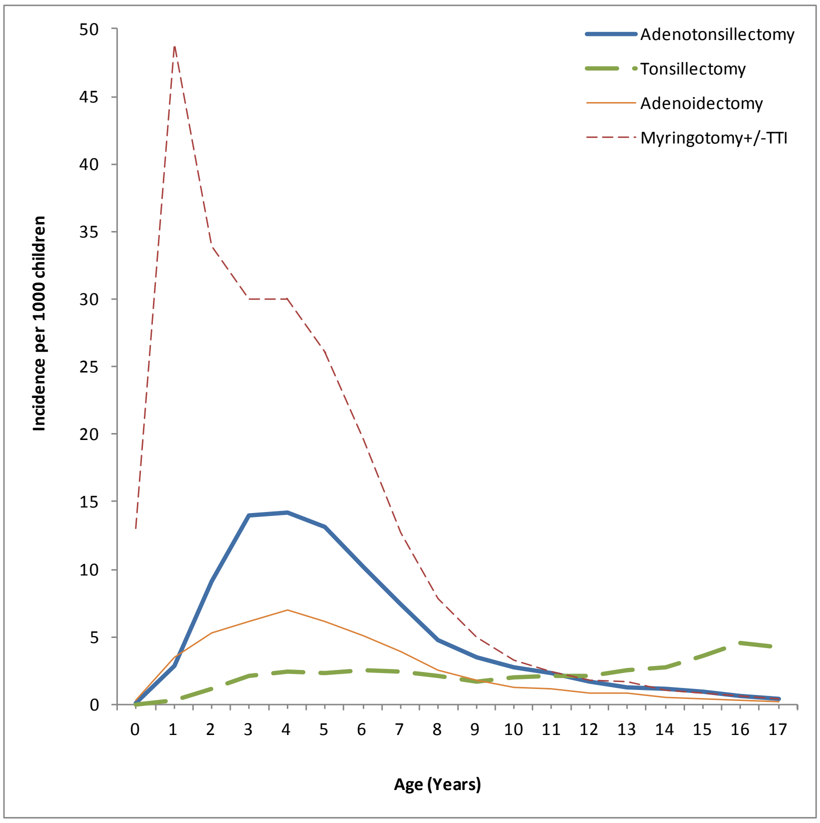


Figure 4-6: Age-specific incidence, SA, 1997-2007 (per 1,000 child-years).

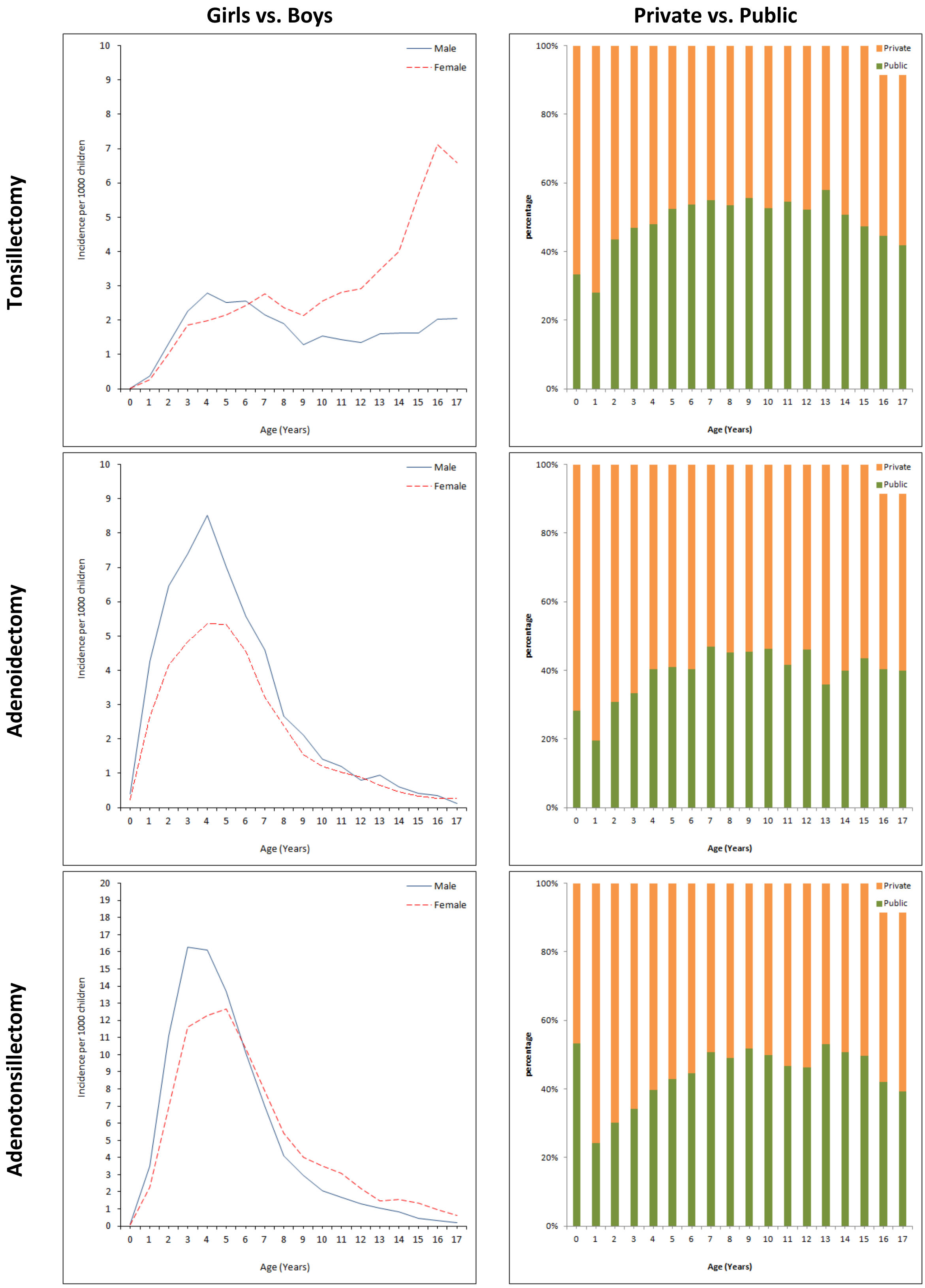


Figure 4-7: Age and sex-specific incidence (per 1,000 child-years) of tonsillectomy, adenoidectomy, and adenotonsillectomy by sex (boys vs. girls) and the ratio of hospital election status (public vs. private funding), SA, 1997-2007.

Girls vs. Boys **Private vs. Public**

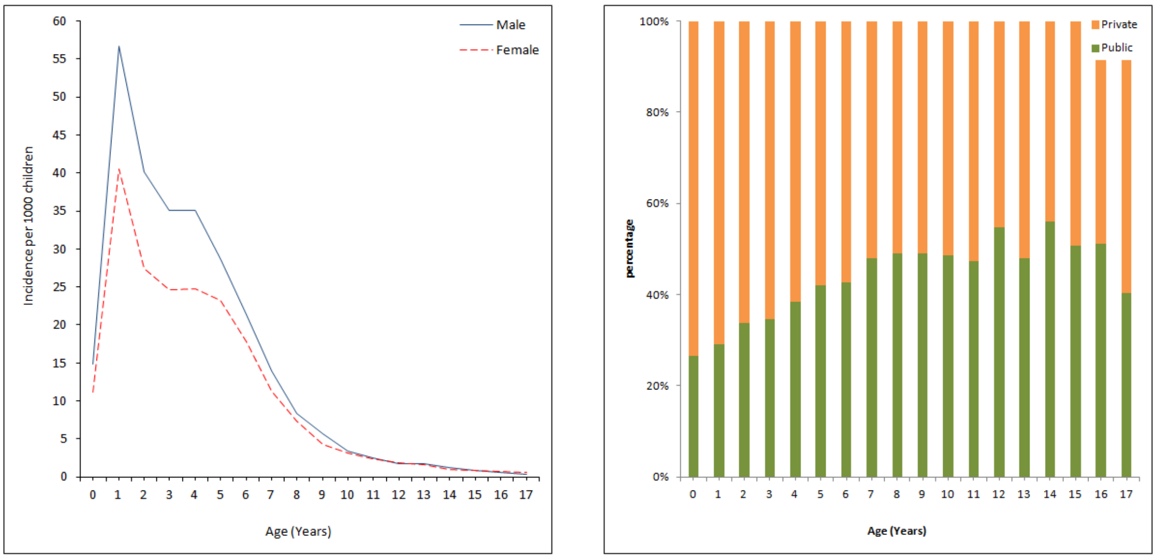


Figure 4-8: Age and sex-specific incidence (per 1,000 child-years) of myringotomy with/without tympanostomy tube insertion by sex (boys vs. girls) and the ratio of hospital election status (public vs. private funding), SA, 1997-2007.

4.3.6 Cumulative Incidence

Tonsillectomy and Adenoidectomy

As noted previously, the cumulative incidence can be thought of as an estimate of the prevalence (or frequency) of tonsillectomy and/or adenoidectomy. As expected from the previous results, the cumulative incidence of the procedures was different for the sexes (Figure 4-9). The cumulative incidence of adenotonsillectomy and adenoidectomy was greater for boys and had a similar pattern. The cumulative incidence rose sharply for the first five years, but did not greatly increase thereafter. In contrast, the cumulative incidence of tonsillectomy was not too dissimilar for both sexes until adolescence, when the cumulative incidence for girls rose much higher than that for boys. The cumulative incidence of these procedures, for school-aged children (6-years-old) and for young adults (17-years-old), is reported in Table 4-7. Overall, by the age of 18-years-old, 178.8 per 1000 persons has had their tonsils and/or adenoids removed.

Table 4-7: Cumulative Incidence, SA, 1997-2007 (per 1,000 child-years).

	Tonsillectomy [ICD-10-AM 48901-00]	Adenoidectomy [ICD-10-AM 41801-00]	Adenotonsillectomy [ICD-10-AM 48901-01]
6-years-old			
Boys	11.9	39.6	70.9
Girls	9.7	27.1	56.2
Total	10.8	33.5	63.7
17-years-old			
Boys	30.5	54.9	92.8
Girls	52.1	39.3	88.2
Total	41.0	47.3	90.5

Note: Adenotonsillectomy, tonsillectomy and adenoidectomy are mutually exclusive.

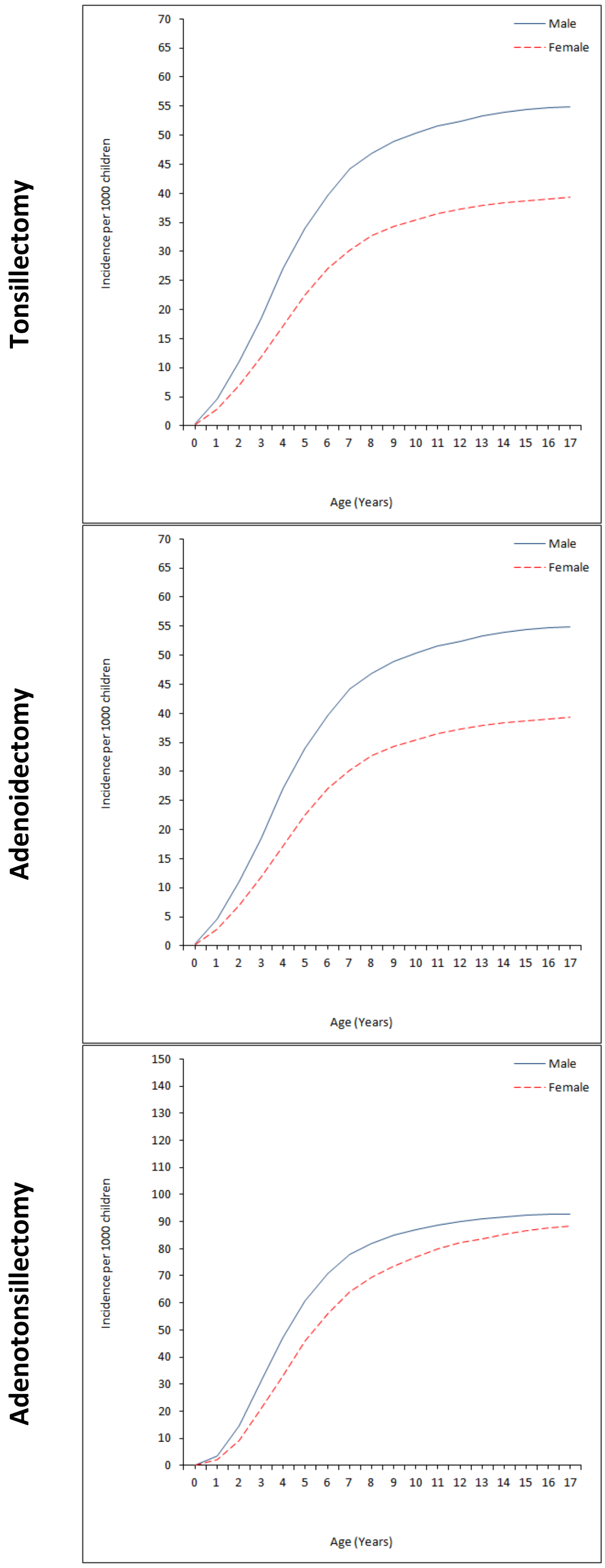


Figure 4-9: Cumulative incidence (per 1,000 child-years) of tonsillectomy, adenoidectomy, and adenotonsillectomy by sex (boys vs. girls), SA, 1997-2007.

4.3.7 Indications for Surgery

Tonsillectomy and Adenoidectomy

Adenotonsillectomy was primarily performed for tonsillitis or obstructive symptoms, whereas tonsillectomy was mainly performed for tonsillitis (Figure 4-10). When adenotonsillectomy was performed for tonsillitis, the peak incidence occurred broadly over ages 3 to 5-years-old (8.5 to 9.3 per 1,000 child-years). However, it was performed 2-years earlier when the indication was obstructive symptoms (4.3 per 1,000 child-years). In contrast, the incidence of tonsillectomy with tonsillitis as the main indication was nearly identical to the incidence of the procedure itself. Conversely, adenoidectomy alone could be performed for one of three indications: tonsillitis, obstructive symptoms, or otitis media. When the indications for surgery were examined over the study period, it became obvious that there were some changes in underlying diagnoses. Tonsillitis became less used as an indication for adenotonsillectomy, while obstructive symptoms became more likely. In 1997, 75.3% of adenotonsillectomies had tonsillitis listed as the indication for surgery, but by 2007 this was just 58.6%. In comparison, obstructive symptoms increased from 19.2% to 33.4% over the study period. There was no change in the proportion of tonsillectomies performed for tonsillitis throughout the study period. However, there were small changes in the indications for adenoidectomy alone. There was a small decrease in the proportion of adenoidectomy performed for tonsillitis and obstructive symptoms, with a small increase in the proportion of cases performed for other conditions.

Myringotomy with/without Tympanostomy Tube Insertion

As expected, the underlying diagnoses for myringotomy with/without tympanostomy tube insertion were mostly ear-related (Figure 4-11). The majority were performed for otitis media with effusion (“glue ear”) and this was the most likely indication at one-year-old (31.6 per 1,000 child-years). “Other” otitis media was also a common indication in this age-group (14.0 per 1,000 child-years). However, myringotomy with/without tympanostomy tube insertion was also performed at age 4-years-old (5.5 per 1,000 child-years) in the treatment of tonsil and adenoidal conditions – most likely in combination with one of the other surgical procedures. The proportion of myringotomy with/without tympanostomy tube insertion performed for otitis media with effusion decreased over the study period from 62.5% to 54.4%, while the proportion performed for “other” otitis media rose from 18.7% to 27.8%. There were only small changes for other causes.

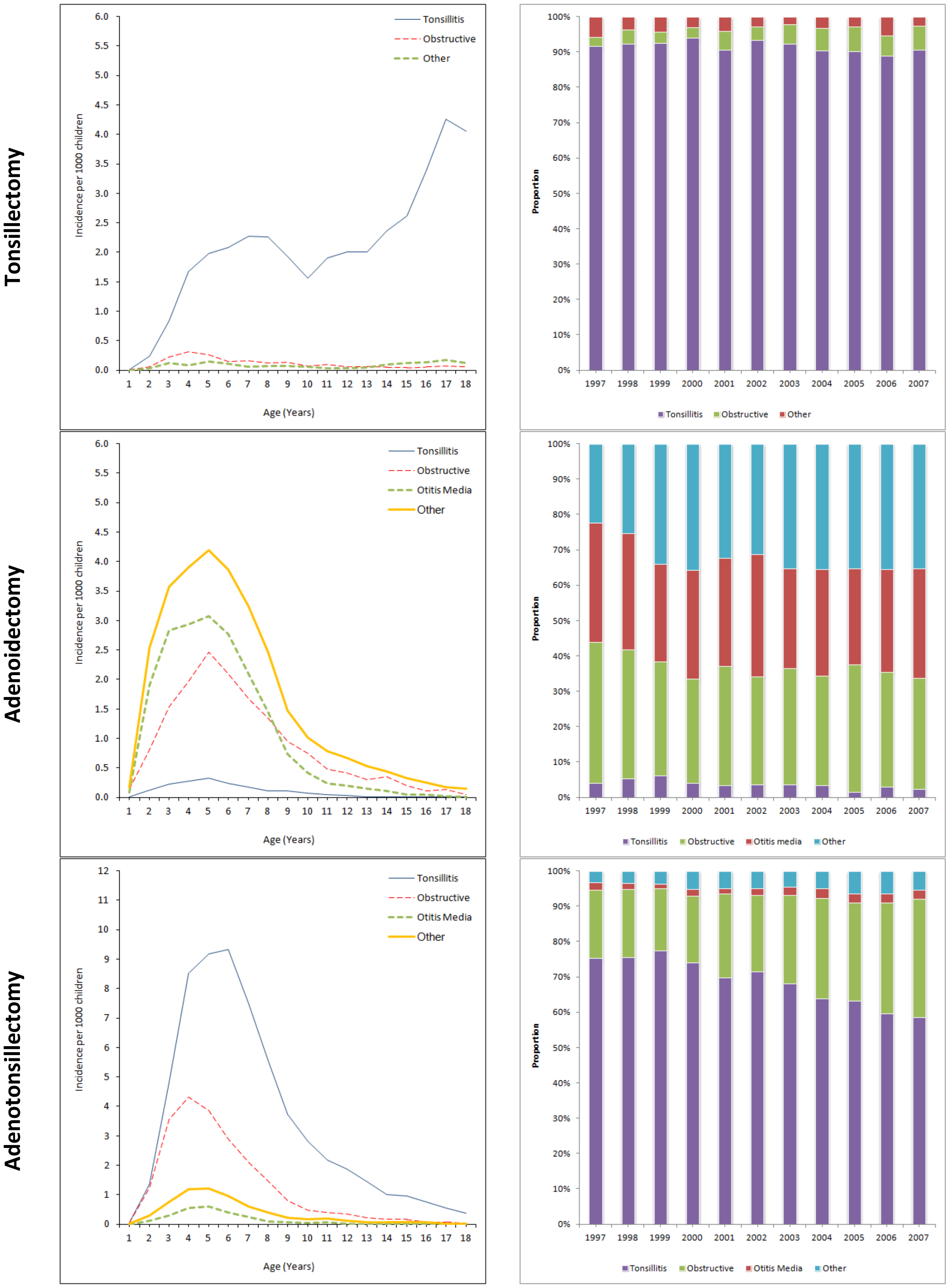


Figure 4-10: Age-specific incidence and annual proportion of surgical indications for tonsillectomy, adenoidectomy, and adenotonsillectomy, SA, 1997-2007.

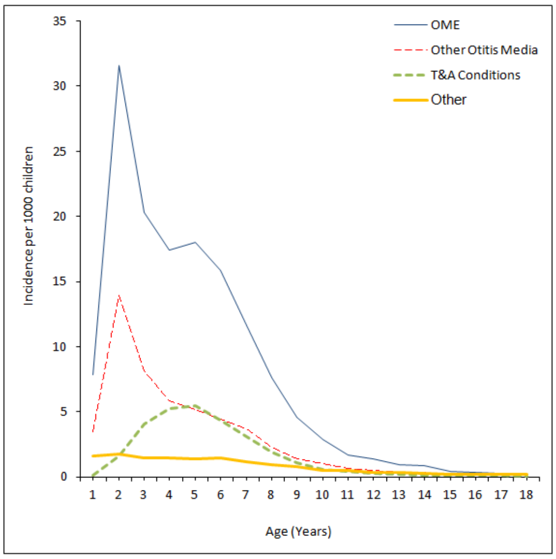


Figure 4-11: Age-specific incidence and annual proportion of surgical indications for myringotomy with/without tympanostomy tube insertion, SA, 1997-2007.

4.4 DISCUSSION

In this chapter, a detailed description has been presented of the demographic and epidemiological profile of children who underwent tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion in South Australia during 1997-2007. The main findings were that, overall, more boys underwent these procedures than girls, although, adolescent girls had a strikingly higher incidence of tonsillectomy alone than their male counterparts. The main underlying indication for tonsillectomy was tonsillitis. Boys more commonly underwent the procedure with concomitant adenoidectomy. The incidence of adenotonsillectomy peaked in four-year-old children, as did the incidence of adenoidectomy. Tonsillitis and sleep disordered breathing were the main indications for adenotonsillectomy, while ear-related conditions were most commonly the indication for adenoidectomy. The peak incidence of myringotomy with/without tympanostomy tube insertion occurred in one-year-old children. For children aged one-year-old and under, the proportion of the procedure that was funded by private insurance was nearly three times those that were publicly funded. The main indication for myringotomy with/without tympanostomy tube insertion was otitis media with effusion. The majority of children that underwent this procedure were boys. The following discussion will compare the results of this phase of research to other reported incidence from within Australia and internationally.

4.4.1 Tonsillectomy, Adenoidectomy, and Adenotonsillectomy

Incidence Estimates

In this study, the overall incidence of tonsillectomy amongst South Australian children was 6.47 per 1,000 child-years. Despite this being similar to other reported incidences, such as for the Veneto region in Italy (6.5 per 1000 person-years)[240] and for England (6.5 per 1,000 child-years),[250] and was much higher than reported for some regions of the USA (approx. 0.9 per 1000 person-years for children under 19-years-old),[248] direct comparisons are not possible due to differences in the methodology used internationally to calculate these results. However, a more appropriate comparison can be made of these South Australian results to other reported Australian incidences. Australian authors reported that the incidence in New South Wales in 1989/90 was 5.1 per 1,000 child-years,[249] and in 1981-1998/9 was 5.45 per 1,000 child-years.[8] An international publication reported that the incidence of tonsillectomy in Australia was 7.5 per 1,000 child-years.[250] When compared to Denmark, the incidence of tonsillectomy in South Australian 4-year-olds was nearly double that for Danish children. The South Australian incidence identified in this research was 16.6 per 1,000 child-years; however, the incidence reported for this age-group in Denmark was 8.6 per 1,000 child-years.[235] Furthermore, the incidence profile for tonsillectomy alone in South Australia was bimodal – with a peak at 4-years-old and another at 16-years-old. This incidence profile was similar to that reported by Danish authors,[235] however the magnitudes were different. A report from the USA, that despite not having the same incidence profile as the study population, stated that the estimated surgical ratio for 15-19-year-old girls in 1997 was 16.42 per 1,000 persons[247] – a very similar incidence to this South Australian cohort. However, the age-specific incidence for adolescent boys was much lower than for girls. In Denmark, both male and female adolescents had a high incidence of tonsillectomy,[235] however, this trend for adolescent boys was not observed in South Australia. It can be posited that this may be due to the social stigma that teenage girls experience due to the significant halitosis and chronic sore throats often caused by chronic tonsillitis. Overall, however, the frequency of adolescent tonsillectomy seen in this research reflects other Australian reports that chronic diseases of the adenoids and tonsils are the primary reason for paediatric hospital admissions in children aged 5 to 9-years and the second most common reason in children aged 10 to 14-years.[6]

The annual incidence of adenotonsillectomy in South Australian children was 4.4 per 1,000 child-years. Erickson *et al.*[248] reported much lower results for an USA county (2.66 per 1,000 person-years), however their results are “diluted” by the inclusion of persons up to the age of 29-years. This is also an issue for an earlier report that quoted the population-wide incidence of adenotonsillectomy in USA as 1.018 per 1,000 persons.[247] The incidence in New South Wales is reported to be 3.9 per 1,000 child-years.[249] However, again, this is not directly comparable to the South Australian results because the population only included children less than 15-years-old and the data was nearly two decades older than the South Australian data.[249] In comparison, the incidence in region of northern Italy was much higher (14.4 per 1,000) but these results are for 2 to 9-year-old children only.[240]

In South Australia, adenoidectomy was performed on 2.3 per 1,000 child-years. The reported incidence for New South Wales in the late 1980s was similar (2.4 per 1,000 child-years).[249] As with adenotonsillectomy, the incidence in northern Italy was much higher (7.9 per 1,000) than the incidence seen in South Australia but the uncomprehensive nature of the same population means that this data is not comparable to the South Australian results.[240] In contrast, the incidence of adenoidectomy alone in Finnish children has been reported as between 9.5 to 13.9 per 1,000 children,[261, 270, 271] while even lower incidence have been reported for Norwegian children: between 3.9 to 4.4 per 1,000 persons.[261, 271] For both adenotonsillectomy and adenoidectomy there is a scarcity of literature that reports the frequency of the procedures. Generally, adenoidectomy is reported without differentiating whether tonsillectomy was performed concomitantly, while tonsillectomy is reported “*with or without adenoidectomy*”. Inconsistencies, both in the age of the study populations under investigation and in the definition and reporting of the surgical procedures being examined, makes it difficult to draw comparisons between the incidence reported for various locales. Despite this, it was clear that for both adenoidectomy and adenotonsillectomy, the peak incidence in South Australia occurred in younger children than reported elsewhere.[248]

Age-specific Incidence and Indications

Generally, the age distribution of tonsillectomy and adenotonsillectomy might be explained by what is known about the prevalence of the underlying indications for surgery. Two of the most common childhood illnesses managed by general practitioners are upper respiratory tract infections and tonsillitis.[6] Both of these diagnoses are common indications for surgery.[20-25] The peak incidence of tonsillectomy coincides with a period when young children are most likely to be exposed to these illnesses, that is, the introduction to the school system. In South Australia, formal education commonly commences at the age of four-years-old with attendance at kindergarten or preschool,[312] with all children commencing school by six-years-old.[313, 314] However, it is increasingly common for children to attend childcare prior to commencing preschool or school.[315] This increase in childcare usage is due, in part, to increased subsidies from the Federal Government making childcare more affordable for low income families.[316] This has the potential to expose very young children to a wide range of viral and bacterial infections that they may not have encountered previously. In support of this, research has shown that children in child-care are more likely to require health care services.[317]

While tonsillitis was the main reason for tonsillectomy alone, large proportions of adenoidectomy and adenotonsillectomy were performed to relieve obstructive symptoms. The peak incidence of adenotonsillectomy for obstructive symptoms occurred in children aged four-years-old, which was younger than previously reported in Australia.[7] This shift in age may reflect an underlying shift in medical practice. Indeed, this analysis has shown that by the end of the study period obstructive symptoms were more frequently used as the primary indication for surgery – increasing from 9% of cases in

1997 to nearly 26% of cases by 2007. A number of reasons could explain this, including a change in the management of tonsillitis which could result in a decrease in surgical intervention; or the earlier detection and change in treatment of childhood sleep disordered breathing. Theories as to possible tonsillitis management changes could include an increased inclination to treat the condition with medical interventions, waiting for spontaneous resolution of the condition, or a natural decrease in the underlying disease in the population. Changes to the referral guidelines may also have occurred, however, research has shown that the introduction of guidelines does not influence clinician decision-making.[318, 319] Clinicians are unlikely to withhold surgery when it is indicated.[318] However, it is possible that surgeons may be less likely to intervene for case of tonsillitis, needing to prioritise children with obstructive symptoms in preference. Obstructive symptoms may have become more prevalent or diagnosed more easily due to advances in medical care and diagnostic testing. A final possibility is that there were changes during the study period to hospital coding practices. For example, when children had both diagnoses of tonsillitis and obstructive symptoms, changes in coding practices may result in a perceived increase in the prevalence of obstructive symptoms. This would have occurred if a change in coding practices resulted in obstructive symptoms being coded as the primary indication in preference to tonsillitis, or if there was an increase in general practitioner knowledge of obstructive sleep disorders during the study period.

Gender Differences

Overall, boys had a higher incidence of tonsillectomy in South Australia throughout the study period. While differences in the sex-specific incidence of tonsillectomy were identified as early as 1936,[217] these differences are still to be explained. One potential explanation may be that there are variations in the underlying disease aetiology. Differences in the pharyngeal anatomy, pharyngeal muscle activity, hormonal influences and ventilator control stability have been suggested to play a role in the sex differences seen in obstructive sleep apnoea.[320] Variations in the exposure of boys and girls to pathogens or a difference in the functioning of their immune responses have been proposed as a possible mechanism of action.[248] A review by Falagas *et al.* showed that girls were more frequently affected with upper respiratory tract infections, such as tonsillitis.[321] While a number of possible explanations have been suggested as to the difference in the incidence of tonsillectomy between boys and girls, to date no definitive explanation has been identified.

Private Health Insurance

During the study period, between 50.3% and 61.7% patients had their surgery privately funded in South Australia. This proportion is much higher than the reported proportion of Australians who have private health insurance. In 1998, it was reported that 32% of Australians had hospital coverage.[322] By 2004-5, this had risen to 47%,[323] with this increase attributable to the introduction of a number of policies by Australian Federal Government in the late 1990s. Firstly, the introduction of the Private Health Insurance Incentives Scheme in July 1997, and then the *Private Health Insurance Incentives Act* 1998 in January 1999, introduced a 30% rebate for those with private health insurance and a punitive tax for those without private insurance (known as the Medicare Levy Surcharge).[324-326] The introduction of the Lifetime Community Rating Scheme (known as Lifetime Healthcover) in July 2000 further encouraged the acquisition of health insurance through the use of financial incentives, particularly targeting young adults to acquire health insurance before turning 30-years-old.[327] However, despite this, there was still a much lower proportion of Australians with private health insurance coverage, compared to the proportion of South Australian children who had their tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion surgery privately funded.

While it might be assumed from these figures that South Australians must therefore have a higher proportion of private health insurance compared with the rest of Australia, this is not the case. In 2005, both New South Wales (44.4%) and Western Australia (45.7%) had slightly higher proportions of the population with private hospital insurance compared to South Australia (43.4%).[328] Furthermore, this had changed little from 1998, when Western Australia (36.5%) and Tasmania (37.4%) had larger proportions of the population with health insurance, compared to South Australia (32.3%).[322] The most likely explanation is that patients with private health insurance are more readily able to access surgical intervention. The results presented herein support this theory. The proportions of privately funded adenoidectomy and adenotonsillectomy were much greater for young children. This raises the possibility that parents with private health insurance have better, or more timely access, access to surgical intervention compared to those parents without private health insurance. In fact, several studies have shown that children without private health insurance are less likely to receive medical care,[224, 329] and that patients with low socioeconomic status are less likely to receive surgical intervention.[221] This is reinforced by the perception amongst parents that lack of private health insurance is a barrier of access to childhood health care services.[330]

4.4.2 Myringotomy with/without tympanostomy tube insertion

Incidence

In South Australia, the annual incidence of myringotomy with/without tympanostomy tube insertion ranged between 8.5 and 14.7 per 1000 child-years. These figures are not too dissimilar to the 1997 incidence reported for the United Kingdom of 12 per 1,000 child-years.[258] However, other Australian reports have shown much lower incidence. For the year 1989/90, in New South Wales the incidence was 5.8 per 1,000 child-years aged under 14-years-old.[249] In Western Australia, the incidence of myringotomy with/without tympanostomy tube insertion in children under 15-years-old has been steadily decreasing: dropping from 6.7 per 1000 person-years in 1997 to 5.6 per 1000 person-years by 2004.[262] The incidence in South Australia was also much higher than international reports. In 2002, the reported incidence in Finland was 4.3 per 1,000 child-years while in Norway it was 5.1 per 1,000 child-years.[261] In the Canadian province of Ontario the incidence was 8.35 per 1000 person-years – a figure more comparable to the South Australia.[259]

Reporting incidence in 5-year age-bands is not uncommon,[7, 8, 247-249] however, by doing so authors mask, or miss reporting, the high frequency of this procedure in very young children. The research presented herein highlights this, with children aged one to four-years-old having widely varied incidence of myringotomy with/without tympanostomy tube insertion. Had these data been reported in 5-year age-bands these large variations would not have been discernible. The results presented in this chapter have highlighted the importance of reporting incidence for very young children in one-year age-bands. These findings could have important implications for clinical practice and evidence-based medicine, particularly when planning access to, and provision of, healthcare within South Australia and early intervention programmes to target children most likely to require these surgical procedures.

Incidence and Indications

In this research, it was found that the peak incidence of myringotomy with/without tympanostomy tube insertion occurred in one-year-old children. Similarly, the peak has been reported to occur in one-year-old children in Canada (21 per 1,000 child-years).[259] Whereas in 1988 in the United States the peak prevalence occurred in two-year-olds (31 per 1,000 child-years).[267] In contrast to these reports, the incidence observed in South Australia was much higher at 49 per 1000 child-years. The very young age at which the peak incidence occurred can be explained by the high prevalence of otitis media in very young children. It has been reported that the peak incidence of acute otitis media occurs in 6 to 11-months-old infants,[108] and that by 12-months-old, between 62 to 97% of children have had at least one episode of acute otitis media.[108, 171] Antimicrobial prescribing for children diagnosed acute otitis media is also highest amongst one-year-old children.[296] Furthermore, it is estimated that the prevalence of otitis media with effusion amongst young children is 20%.[331] These formative years are crucial for the development of speech and communication and this may underpin clinician's reluctance to delay intervention. Adding to this is evidence that 30% of children receiving antibiotic therapy still experience pain and fever after treatment,[61] and that parents are less likely to accept this antibiotic treatment if they live in an area where antimicrobial use is not common.[296] This would encourage high incidence of surgical intervention. In addition, evidence suggests that there have been increases in the incidence of otitis media in recent decades, with increases in Finland of 68% and in USA of 39%.[105, 332] However, these increases may be an artefact of improved diagnostic techniques or increased awareness amongst parents and health practitioners.

Gender Differences

In this study population, myringotomy with/without tympanostomy tube insertion was more frequently performed on boys (58.2%). This is consistent with other reports, in which proportions ranged from 58 to 66%.[213, 234, 249] This high frequency of the procedure in boys is underpinned by a well-documented higher incidence of otitis media in boys.[135, 142, 150, 173, 270] However despite this, the reasons for the gender disparity continue to remain unexplained.

Private Health Insurance

The proportion of privately funded myringotomy with/without tympanostomy tube insertion was nearly double compared to publicly funded cases. This may reflect the ability of the private sector to provide intervention more promptly for a large number of children requiring this procedure. Indeed, this may be indicative of parental pressures to intervene in a timely fashion to alleviate symptoms and provide relief to the child and caregivers. Interestingly, in very young children aged one-year and under there were nearly three times as many privately funded cases. While it is not clear why this may occur, when the underlying conditions are examined, some explanations can be inferred. The majority of children underwent this procedure for otitis media. Furthermore, there were two peaks in the incidence of underlying otitis media with effusion – one peak at age one-year and another at four-years-old. This may reflect two major exposure opportunities. The first exposure coincides with the introduction of children to childcare. The Australian legislative document, the *Fair Work Act 2009,* includes the provision that employees be allowed a 52-week period of unpaid parental leave.[333] Many parents find it necessary to return to work, whether part-time or full-time, after this period of parental leave, thus introducing their very young children to childcare. The second exposure occurs at the introduction to the preschool/school system at ages four and five, which may also coincide with a 'relapse' as tympanostomy tubes typically remain patent and in-situ for one-year.[334, 335] Finally, a proportion of children undergo the procedure in conjunction with treatment for tonsil and adenoid-related conditions. Evidence of this is reflected by the Venn-Euler diagram presented herein, whereby a small proportion of children underwent adenotonsillectomy concomitantly with tympanostomy tube insertion – with the greatest frequency of this occurring at age four-years-old. This accounts for a large proportion of the second peak seen in 4-year-old publicly funded cases but not for those that were privately funded. This may allude to a difference in treatment approaches with children treated in the private sector undergoing adenotonsillectomy with tympanostomy tube insertion less frequently.

4.4.3 Conclusions

Within South Australia, the children who most frequently underwent ENT surgery were very young children with private health insurance, and more often these children were boys. The frequencies of the procedures within South Australia were difficult to compare to other jurisdictions due to differences in definitions, analysis and reporting of results. However, these ENT procedures appear to occur with similar or higher frequency than many countries around the world.

CHAPTER 5
The Australian Epidemiology

5.1 INTRODUCTION

The previous chapter described in detail the age and sex-specific incidences of adenoidectomy, tonsillectomy and myringotomy with/without tympanostomy tube insertion within the South Australian paediatric population. Obtaining the depth of detail reported in Chapter 3 was an important first step in understanding why these procedures occur more frequently in South Australia. The results showed that children who most commonly underwent these procedures within South Australia were preschool aged boys and that the incidence of these procedures was higher for privately insured children – the only exception was for tonsillectomy alone which is more frequent in adolescent girls.

As a result of Chapter 3, questions arose about how these results might compare to other Australian populations. While there was the suggestion that South Australia had a higher incidence of these procedures compared to the rest of Australia[7] – this being the premise for this thesis – there was a paucity of literature and lack of commentary on why this was so. It was evident that further research was required to compare the children that underwent surgery in South Australia to those having surgery in other Australian states and territories. Particular focus would be on whether age- and sex-specific incidence profiles or the use of private and public hospitals varied between jurisdictions.

Furthermore, while older children may have the opportunity to be involved in healthcare decisions, as a rule, infants and very young children do not.[336] Healthcare decisions for very young children rest with the adults responsible for the child; those that provide consent for the surgery – the parents and caregivers; and those that advise on and, ultimately, perform the surgery – the surgeon. Given that the frequency of surgery must be somewhat influenced by those that perform the procedures, insight would undoubtedly be gained by exploring the surgical workforce within each state.

Therefore, this chapter reports the results of a study conducted to describe the age and sex-specific incidence of these procedures in five Australian paediatric populations. This study builds on the results of Chapter 3 and provides an opportunity to interpret and situate the South Australian figures within the wider Australian context. In addition, the otorhinolaryngology surgical workforce within Australia, and specifically within these five states, is presented and discussed in reference to the procedural incidences.

5.1.1 Aims and Objectives

The primary aim of this study was to describe and compare the epidemiology of adenoidectomy, adenotonsillectomy, tonsillectomy, and myringotomy with/without tympanostomy tube insertion within five Australian paediatric populations. The secondary aim was to explore the relationship between these incidences and the otorhinolaryngology surgical workforce across Australia.

The following objectives were set for this component of research:

1. To describe the population of children that underwent these procedures in each study state.
2. To determine the age and sex-specific incidences of these procedures across the study states.
3. To determine whether the incidence of these procedures changed over the course of the study period.
4. To determine whether the incidence of these procedures varied between the public and private hospital sectors.

5. To investigate how these procedures were funded.
6. To identify regions of Australia where both the workforce and procedural incidences are high.

5.2 METHODS

5.2.1 Study Design

A retrospective cross-sectional study was conducted to assess and compare the incidence of ENT surgical procedures within five Australian paediatric populations between 1 July 2001 and 30 June 2009. This study used existing data collected through the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (NHMD) and the Australian Bureau of Statistics (ABS) Census of Population and Housing (the "Census"). South Australian data extracted from the AIHW NHMD were cross-checked to the ISAAC dataset (Chapter 3) for the overlapping study years, 2002 to 2007, to ensure data integrity.

Sub-Study Design

A descriptive study was conducted in 2009 to investigate the relationship between the incidence of paediatric ENT surgery and that of ENT surgeons working within Australia. Data was extracted from a variety of sources and compiled into a dataset, as illustrated in Figure 5-1.

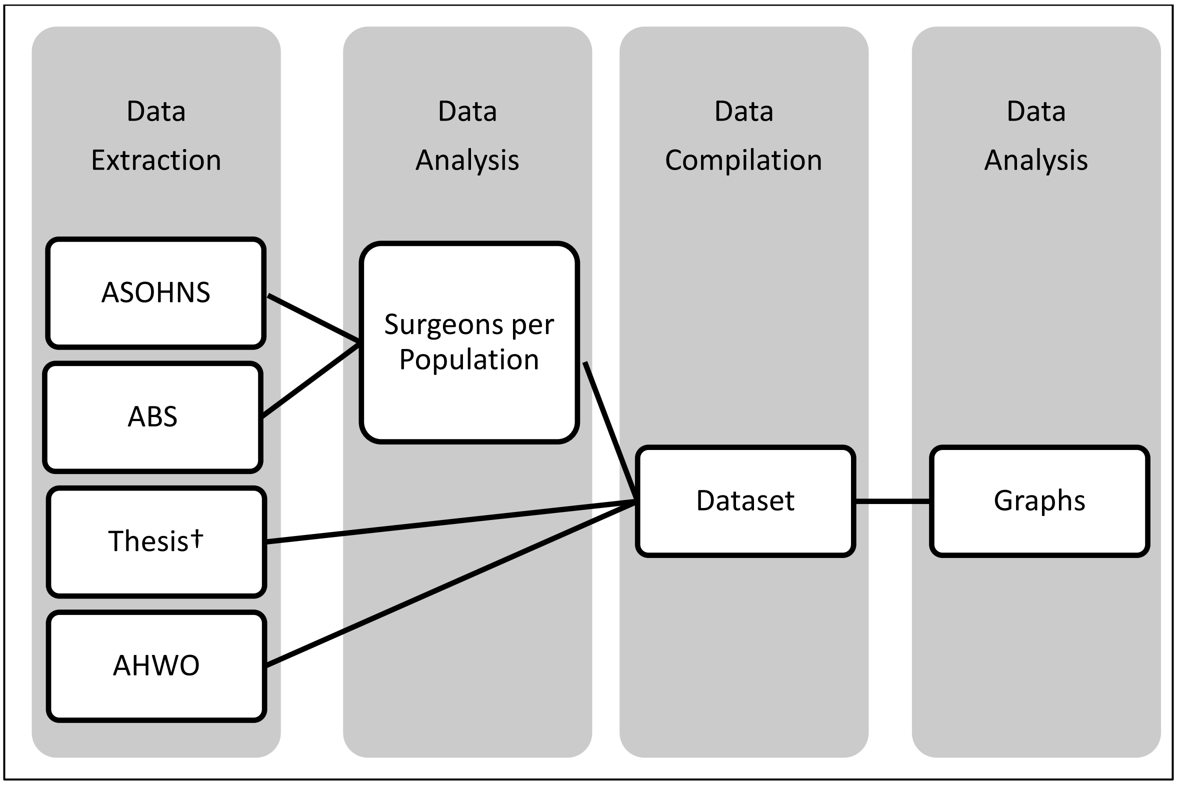


Figure 5-1: Study Process

ABS – Australian Bureau of Statistics
ASOHNS – Australian Society of Otolaryngology Head and Neck Surgery
AHWO – Australia's Health Workforce Online
† Surgical incidences calculated in Chapter 3. Source Data: AIHW, ABS

The ABS regularly publishes Australian demographic statistics.[306] The estimated residential population for each state is published based on data collected during the Census of Population and Housing with adjustments made considering the estimated rate of population growth. As of June 2009, there were over 21 million people living in Australia, with the majority of these living in major cities or along the eastern coast of Australia. The Australian Society of Otolaryngology Head and Neck Surgery (ASOHNS) is the organisation that represents and together with the Royal Australasian College of Surgeons, is predominantly responsible for training ENT surgeons within Australia. The ASOHNS makes freely available on their website access to a database of specialist ENT surgeons working across Australia.[337] Data was extracted from this database and used to compile the number of ENT surgeons working within each Australian state as of June 2009. The Australia's Health Workforce Online (AHWO) website[338] is used by the Federal Government to provide the public with information about the current state of Australia's health workforce and the planning being undertaken to ensure adequate healthcare provision. The website provides the public with information about the activities of a number of healthcare agencies, including the Australian Medical Workforce Advisory Committee (AMWAC).[339] The AMWAC is comprised of representatives from a variety of healthcare organisations with the purpose of reviewing, reporting and planning the medical workforce requirements of Australia. The AMWAC have previously published reports on the ENT surgical workforce, with predictions of the required numbers to meet the needs of the Australian population.

5.2.2 Research Setting

Australia is a country comprised of seven states and two territories, each governed by a locally-elected parliament. The state and territory governments are responsible for the provision and management of the public healthcare system, including acute and psychiatric hospitals, maternal and child health, and disease prevention. The Australian public hospital system is jointly funded by Federal Government and the state and territory governments; with the administration of these funds the responsibility of the states and territories. In 2011, the Australian population was over 22-million persons. The Australian Government estimates that 43% of Australians have private health insurance hospital coverage and that one-third of all hospital beds within Australia are provided by private hospitals.[323]

The AIHW is an Australian Government agency responsible for providing statistics and information on the health and welfare of Australia. This information is then used by a wide range of Governmental and community organisations for policy planning, service provision and research. Data were provided by the AIHW for all paediatric hospital separations recorded in the NHMD that occurred during the study period and within the study jurisdictions. The NHMD contains de-identified data provided by the Australian state and territory health departments for the financial years 1993-94 to 2008-09. The database includes demographic and hospital separation data for each hospital separation from all Australian public or private hospitals. While the database is able to record up to 100 diagnostic and 100 procedural data fields for each hospital separation, the collection of procedural data only commenced in the 2000-1 financial year thereby limiting our study period. A standardised "data dictionary" accompanies the NHMD to ensure a high level of data comparability; however, there may still be variations in coding practice both between the individual data providers (hospitals) and over time.

Population data from the 2001 and 2006 Census were accessed through the ABS website[340, 341] as previously described in Section 4.2.2. The Census data were used to estimate the size of the paediatric population within each participating Australian jurisdiction and to calculate the incidence estimates, as described in Section 5.2.5. Estimated resident population data for each socioeconomic status 'fifth' (commonly termed quintiles) were sourced from the Commonwealth Grants Commission.[342] These data were used to estimate expected numbers of procedures for each socioeconomic group within the study states.

5.2.3 Study Sample

All hospital separations in the NHMD that met the inclusion criteria were included in the study (Table 5-1). Records were excluded for hospital separations where the patient was hospitalised in a state or territory that was not their usual place of residence. In addition, records were not extracted from the NHMD for hospital separations that occurred in a jurisdiction, that is, an Australian state or territory that did not provide consent for their data to be released as part of this research project.

Identification of Sample

Permission to use the NHMD was granted by the AIHW; however, each jurisdiction was individually contacted by the AIHW to obtain consent for the release of the NHMD data to the researcher. Six states and territories provided consent. Queensland and the Australian Capital Territory declined access to their data. Records meeting the inclusion and exclusion criteria were extracted from the NHMD by AIHW personnel, who then provided this de-identified subset to the researcher. All 100 procedure fields were searched to ensure completeness of the dataset.

Table 5-1: Inclusion Criteria for the Identification of the Study Sample.

Criterion
1. The patient was aged less than 18 years at time of surgery.
2. At least one of the following procedures was performed at any time during the hospital stay: a. tonsillectomy; b. adenoidectomy; and/or c. myringotomy with/without tympanostomy tube insertion
3. The hospital separation was between 1 July 2001 and 30 June 2009.
4. The patient's usual place of residence was within a consenting jurisdiction.

Surgical Procedure and Diagnostic Codes

The surgical procedures were identified using the following standardised coding systems, which have been previously described in Section 4.2.4:

- International Classification of Diseases, 10th Revision, Australian Modified (ICD-10-AM); and
- Australian-Refined Diagnostic Related Groups (AR-DRG).

The ICD-10-AM codes used in this study for the identification of surgical procedures (Table 4-3) and diagnostic codes (Table 4-4) have been previously discussed.

5.2.4 Dataset

There were six study datasets provided by AIHW to the researchers, one for each consenting jurisdiction. The datasets contained demographic data, procedural data, and diagnostic data. The NHMD fields listed in (Table 5-2) were included in the datasets. The Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage (IRSD) Index was used as an indicator of the socioeconomic status of the children undergoing surgery. This ABS-defined measure summarises information about the economic and social resources of an area, with a low score (1) indicating the most disadvantage and a high score (10) indicating a lack of disadvantage. The score incorporates a number of variables including educational and employment status of the people living within the designated area, income, dwellings with no cars or internet, and elderly with long-term health conditions.[343]

Although six states and territories consented to provide access to their data, several of these jurisdictions only provided conditional access and imposed exceptions to the data fields to be released. A list of these conditions and exceptions is provided in Table 5-3. As a result of these restrictions, the data provided by Northern Territory was excluded - without private sector data incidences would be underestimated. While Tasmania was included in the study, data identifying hospital sector (public vs. private hospital) was not provided, so this level of analysis was not possible for this state.

Data extracted from the NHMD for South Australia were cross-referenced with data used in Chapter 3 for the same time period to ensure that the data matched. The number of cases for each of the overlapping study years was compared for all procedures being studied and found to be identical.

Table 5-2: Australian Institute of Health and Welfare National Hospital Morbidity Database fields included in the dataset.

Field	Definition
proj_id	Australian Institute of Health and Welfare generated record identifier
seifaQuintile	Quintile of SEIFA score IRSD index. For years 2006-07 to 2008-09 inclusive, SEIFA 2006 was applied; for years 2001-02 to 2005-06, SEIFA 2001 was applied
sepmonth	Separation month
sepyear	Separation year
residence_state	State of patient usual residence
age	In years, up to age of 17 years inclusive
sex	Male/Female
sector	Sector of hospital (public hospital or private hospital)
funding_source	Funding options: - Australian Health Care Agreements - Department of Defence - Department of Veterans Affairs - Motor vehicle third party personal claim - Other - Other compensation (e.g. public liability, common law, medical negligence) - Other hospital or public authority (contracted care) - Private health insurance - Reciprocal health care agreements (with other countries) - Self-funded - Workers compensation
totprocs	Number of procedures reported
procs1 … procs100	ICD-10-AM procedural codes
blocs1 ... blocs100	ICD-10-AM block number for procedure
totdiags	Number of diagnoses reported
diag1 … diag100	ICD-10-AM diagnostic codes

Table 5-3: Conditions and exceptions to the release of data from the Australian Institute of Health and Welfare National Hospital Morbidity Database.

State	Consent Provided	Exceptions	Conditions of Data Release	Included
Australian Capital Territory	No	-	-	No
New South Wales	Yes	-	Confidentiality Agreement	Yes
Northern Territory	Yes	Private hospital data were not released.	Separation counts less than 5 were suppressed.	No
Queensland	No	-	-	No
South Australia	Yes	-	-	Yes
Tasmania	Yes	Sector of hospital was not released.	Separation counts less than 5 were suppressed.	Yes
Victoria	Yes	-	Confidentiality Agreement	Yes
Western Australia	Yes	-	-	Yes

5.2.5 Data Analysis

All data manipulations and analyses were performed using R© (Version 2.14.1, 22 December 2011, The R Foundation for Statistical Computing, Vienna, Austria). The commands used to perform data manipulation and analyses are presented as R© scripts in Appendix C. The incidences were calculated as described below. Workforce incidences were calculated as the surgeons per Australian population using data from the ABS and ASOHNS.

Mean values were calculated for age and incidence, and these are reported with one standard deviation (SD). Differences in continuous data were tested for significance with the Student's t-test. Categorical data are presented as proportions: patient's sex (male vs. female), hospital sector (public vs. private hospital), and SEIFA IRSD (most to least disadvantaged). These were tested using Pearson's chi-square test. All statistical tests were two-tailed, with a $p<0.05$ deemed statistically significant.

Age-Specific Incidences

Age and sex-specific incidence estimates were calculated for each procedure within each of the five states using the AIHW NHMD data (the "*numerator*") and child population data from the ABS Census (the "*denominator*"). Linear interpolation between the Census years 2001 and 2006 was performed to estimate population sizes for each of the inter-Censual years. Linear extrapolation was performed to estimate population sizes for the years 2007 to 2009. Age-specific incidences were calculated according to the patient's sex and hospital sector. Plots are presented with the text to summarise most findings – but tabulated results can be found in Appendix E.

Socioeconomic Profiles

For each of the four procedures under investigation, the proportion of children living within each SEIFA quintile was calculated for each state using the AIHW NHMD data (the "observed" profile). For each state, the proportion of children living within each SEIFA quintile was calculated for the paediatric estimated resident population, aged 0 to 17-years, using ABS census data (the "expected" profile). The difference between the profiles was calculated and is presented in Section 5.3.9.

Poisson Regression

Differences between the Australian states in their incidence of surgical procedures were analysed using Poisson regression. The probabilities (Pijk) of children undergoing a specified procedure were assumed to conform to the model:-

$$\log(P_{ijk}) = \beta_0 + \beta_{1i} + \beta_{2j} + \beta_{3k} + \text{interaction terms}$$

where i = male or female; j= 0,1,2,…17 years of age; and k = state of residence (New South Wales, South Australia, Victoria, Western Australia, and, if appropriate, Tasmania); and

$$P_{ijk} = n_{ijk}/N_{ijk}$$

where n_{ijk} = the number of children of sex i, and age j, undergoing the procedure in state k; and N_{ijk} was the corresponding population number as obtained or generated from ABS census data (see Section 4.2). The analysis was performed by supplying the regression software with the procedure counts, n_{ijk}, as the dependent variable, and including the ABS denominators, N_{ijk}, as a (logged) offset in the regression model.

Initially, the modelling strategy consisted of fitting main effects for age, sex and an age-by-sex interaction term. Systematic differences between states were then addressed by fitting main effects for the states. To ascertain whether the states differed with respect to the age-profile of the children undergoing these procedures, or with respect to their gender, the interactions between state and age, and between state and sex, were tested. The significance of model terms was tested by assessing the changes in residual deviance, which, under a null hypothesis is distributed as χ^2 with degrees of freedom equal to the corresponding decrease in the model degrees of freedom.

The residual deviance suggested that, in most cases, the Poisson assumption was reasonable and there was not much over-dispersion. Furthermore, qualitatively similar results were obtained by using the quasipoisson model-family, that is, if the Poisson assumption that the mean was the same as the variance was relaxed.

5.3 RESULTS

The final study population consisted of 338,976 paediatric ENT hospital separations from five Australian states. The largest proportion of hospital separations occurred in New South Wales (37.4%) and Victoria (31.7%), with the smallest proportion from Tasmania (Table 5-4).

Table 5-4: Demographic profile, all cases, 2001-2009.

	New South Wales	South Australia	Tasmania	Victoria	Western Australia
n	126,855	48,064	6,608	107,513	49,937
%	37.4%	14.2%	1.9%	31.7%	14.7%

The proportions of the procedures performed varied significantly across states and territories ($\chi^2_{(df=24)}$=8373.1, p<0.001). However, adenotonsillectomy or myringotomy with/without tympanostomy tube insertion were typically the most common procedural combinations. A series of Venn-Euler diagrams provide a graphical representation of the combinations of surgical procedures performed in each of the Australian study states (Figure 5-2).

Figure 5-2: Euler Diagram of the Surgical Combinations for each Australian state.

5.3.1 Study Population

More girls underwent tonsillectomy alone, while adenotonsillectomy, adenoidectomy alone and myringotomy with/without tympanostomy tube insertion were more commonly performed on boys (Table 5-5). The proportion of girls in New South Wales who underwent tonsillectomy alone (56.6%) or adenotonsillectomy (45.3%) was significantly lower than the four other states (p<0.001). However, these four states were not statistically different from each other for tonsillectomy (p=0.160) or adenotonsillectomy (p=0.741). In contrast, Western Australia had the largest proportion of boys (61.7%) that underwent adenoidectomy alone – a difference that was statistically significantly higher (p=0.031) than in any other state. Amongst the remaining states, there were no statistically significant differences in the proportion of boys (p=0.876). The proportion of boys that underwent myringotomy with/without tympanostomy tube insertion within each state was comparable, with any statistical differences being the result of the large sample sizes. Furthermore, the absolute differences between the percentages are sufficiently small that any statistically significant differences may be only of very limited clinical importance.

The mean age of children who underwent tonsillectomy alone or adenotonsillectomy differed between the five states. Children that underwent tonsillectomy were youngest in New South Wales compared to the other states, while for adenotonsillectomy children were youngest in South Australia. Western Australian children were the youngest that underwent adenoidectomy alone (5.3-years), with Tasmanian children the oldest (6.7-years). The mean age of children that underwent myringotomy with/without tympanostomy tube insertion also differed across the states. However, while the differences in age between the states were statistically significant for these procedures (p<0.0001), the results are unlikely to be of any clinical significance given the large sample sizes involved.

Table 5-5: Demographic profile, 2001-2009.

	New South Wales	South Australia	Tasmania	Victoria	Western Australia	p-value
Tonsillectomy alone						
N	17,873	5,753	1,099	14,640	5,534	
Age (years, mean ± SD)	10.3 ± 4.8	11.0 ± 4.8	10.8 ± 4.6	11.3 ± 4.7	11.4 ± 4.7	*
Sex (n, %)						
Girls	10,118 (56.6%)	3,618 (62.9%)	675 (61.4%)	9,039 (61.7%)	3,499 (63.2%)	†
Boys	7,755 (43.4%)	2,135 (37.1%)	424 (38.6%)	5,601 (38.3%)	2,035 (36.8%)	
Adenotonsillectomy						
N	48,288	13,301	1,499	33,554	17,425	
Age (years, mean ± SD)	5.8 ± 3.4	5.6 ± 3.3	6.4 ± 3.5	6.0 ± 3.5	5.7 ± 3.3	**
Sex (n, %)						
Girls	21,872 (45.3%)	6,220 (46.7%)	717 (47.8%)	15,701 (46.8%)	8,098 (46.7%)	††
Boys	26,416 (54.7%)	7,081 (53.2%)	782 (52.2%)	17,853 (53.2%)	9,327 (53.5%)	
Adenoidectomy alone						
N	24,529	6,107	1,276	16,825	7,571	
Age (years, mean ± SD)	5.8 ± 3.6	5.6 ± 3.5	6.7 ± 3.5	6.2 ± 3.8	5.3 ± 3.5	***
Sex (n, %)						
Girls	9,878 (40.3%)	2,461 (40.3%)	526 (41.2%)	6,745 (40.1%)	2,902 (38.3%)	†††
Boys	14,651 (59.7%)	3,646 (59.7%)	750 (58.8%)	10,080 (59.9%)	4,669 (61.7%)	
Myringotomy ± Tympanostomy Tube Insertion						
N	60,834	29,970	3,600	58,392	29,088	
Age (years, mean ± SD)	4.2 ± 2.9	3.9 ± 3.0	4.8 ± 3.3	4.3 ± 3.1	4.1 ± 2.9	****
Sex (n, %) a						
Girls	23,977 (39.4%)	12,320 (41.1%)	1,517 (42.1%)*	23,271 (39.9%)	11,554 (39.7%)	††††
Boys	36,857 (60.6%)	17,650 (58.9%)	2,082 (57.8%)	35,121 (60.1%)	17,534 (60.3%)	

a One case in Tasmania "Not Known".
* ANOVA: F-statistic = 104.9, df=4, p<0.0001
† Pearson's chi-squared test of homogeneity: $\chi2$=149.03, df=4, p<0.0001
** ANOVA: F-statistic=57.4, df=4, p<0.0001
†† Pearson's chi-squared test of homogeneity: $\chi2$=24.21, df=4, p<0.0001
*** ANOVA: F-statistic = 103.8, df=4, p<0.0001
††† Pearson's chi-squared test of homogeneity: $\chi2$=10.612, df=4, p=0.031
**** ANOVA: F-statistic = 158.5, df=4, p<0.0001
†††† Pearson's chi-squared test of homogeneity: $\chi2$=32.16, df=4, p<0.0001

5.3.2 Incidence by State

Of the five states, South Australia had the largest average annual incidence of each of the procedures (Table 5-6). The incidence in South Australia ranged from 2.1 per 1,000 child-years for tonsillectomy, up to 11.0 per 1000 child-years for myringotomy with/without tympanostomy tube insertion. The average incidence of adenoidectomy was low, ranging from 1.4 to 2.2 per 1,000 child-years. Tasmania had the lowest annual incidences of each of the procedures.

For tonsillectomy the estimated incidence rate ratios relative to South Australia (100%) ranged from 57% (Tasmania) to 76% (Victoria) – highlighting a much greater use of this procedure in South Australia. In comparison, South Australia performed adenotonsillectomy at a greater frequency compared to some states (Tasmania, 33.8%), but at a similar incidence compared to others (Western Australia, 93.8%). This suggests that there is much more variability in the usage of this procedure across the states. There was not as much variation in the frequency of adenoidectomy, with the incidence rate ratios ranging from 62.7 to 88.7% relative to South Australia. Reminiscent of the other surgical procedures, but even more marked, were the differences in the incidence of myringotomy with/without tympanostomy tube insertion between the states. The estimated incidence rate ratios relative to South Australia ranged from just 36.0% in Tasmania to 69.5% in Western Australia.

Table 5-6: Incidence and Incidence Rate Ratios

State	**Mean Incidence per 1,000 child-years (± SD)**	**Incidence Rate Ratio (95% Confidence Interval) †**
Tonsillectomy alone		
New South Wales	1.42 ± 0.07	0.681(0.662,0.702)
South Australia	2.10 ± 0.13	1
Tasmania	1.21 ± 0.24	0.572 (0.537,0.611)
Victoria	1.60 ± 0.09	0.761 (0.738,0.785)
Western Australia	1.46 ± 0.21	0.688 (0.663,0.714)
Adenotonsillectomy		
New South Wales	3.87 ± 0.79	0.796 (0.781, 0.812)
South Australia	4.92 ± 0.72	1
Tasmania	1.67 ± 0.52	0.338 (0.320, 0.356)
Victoria	3.68 ± 0.53	0.755 (0.740, 0.770)
Western Australia	4.62 ± 1.13	0.938 (0.917, 0.959)
Adenoidectomy alone		
New South Wales	1.98 ± 0.24	0.881 (0.857, 0.906)
South Australia	2.23 ± 0.29	1
Tasmania	1.37 ± 0.19	0.627 (0.590, 0.665)
Victoria	1.84 ± .014	0.824 (0.800, 0.849)
Western Australia	2.00 ± 0.44	0.887 (0.858, 0.918)
Myringotomy ± Tympanostomy Tube Insertion		
New South Wales	4.87 ± 0.57	0.445 (0.439, 0.451)
South Australia	11.00 ± 1.24	1
Tasmania	3.88 ± 0.58	0.360 (0.348, 0.373)
Victoria	6.37 ± 0.86	0.583 (0.575, 0.591)
Western Australia	7.65 ± 1.03	0.695 (0.683, 0.709)

† estimated by Poisson Regression

5.3.3 Incidence by State and Calendar Year

The incidence of tonsillectomy was highest in South Australia throughout the entire period 2001 to 2009 (Figure 5-3). There was no obvious trend, except perhaps in Tasmania, where the incidence of tonsillectomy was lower than in any state for the first 5 years, but thereafter was comparable with the other states. In comparison, the incidence of adenotonsillectomy was relatively flat until 2005, when thereafter noticeable increases were evident. However, while these increases were consistent across all the states, the increase was not sustained in New South Wales after 2008. Furthermore, at the same time in the other states the size of the increases in incidence also slowed. It is noteworthy that this stagnation corresponds to the publication of a national position statement by leading Australian child health physicians, which stated that "*an increase in access to adenotonsillectomy for children with moderate/severe obstructive sleep apnoea [OSA] is urgently required*".[25]

There was no consistent incidence pattern for adenoidectomy alone, although the annual incidence was fairly flat in each state for the majority of the study period. The only noteworthy divergence to this occurred in Western Australia where there was an upward trend in the incidence towards the end of the study period – from 2007 onwards. In contrast, throughout the study period there was a consistent downward trend in the incidence of myringotomy with/without tympanostomy tube insertion within the five states. However, despite a decrease over time, at the end of the study period the incidence of the procedure in South Australia still far exceed the incidence in the other states.

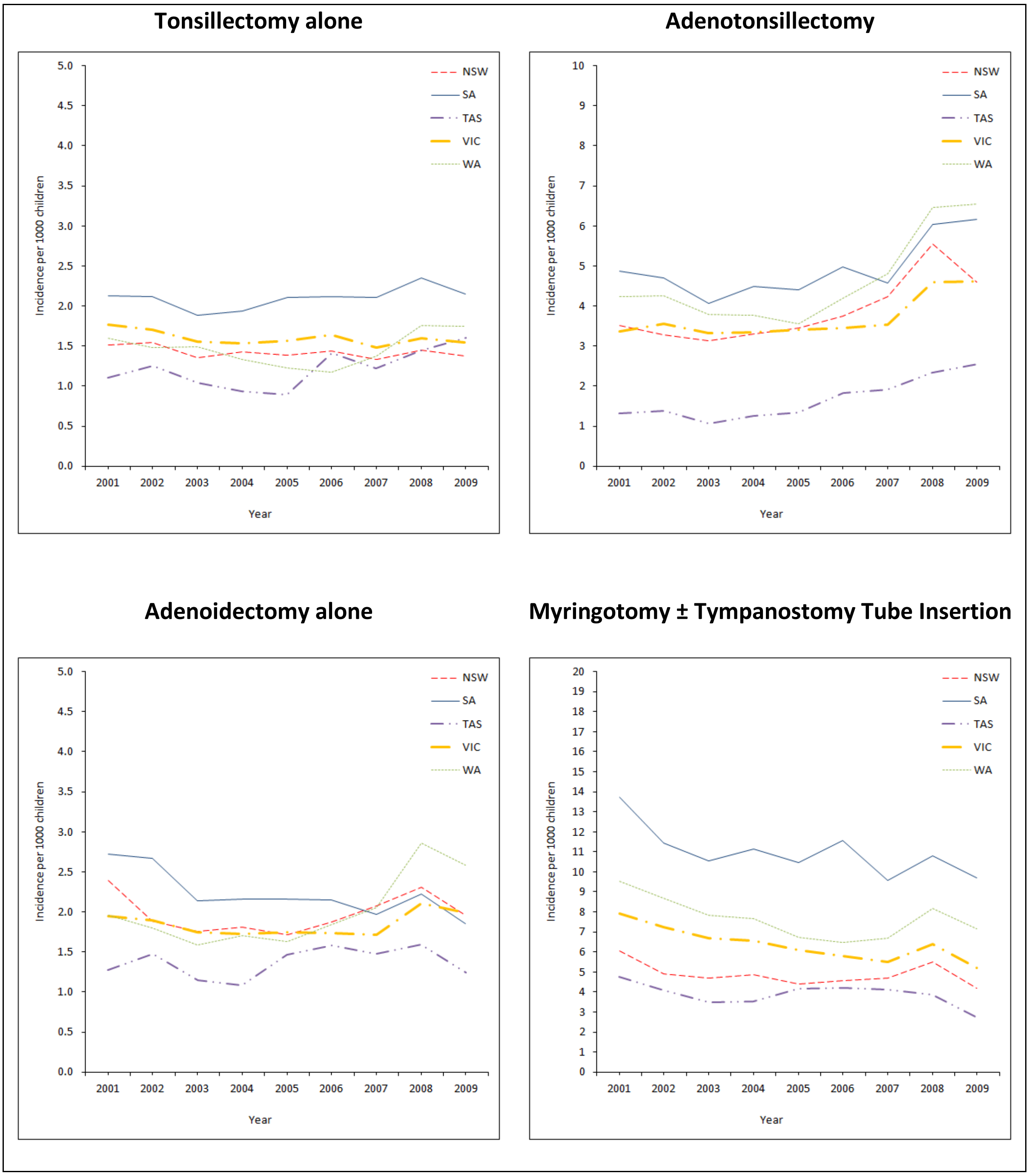


Figure 5-3: Incidence over time by Australian state.

5.3.4 Incidence by State and Sex

Tonsillectomy alone was performed more frequently in girls than in boys and this was consistent for all states (Figure 5-4). In contrast, the sex-specific incidences of adenoidectomy, adenotonsillectomy and myringotomy with/without tympanostomy tube insertion were greater for boys. The sex disparity was greatest for tonsillectomy, with an overall incidence rate ratio for girls compared to boys of 1.57 (95% CI 1.54 – 1.60), while the disparity was smallest for adenotonsillectomy with an incidence rate ratio of boys compared to girls of 1.12 (95% CI 1.11 – 1.13). The incidence rate ratios for adenoidectomy and myringotomy with/without tympanostomy tube insertion the incidence rate ratio were similar: 1.44 (95% CI 1.42 – 1.46) for adenoidectomy and 1.44 (95% CI 1.43 – 1.45) for myringotomy with/without tympanostomy tube insertion.

The incidence rate ratios varied across the states. Western Australia had the highest incidence rate ratio of tonsillectomy where nearly twice as many girls underwent the procedure compared to boys (Incidence Rate Ratio 1.83), while New South Wales had the lowest ratio (Table 5-7). Similarly, Western Australia had the largest incidence rate ratios for adenoidectomy, while New South Wales had the highest incidence rate ratios for adenotonsillectomy and myringotomy with/without tympanostomy tube insertion. Tasmania consistently had the least inequality between the incidence of boys and girls – in fact, in Tasmania adenotonsillectomy was performed with almost identical frequency for both boys and girls (Incidence Rate Ratio 0.99). Poisson regression confirmed that there was a strong relationship between sex and residential state, as is evidenced by the significance of the state-sex interaction (Table 5-8).

While these ratios were *clinically* similar across the five states, they were statistically significantly different due to the large numbers involved in the study population.

Furthermore, the disparity in the sex-specific incidences for South Australia did not stand out as far greater or less than the other states, instead falling "in the middle". Therefore, these results, while important in themselves, do not aid in explaining the underlying reason for the excessive incidence observed in South Australia.

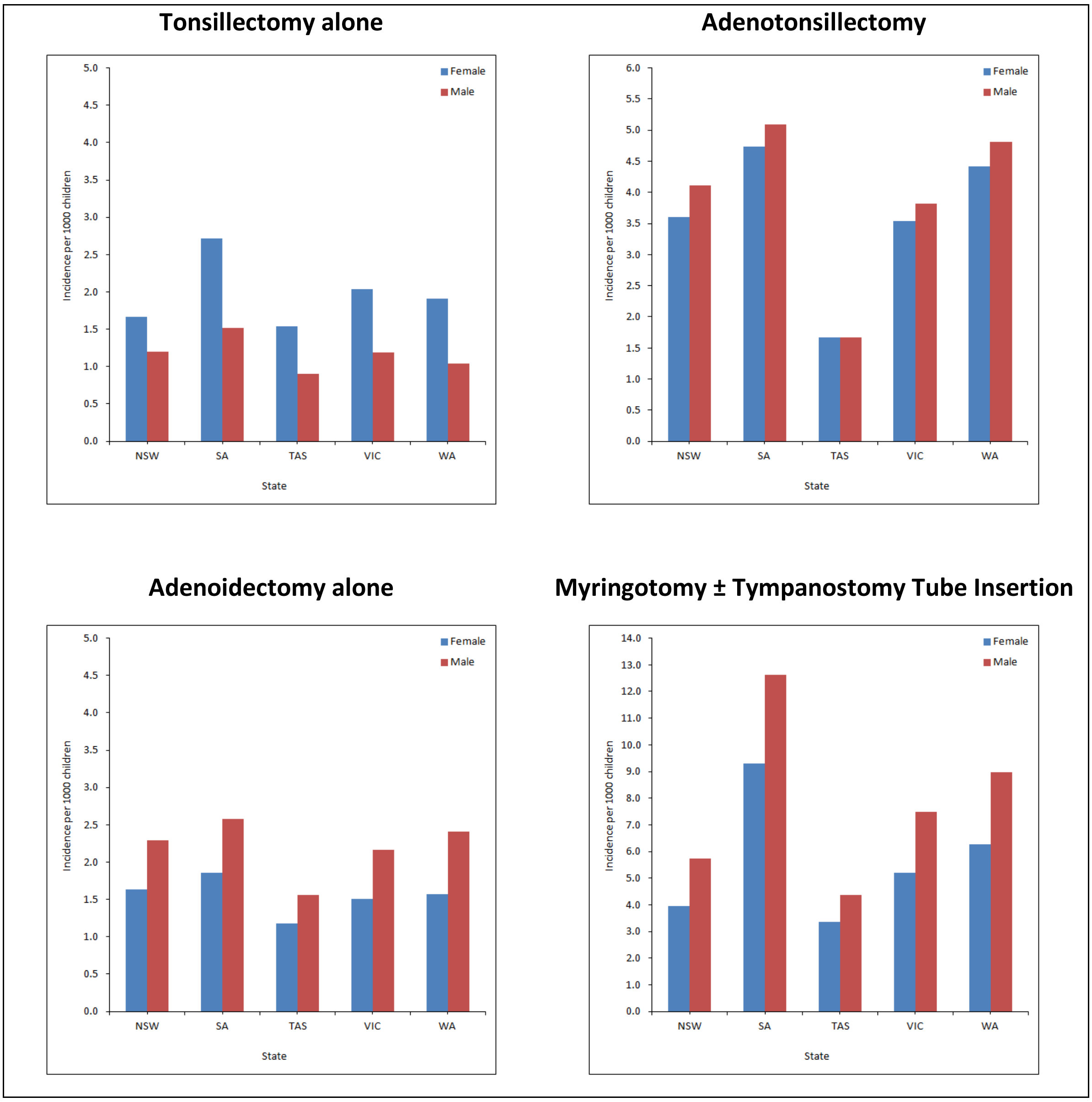


Figure 5-4: Sex-specific Incidence by State of Residence.

Table 5-7: Sex-specific Incidence and Incidence Rate Ratios by State of Residence.

State	Mean Incidence (± SD) per 1,000 female-years	Mean Incidence (± SD) per 1,000 male-years	Incidence Rate Ratio (F:M) (95% C.I)
Tonsillectomy alone			
New South Wales	1.662 ± 0.078	1.200 ± 0.090	1.385 (0.132, 14.492)
South Australia	2.729 ± 0.186	1.514 ± 0.090	1.802 (0.247, 13.137)
Tasmania	1.537 ± 0.344	0.905 ± 0.177	1.698 (0.126, 22.797)
Victoria	2.033 ± 0.140	1.186 ± 0.069	1.714 (0.178, 16.504)
Western Australia	1.909 ± 0.276	1.044 ± 0.159	1.828 (0.168, 19.872)
Adenotonsillectomy			
New South Wales	3.604 ± 0.726	4.116 ± 0.856	0.876 (0.213, 3.601)
South Australia	4.739 ± 0.647	5.094 ± 0.801	0.930 (0.233, 3.250)
Tasmania	1.668 ± 0.603	1.664 ± 0.497	1.002 (0.117, 8.584)
Victoria	3.539 ± 0.524	3.822 ± 0.540	0.926 (0.218, 3.931)
Western Australia	4.423 ± 1.038	4.815 ± 1.216	0.918 (0.252, 3.339)
Adenoidectomy alone			
New South Wales	1.639 ± 0.208	2.295 ± 0.270	0.714 (0.096, 5.300)
South Australia	1.854 ± 0.284	2.583 ± 0.313	0.718 (0.109, 4.735)
Tasmania	1.173 ± 0.202	1.558 ± 0.227	0.753 (0.069, 8.266)
Victoria	1.508 ± 0.127	2.164 ± 0.182	0.697 (0.087, 5.573)
Western Australia	1.566 ± 0.263	2.414 ± 0.629	0.649 (0.087, 4.847)
Myringotomy ± Tympanostomy Tube Insertion			
New South Wales	3.950 ± 0.499	5.740 ± 0.649	0.688 (0.191, 2.478)
South Australia	9.284 ± 1.180	12.617 ± 1.314	0.736 (0.315, 1.717)
Tasmania	3.369 ± 0.498	4.364 ± 0.712	0.772 (0.186, 3.198)
Victoria	5.213 ± 0.687	7.477 ± 1.025	0.697 (0.228, 2.133)
Western Australia	6.268 ± 1.013	8.965 ± 1.053	0.699 (0.252, 1.939)

Table 5-8: Poisson Regression Models: State:Sex Interaction.

	Df	Deviance	Residual Df	Residual Deviance	Pr (chi-square statistic > χ^2)
Tonsillectomy alone					
Null Model			179	20810	
+state	4	714.76	175	20095	<0.0001
+sex	1	2214.92	174	17880	<0.0001
+state:sex	4	145.51	170	17735	<0.0001
Adenotonsillectomy					
Null Model			179	109318	
+state	4	2657.8	175	106660	<0.0001
+sex	1	363.7	174	106296	<0.0001
+state:sex	4	22.87	170	106274	0.0001
Adenoidectomy alone					
Null Model			179	40875	
+state	4	323.43	175	40551	<0.0001
+sex	1	1823.47	174	38728	<0.0001
+state:sex	4	9.77	170	38718	0.045
Myringotomy ± Tympanostomy Tube Insertion					
Null Model			179	23116	
+state	4	13942	175	21722	<0.0001
+sex	1	5969.7	174	211252	<0.0001
+state:sex	4	23.1	170	211229	0.0001

Df – degrees of freedom

5.3.5 Incidence by State, Sex and Age

The incidence profile for tonsillectomy alone was bimodal, with the peak incidence occurring in adolescents. However, when the sexes were analysed separately, it was clear that the peak incidence in adolescents was attributable largely to a higher incidence in girls of this age (Figure 5-5). In contrast, the peak incidence for boys occurred much earlier at around four to six-years-old.

For adenotonsillectomy, the shape of the incidence profile curves were very similar for the five states, however, the size of, and age at which, the peak incidences occurred differed. In all except South Australia, the peak incidence occurred at four-years-old, whereas in South Australia the peak incidence occurred one year earlier in children aged three-years-old. While these peak incidences were similar for both boys and girls, the incidence profiles were different. The incidence profile for girls who underwent adenotonsillectomy extended further into the later years (8-years-old and above) than for boys.

There was marked variability in the shape of the incidence profiles for adenoidectomy. Most noticeably, in South Australia and Western Australia, this procedure was more frequently performed on very young children (infants and toddlers) compared to the other states. In Tasmania, children underwent adenoidectomy alone at an older age. In addition, there was a large amount of variability in the incidence profiles. While each state had a different shaped profile pattern for young children, thereafter there was little difference in the incidence profiles for both boys and girls within each state. Of particular note was the age-shift seen for children that underwent the procedure in South Australia and Western Australia. This is evidenced by the shape of the incidence curve, where a greater proportion of young children can be seen.

In all but New South Wales, the peak incidence of myringotomy with/without tympanostomy tube insertion occurred in children aged one-year-old (Figure 5-6). The peak incidence in New South Wales occurred at age four-years. Surprisingly, within South Australia the incidence in one-year-olds was nearly double the incidence of any other state. However, in the latter years (after age 10-years) the incidences were more comparable between the states.

Poisson regression provided further confirmation that the frequency of these procedures was greatly influenced by the child's age (Table 5-9). Furthermore, that the child's age was closely linked to the child's sex and state of residence, as is evidenced by the statistically significant interaction terms. Importantly, children, regardless of age, who resided in South Australia, underwent this procedure more frequently than their interstate counterparts.

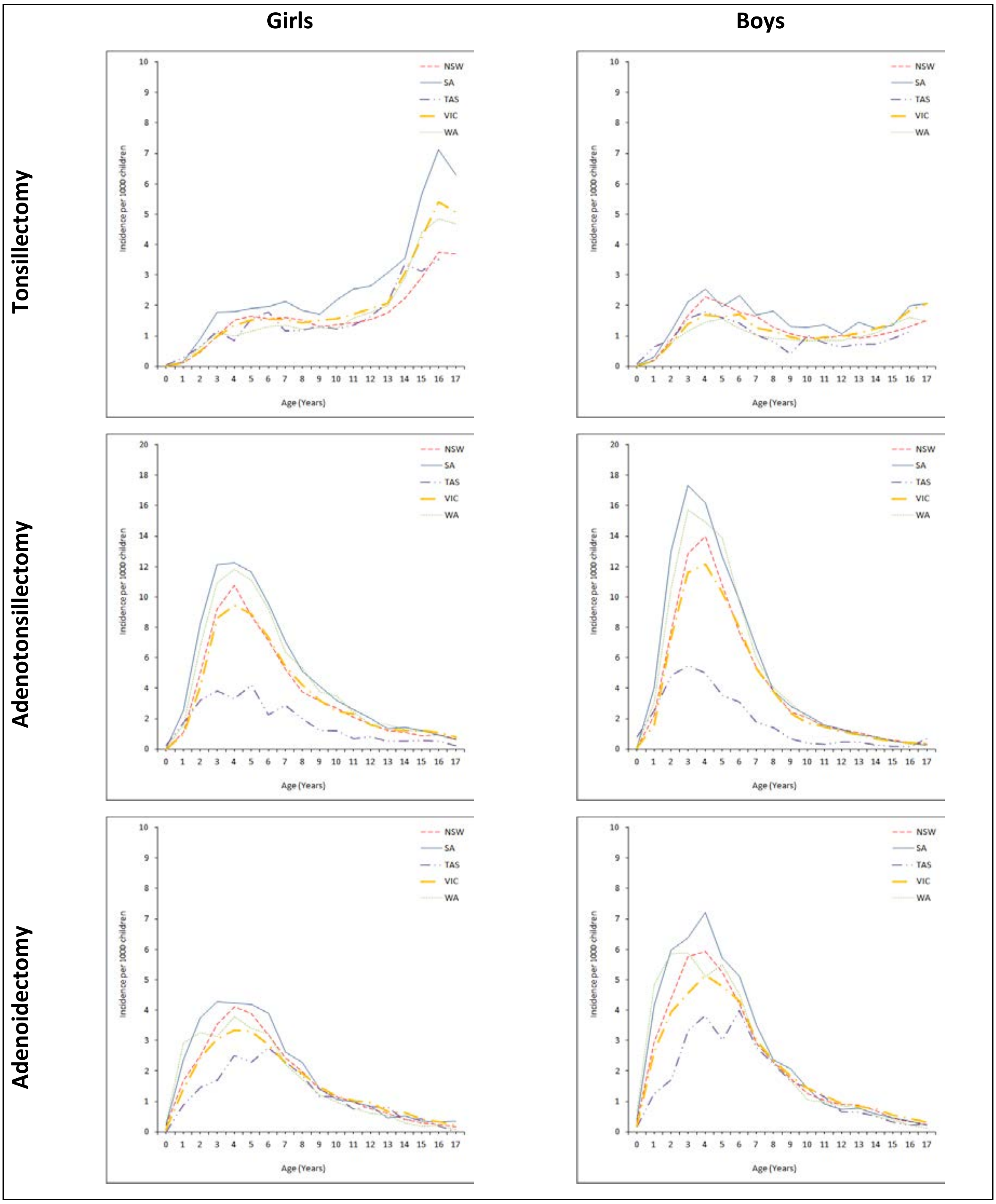


Figure 5-5: Incidence by State, Sex and Age.

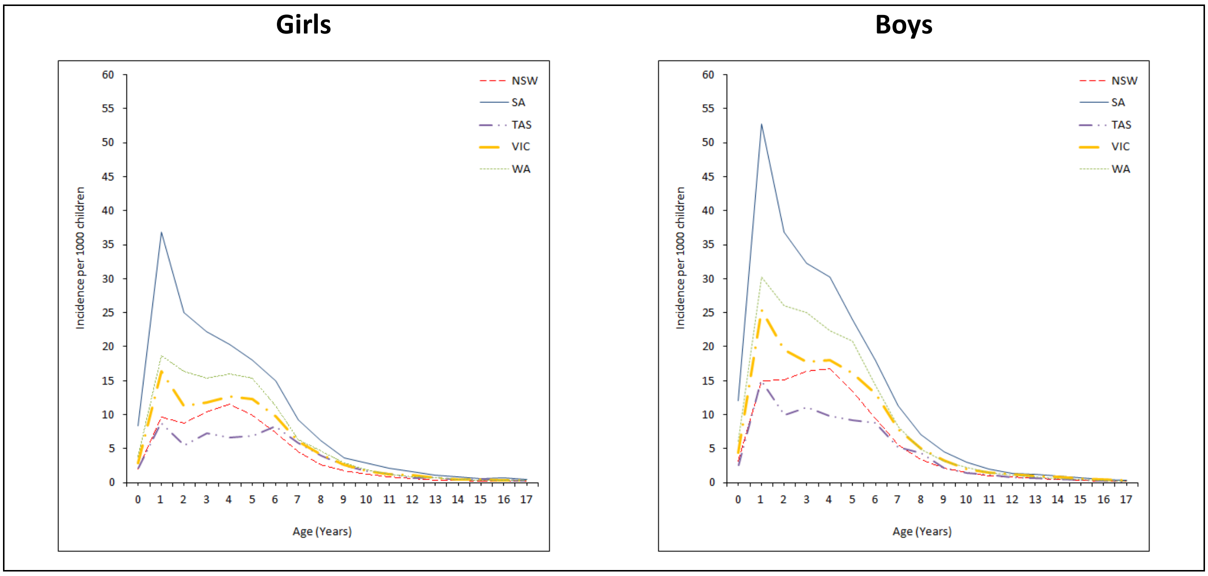


Figure 5-6: Incidence by State, Sex and Age: Myringotomy ± Tympanostomy Tube Insertion.

Table 5-9: Poisson Regression Models: State:Age and Sex:Age Interactions.

	Df	Deviance	Residual Df	Residual Deviance	Pr (chi-square statistic > χ^2)
Model: state + sex + state:sex					
Tonsillectomy alone					
			157	20810	
+age	17	14278.4	153	3456.3	<0.0001
+sex:age	17	2970.4	136	485.9	<0.0001
+state:age	68	412.2	68	73.8	<0.0001
Adenotonsillectomy					
			170	106274	
+age	17	103069	153	3205	0.0002
+sex:age	17	2524	136	681	<0.0001
+state:age	68	570	68	111	<0.0001
Adenoidectomy alone					
			170	38718	
+age	17	37719	153	999	0.048
+sex:age	17	243	136	756	<0.0001
+state:age	68	666	68	90	<0.0001
Myringotomy ± Tympanostomy Tube Insertion					
			170	211229	
+age	17	208468	153	2765	0.0007
+sex:age	17	505	136	2260	<0.0001
+state:age	68	2177	68	82	<0.0001

Df – degrees of freedom

5.3.6 Hospital Sector

A larger proportion of tonsillectomy and adenotonsillectomy were performed at public sector hospitals in both South Australia and Victoria (Table 5-10). In Victoria, adenoidectomy and myringotomy with/without tympanostomy tube insertion were also performed in greater proportions at public hospitals. However, this was not true in South Australia, where these two procedures occurred more often at private hospitals. In New South Wales and Western Australia, private hospitals were used more often for all four procedures.

These results provide an insight into where these procedures were performed within each state. However, while the proportion of children who underwent these procedures at public or private sector hospitals was significantly statistically different between the states ($p<0.0001$), this is unlikely to be of any clinical significance. Furthermore, in South Australia the size of the disparity in the proportion of cases performed at private and public hospitals was less marked than for the other states. This more balanced use of the public and private sector in South Australia does little to explain why there is a greater frequency of the procedures in South Australia.

5.3.7 Funding Source

While there are only two hospital sectors - public or private - the source of funding for the procedures, and the associated hospital admission, can come from a variety of sources. In this dataset funding sources included Australian Health Care Agreements (that is, public funding), private health insurance, Department of Veterans Affairs, Department of Defence, reciprocal health care agreements (with other countries), and self-funding.

In both New South Wales and Western Australia, the procedures were most frequently funded through private health insurance (Table 5-11) which corroborates the results reported above in Section 5.3.6. Victoria and Tasmania were similar in their sources of funding with tonsillectomy and adenotonsillectomy most often funded through the public funding system (Australian Health Care Agreements), and a larger proportion of MTTI funded through private health insurance. The exception was adenoidectomy which was funded more often through private health insurance in Victoria (47.2%), but with public funding in Tasmania (52.0%). Notably, across all states a larger proportion of myringotomy with/without tympanostomy tube insertions were funded by private health insurance.

When comparing the funding sources in South Australia to the other states a number of points become evident. In South Australia, a greater proportion of tonsillectomies (44.7%) were funded through the public system, with a similar proportion (43.7%) being funded by private health insurance. The remaining three procedures were predominantly funded with private health insurance. Most noticeably, however, was that South Australia had the highest proportion of procedures that were self-funded, that is, procedures being paid for "out-of-pocket". Over 10% of tonsillectomies were self-funded with even greater proportions for the remaining procedures: 17.3% adenotonsillectomies, 13.9% adenoidectomies, and 14.8% MTTI. Similarly, New South Wales also had proportions of self-funded cases that were greater than the other states but not to the same magnitude as South Australia. The proportion of self-funded procedures in the other states were noticeably lower, ranging from just 4.9% to 6.3% in Tasmania, up to 6.5% to 9.3% in Victoria. This indicates that a greater proportion of South Australian parents/caregivers paid for surgery "out-of-pocket" compared to the other states. However, it cannot be speculated whether this occurs as a result of parental choice or a result of service provision.

Table 5-10: Incidence by hospital sector.

		New South Wales	Victoria	South Australia	Tasmania
Tonsillectomy alone †					
Public Sector [a]	N	7,481	3,045	8,585	2558
	%	41.9%	52.9%	58.6%	46.2%
	Incidence [b]	0.59 ± 0.05	1.11 + 0.12	0.94 ± 0.06	0.68 ± 0.13
Private Sector	N	10,392	2,708	6,055	2976
	%	58.1%	47.1%	41.4%	53.8%
	Incidence	0.83 ± 0.06	0.99 ± 0.08	0.66 ± 0.05	0.79 ± 0.10
Adenotonsillectomy ‡					
Public Sector [a]	N	19,325	7,374	21,408	7,326
	%	40.0%	55.4%	63.8%	27.5%
	Incidence [b]	1.55 ± 0.33	2.72 ± 0.41	2.35 ± 0.27	1.94 ± 0.46
Private Sector	N	28,963	5,927	12,146	10,099
	%	60.0%	44.6%	36.2%	72.5%
	Incidence	2.31 ± 0.47	2.20 ± 0.35	1.34 ± 0.28	2.69 ± 0.68
Adenoidectomy alone §					
Public Sector [a]	N	7,938	2,860	9,033	2,456
	%	32.4%	46.8%	53.7%	32.4%
	Incidence [b]	0.64 ± 0.08	1.04 ± 0.12	0.99 ± 0.07	0.65 ± 0.17
Private Sector	N	16,591	3,247	7,792	5,115
	%	67.6%	53.2%	46.3%	67.6%
	Incidence	1.33 ± 0.17	1.18 ± 0.19	0.85 ± 0.11	1.36 ± 0.28
Myringotomy ± Tympanostomy Tube Insertion #					
Public Sector [a]	N	22,861	13,586	32,306	11,397
	%	37.6%	45.3%	55.3%	39.2%
	Incidence [b]	1.83 ± 0.24	4.99 ± 0.50	3.52 ± 0.59	3.01 ± 0.55
Private Sector	N	37,973	16,384	26,086	17,691
	%	62.4%	54.7%	44.7%	60.8%
	Incidence	3.04 ± 0.37	6.01 ± 0.76	2.85 ± 0.35	4.65 ± 0.54

a Hospital Sector data not provided for Tasmania
b Mean annual incidence per 1000 children
† Pearson's chi-squared test of homogeneity: $\chi2$=957.89, df=3, p<0.0001
‡ Pearson's chi-squared test of homogeneity: $\chi2$= 5054.435, df=3, p<0.0001
§ Pearson's chi-squared test of homogeneity: $\chi2$= 2194.27, df=3, p<0.0001
# Pearson's chi-squared test of homogeneity: $\chi2$=4269.04, df=3, p<0.0001

Table 5-11: Funding Sources.

Funding Source (n, %)	New South Wales	Victoria	South Australia	Tasmania	Western Australia
Tonsillectomy alone †					
Private Health Insurance	9102 (50.9%)	6213 (42.4%)	2515 (43.7%)	425 (38.7%)	2690 (48.6%)
Australian Health Care Agreements	6882 (38.5%)	7461 (51.0%)	2569 (44.7%)	472 (43.0%)	2472 (44.7%)
Self-funded	1708 (9.6%)	944 (6.5%)	588 (10.2%)	65 (5.9%)	243 (4.4%)
Other [a]	181 (1.0%)	22 (0.2%)	81 (1.4%)	137 (12.5%)	129 (2.3%)
Adenotonsillectomy ‡					
Private Health Insurance	25031 (51.8%)	12859 (38.3%)	5672 (42.6%)	599 (40.0%)	8663 (49.7%)
Australian Health Care Agreements	17107 (35.4%)	17519 (52.2%)	5206 (39.1%)	730 (48.7%)	7151 (41.0%)
Self-funded	5936 (12.3%)	3123 (9.3%)	2307 (17.3%)	94 (6.3%)	1209 (6.9%)
Other [a, b]	214 (0.4%)	53 (0.2%)	116 (0.9%)	76 (5.1%)	402 (2.3%)
Adenoidectomy alone §					
Private Health Insurance	14656 (59.7%)	7942 (47.2%)	2990 (49.0%)	477 (37.4%)	4450 (58.8%)
Australian Health Care Agreements	7260 (29.6%)	7399 (44.0%)	2204 (36.1%)	664 (52.0%)	2420 (32.0%)
Self-funded	2583 (10.5%)	1465 (8.7%)	846 (13.9%)	62 (4.9%)	521 (6.9%)
Other [a]	30 (0.1%)	19 (0.1%)	67 (1.1%)	73 (5.7%)	180 (2.4%)
Myringotomy with/without Tympanostomy Tube Insertion #					
Private Health Insurance	33178 (54.5%)	27136 (46.5%)	14714 (49.1%)	1580 (43.9%)	15055 (51.8%)
Australian Health Care Agreements	20611 (33.9%)	26186 (44.8%)	10516 (35.1%)	1561 (43.4%)	11199 (38.5%)
Self-funded	6805 (11.2%)	4981 (8.5%)	4429 (14.8%)	179 (5.0%)	2271 (7.8%)
Other [a]	240 (0.4%)	89 (0.2%)	311 (1.0%)	280 (7.8%)	563 (1.9%)

a Other includes: Other compensation (eg. public liability, common law, medical negligence), Department of Veterans Affairs, Reciprocal health care agreements (with other countries), Motor vehicle third party personal claim, Department of Defence, Workers Compensation, Other, Not known

b Other includes: Reciprocal health care agreements (with other countries)

† Pearson's chi-squared test of homogeneity: $\chi2=2006.4$, df=12, $p<0.0001$

‡ Pearson's chi-squared test of homogeneity: $\chi2=4334.4$, df=12, $p<0.0001$

§ Pearson's chi-squared test of homogeneity: $\chi2=2404.0$, df=12, $p<0.0001$

Pearson's chi-squared test of homogeneity: $\chi2=5635.1$, df=12, $p<0.0001$

5.3.8 Cumulative Incidences

The cumulative incidence of tonsillectomy, adenoidectomy, and adenotonsillectomy in South Australia far exceeded the cumulative incidence of these procedures in the other states (Figure 5-7). It is clear the apparent 'excesses' in South Australia increased consistently with age, and that there is no obvious age-year at which these patterns were remarkably different for South Australia compared to the other states. Within South Australia, by the time the age of 18-years, 36.9 children in every 1,000 have undergone tonsillectomy alone – a figure that exceeds the other states (Table 5-12). By age 18-years, 90.3 per 1,000 South Australian children have undergone an adenotonsillectomy a figure that is nearly three-times as large as that for Tasmania and approximately 30% greater than in Victoria and New South Wales. For adenoidectomy, by the time South Australian children reach 18-years-old, approximately 41 per 1,000 children have undergone the procedure.

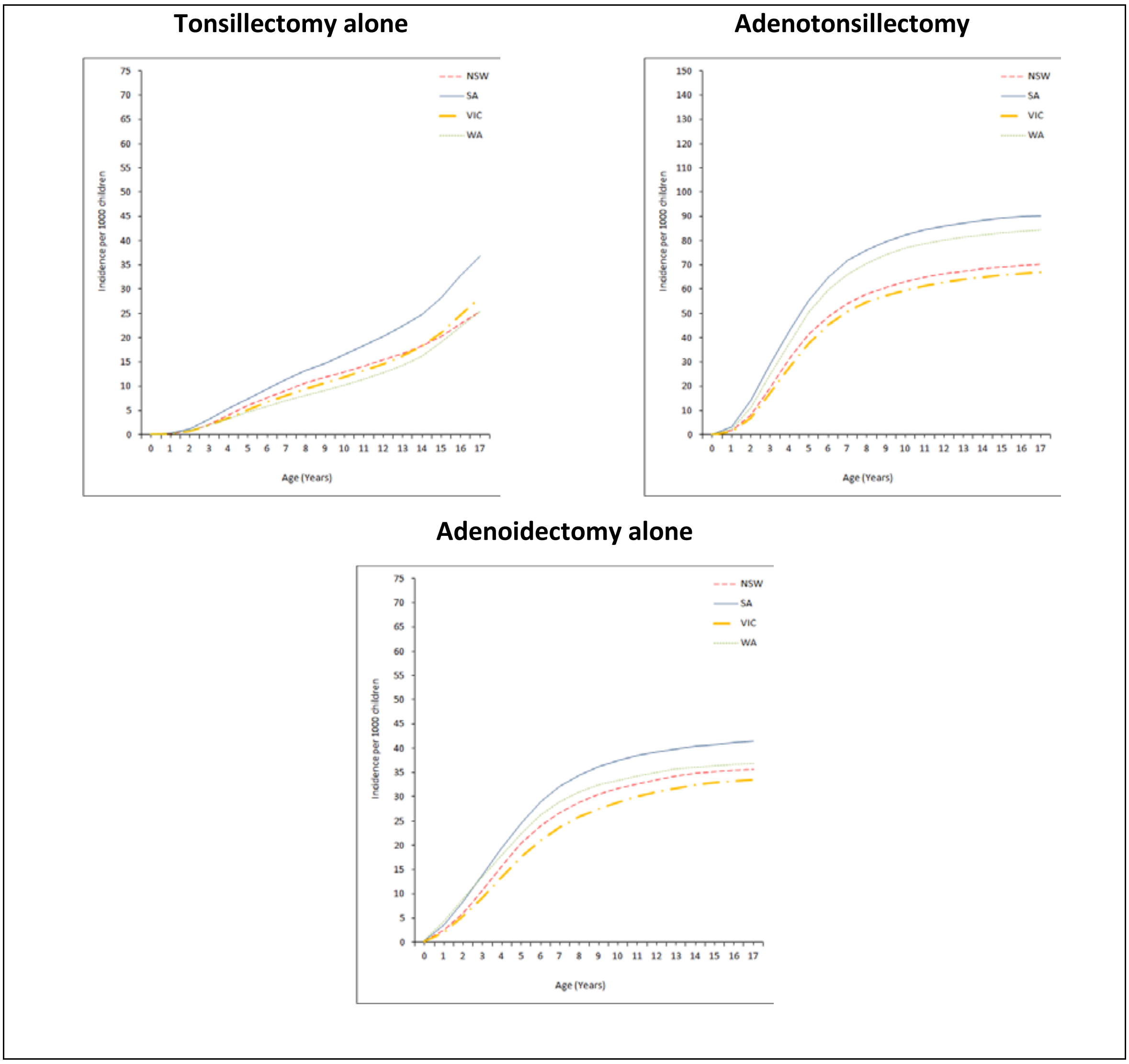


Figure 5-7: Cumulative Incidence by State of Residence.

Table 5-12: Cumulative incidence, by age 18-years.

State	Cumulative incidence	
Tonsillectomy alone	**per 1,000 18-year-olds**	**95% confidence intervals**
New South Wales	25.45	(1.4, 75.33)
South Australia	36.85	(2.04, 91.79)
Tasmania	21.21	(1.12, 68.86)
Victoria	28.22	(1.57, 79.78)
Western Australia	25.35	(1.4, 75.79)
Adenotonsillectomy		
New South Wales	70.34	(3.81, 125.32)
South Australia	90.28	(4.76, 141.23)
Tasmania	31.08	(1.54, 80.66)
Victoria	67.05	(3.61, 122.02)
Western Australia	84.38	(4.46, 136.47)
Adenoidectomy alone		
New South Wales	35.70	(1.93, 88.53)
South Australia	41.44	(2.17, 94.64)
Tasmania	25.45	(1.31, 74.3)
Victoria	33.55	(1.8, 85.65)
Western Australia	36.76	(1.92, 88.94)

5.3.9 Socioeconomic Profile of Population

The socioeconomic profiles of the children who underwent these procedures were different from the overall socioeconomic profile of their residential state. This can be clearly seen by the deviation (percentage difference) between the observed and expected incidences for each SEFIA group (Figure 5-8). From the literature review, it is clear that children across socioeconomic sectors do not have the same likelihood of undergoing ear, nose, and throat (ENT) surgery – therefore intervention should likewise be related to socioeconomic status. As expected, the socioeconomic profile of surgery does not mirror that of the underlying population (Table 5-13 to Table 5-16). For both tonsillectomy and adenotonsillectomy it is clear that there was an under-representation of children from the least disadvantaged fifth, that is, these procedures were less frequently performed on the most affluent children. In contrast, adenoidectomy and MTTI were performed more often than expected in the most affluent children, and less often than might be expected in the most disadvantaged children. Aside from these noticeable under- and over-representations, there was no definitive discernible pattern across the middle SEIFA scores. Although the size of the deviations seen for Tasmania are notable (representation of the lowest SEIFA group approximately 20% greater than expected for all procedures), these results may be less reliable given the smaller study population and much lower incidences seen for this state. The only clear conclusion that can be drawn is that within each state some socioeconomic populations have a greater frequency of tonsillectomy than others, but that there is no consistent pattern for the Australian states studied herein.

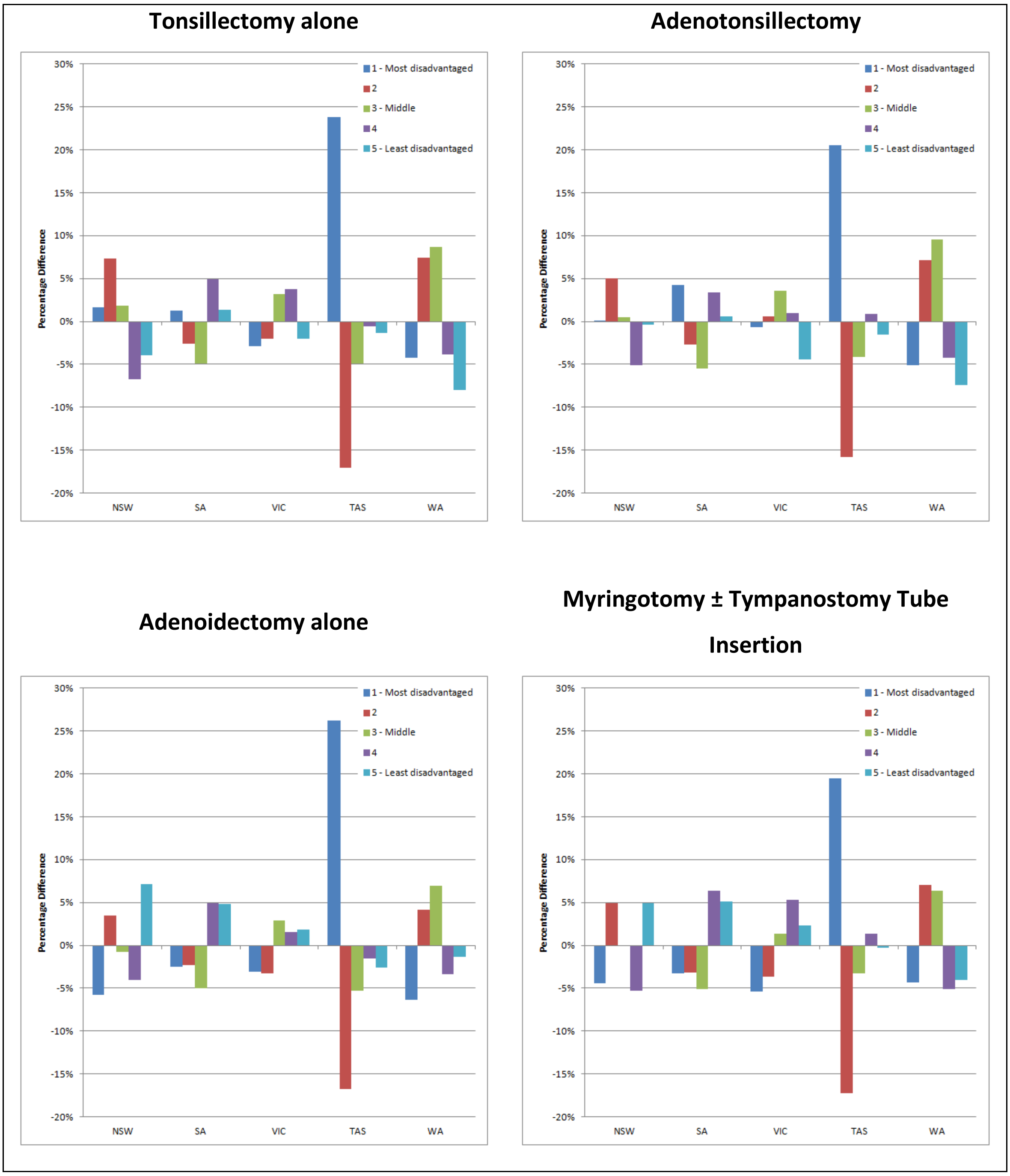


Figure 5-8: Percentage Difference between Observed and Expected Cases.

Table 5-13: Socioeconomic Profile: Tonsillectomy alone.

SEIFA IRSD	New South Wales		South Australia		Victoria		Tasmania		Western Australia	
	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)
Most Disadvantage	4303	1568.2	1572	417.4	2133	929.7	628	166.2	594	324.1
	24.1%	22.5%	27.3%	26.0%	14.6%	17.5%	57.3%	33.4%	10.7%	14.9%
2	4829	1380.4	1218	380.6	2350	960.1	91	125.9	1488	422.7
	27.1%	19.8%	21.2%	23.7%	16.1%	18.1%	8.3%	25.3%	26.9%	19.5%
3	3484	1237.7	787	298.3	3599	1137.3	173	102.8	1542	417.3
	19.5%	17.7%	13.7%	18.6%	24.6%	21.4%	15.8%	20.7%	27.9%	19.2%
4	1934	1227.7	1378	305.9	3870	1204.6	146	69.0	992	473.3
	10.8%	17.6%	24.0%	19.1%	26.4%	22.7%	13.3%	13.9%	17.9%	21.8%
Least Disadvantage	3304	1570.1	797	201.1	2688	1082.0	59	33.6	916	533.8
	18.5%	22.5%	13.9%	12.5%	18.4%	20.4%	5.4%	6.76%	16.6%	24.6%
Total	17854	6984.1	5752	1603.3	14640	5313.7	1097	497.5	5532	2171.2

SEIFA - Socio-Economic Indexes for Areas
IRSD – Index of Relative Socioeconomic Disadvantage
ERP = estimated resident population
Tobs = observed number of cases from AIHW National Hospital Morbidity Database

Table 5-14: Socioeconomic Profile: Adenotonsillectomy.

SEIFA IRSD	New South Wales		South Australia		Victoria		Tasmania		Western Australia	
	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)
Most Disadvantage	10850	1568.2	4029	417.4	5658	929.7	807	166.2	1719	324.1
	22.5%	22.5%	30.3%	26.0%	16.9%	17.5%	54.0%	33.4%	9.9%	14.9%
2	11959	1380.4	2802	380.6	6247	960.1	142	125.9	4627	422.7
	24.8%	19.8%	21.1%	23.7%	18.6%	18.1%	9.5%	25.3%	26.6%	19.5%
3	8762	1237.7	1744	298.3	8376	1137.3	247	102.8	5017	417.3
	18.2%	17.7%	13.1%	18.6%	25.0%	21.4%	16.5%	20.7%	28.8%	19.2%
4	5999	1227.7	2984	305.9	7916	1204.6	221	69.0	3065	473.3
	12.4%	17.6%	22.4%	19.1%	23.6%	22.7%	14.8%	13.9%	17.6%	21.8%
Least Disadvantage	10677	1570.1	1740	201.1	5357	1082.0	78	33.6	2990	533.8
	22.1%	22.5%	13.1%	12.5%	16.0%	20.4%	5.2%	6.76%	17.2%	24.6%
Total	48247	6984.1	13299	1603.3	33554	5313.7	1495	497.5	17418	2171.2

SEIFA - Socio-Economic Indexes for Areas
IRSD – Index of Relative Socioeconomic Disadvantage
ERP = estimated resident population
Tobs = observed number of cases from Australian Institute of Health and Welfare National Hospital Morbidity Database

Table 5-15: Socioeconomic Profile: Adenoidectomy alone.

SEIFA IRSD	New South Wales		South Australia		Victoria		Tasmania		Western Australia	
	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)
Most Disadvantage	4078	1568.2	1438	417.4	2431	929.7	760	166.2	647	324.1
	16.6%	22.5%	23.6%	26.0%	14.5%	17.5%	59.6%	33.4%	8.6%	14.9%
2	5693	1380.4	1307	380.6	2491	960.1	109	125.9	1789	422.7
	23.2%	19.8%	21.4%	23.7%	14.8%	18.1%	8.6%	25.3%	23.6%	19.5%
3	4151	1237.7	831	298.3	4094	1137.3	196	102.8	1983	417.3
	16.9%	17.7%	13.6%	18.6%	24.3%	21.4%	15.4%	20.7%	26.2%	19.2%
4	3324	1227.7	1467	305.9	4067	1204.6	157	69.0	1392	473.3
	13.6%	17.6%	24.0%	19.1%	24.2%	22.7%	12.3%	13.9%	18.4%	21.8%
Least Disadvantage	7269	1570.1	1063	201.1	3742	1082.0	53	33.6	1758	533.8
	29.7%	22.5%	17.4%	12.5%	22.2%	20.4%	4.2%	6.76%	23.2%	24.6%
Total	24515	6984.1	6106	1603.3	16825	5313.7	1275	497.5	7569	2171.2

SEIFA - Socio-Economic Indexes for Areas
IRSD – Index of Relative Socioeconomic Disadvantage
ERP = estimated resident population
Tobs = observed number of cases from Australian Institute of Health and Welfare National Hospital Morbidity Database

Table 5-16: Socioeconomic Profile: Myringotomy ± Tympanostomy Tube Insertion.

SEIFA IRSD	New South Wales		South Australia		Victoria		Tasmania		Western Australia	
	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)	Tobs N (%)	ERP '000 (%)
Most Disadvantage	10957	1568.2	6829	417.4	7063	929.7	1900	166.2	3073	324.1
	18.0%	22.5%	22.8%	26.0%	12.1%	17.5%	52.9%	33.4%	10.6%	14.9%
2	14987	1380.4	6166	380.6	8419	960.1	288	125.9	7717	422.7
	24.7%	19.8%	20.6%	23.7%	14.4%	18.1%	8.0%	25.3%	26.5%	19.5%
3	10743	1237.7	4041	298.3	13302	1137.3	626	102.8	7433	417.3
	17.7%	17.7%	13.5%	18.6%	22.8%	21.4%	17.4%	20.7%	25.6%	19.2%
4	7460	1227.7	7633	305.9	16353	1204.6	548	69.0	4864	473.3
	12.3%	17.6%	25.5%	19.1%	28.0%	22.7%	15.3%	13.9%	16.7%	21.8%
Least Disadvantage	16654	1570.1	5300	201.1	13255	1082.0	232	33.6	5985	533.8
	27.4%	22.5%	17.7%	12.5%	22.7%	20.4%	6.5%	6.76%	20.6%	24.6%
Total	60801	6984.1	29969	1603.3	58392	5313.7	3594	497.5	29072	2171.2

SEIFA - Socio-Economic Indexes for Areas

IRSD – Index of Relative Socioeconomic Disadvantage

ERP = estimated resident population

Tobs = observed number of cases from Australian Institute of Health and Welfare National Hospital Morbidity Database

5.3.10 ENT Consultant Workforce

As of June 2009, there were 357 ASOHNS registered ENT surgeons (Table 5-17).The greatest proportion worked in New South Wales (35.6%), with only 0.3% working in the North Territory. These proportions reflected the distribution of the 21 million persons living in Australia – the majority (32.5%) living in New South Wales while the least (1.0%) lived in the Northern Territory. The highest incidence of surgeons per population was in the Australian Capital Territory, followed by South Australia. When compared to data reported in 1997,[339] it was clear that despite the absolute number of ENT surgeons increasing for all Australian states and territories, the incidence per population did not change greatly for each region from 1997 to 2009. While the increase in the absolute number of surgeons was the smallest in South Australia, the number per population remained amongst the highest in Australia and was almost unchanged from 1997 to 2009 (2.02 *vs*. 2.03 per 100,000 persons). The proportion of surgeons in relation to the incidence of paediatric tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion are presented in Table 5-18. Despite Western Australia having the smallest number of surgeons per population, in 2009 this state had highest incidence of adenoidectomy alone and adenotonsillectomy (Figure 5-9). South Australia had both the highest number of surgeons per population and the highest incidence of tonsillectomy alone and myringotomy with/without tympanostomy tube insertion.

Table 5-17: Surgeons and Total Population, by State/Territory, 1997 and 2009.

State/Territory	1997 *			2009 #				
				Surgeons		Population '000		n/100,000
	n	n/100,000	%	n	%	n	%	
New South Wales	93	1.51	34.3%	127	35.6%	7,100.0	32.5%	1.79
Victoria	73	1.61	26.9%	89	24.9%	5,428.0	24.8%	1.64
Queensland	48	1.45	17.7%	61	17.1%	4,407.0	20.2%	1.38
South Australia	30	2.02	11.1%	33	9.2%	1,623.0	7.4%	2.03
Western Australia	21	1.2	7.7%	29	8.1%	2,237.0	10.23%	1.30
Tasmania	6	2.2	2.2%	9	2.5%	502.6.0	2.3%	1.79
Australian Capital Territory	0	-	-	8	2.2%	351.2	1.6%	2.28
Northern Territory	0	-	-	1	0.3%	224.8	1.0%	0.44
Total	271	1.48	100.0%	357	100.0%	21,873.6	100.0%	1.63

*Source: Adapted from Table 4, AMWAC report 1997 [339]
#Source: Adapted from ASOHNS, June 2009 [337]; ABS ERP, June 2009 [306]

Table 5-18: Incidence of otolaryngological surgeons compared to incidence of surgical procedures, 2009.

State	ENT surgeons*	Procedures per 1,000 †			
	n/100,000	T	A	T&A	M ±TTI
New South Wales	1.79	1.38	1.96	4.61	4.18
South Australia	2.03	2.15	1.85	6.17	9.72
Tasmania	1.79	1.60	1.25	2.55	2.71
Victoria	1.64	1.54	1.99	4.62	5.20
Western Australia	1.30	1.75	2.58	6.56	7.14

* Calculated using data from: ASOHNS 2009, ABS ERP as of June 2009
† Calculated using data from: Australian Institute of Health and Welfare incidences, 2009
T – tonsillectomy alone, A – adenoidectomy alone, T&A – adenotonsillectomy
M ±TTI – myringotomy with/without tympanostomy tube insertion
ERP = estimated resident population

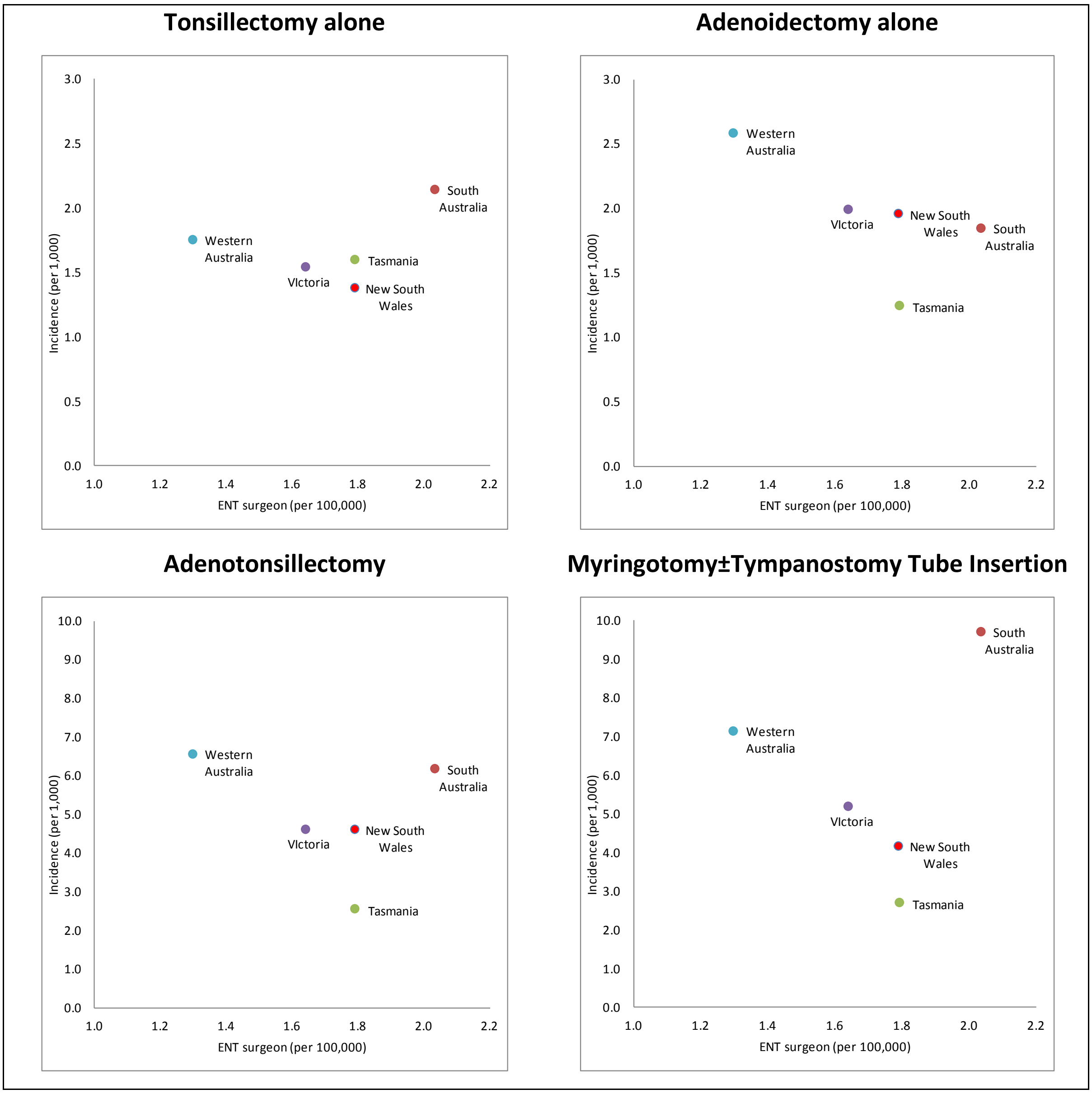


Figure 5-9: Ratio of otolaryngological surgeons per population to the incidence of surgical procedures per population, 2009.

5.4 DISCUSSION

The results presented in this chapter provide a detailed description of the epidemiology of tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion performed on children living within five Australian states during the period spanning 2001 to 2009. The results undoubtedly show that the incidence of these procedures was significantly higher in South Australia than in the other states. Yet despite this definitive discrepancy, there continues to be no clearly defined reason to explain South Australia's greater frequency. What was identified, however, was that there was a definitive link between incidence of surgery and age, sex, and state of residence.

The age-specific incidence profiles highlighted differences in the ages of the children that underwent these procedures. Children in South Australia underwent the procedures at a younger age than in the other states. This was particularly noticeable for myringotomy with/without tympanostomy tube insertion where the profile of the children was significantly different between the states (ranging from a mean age of 3.9-years-old in South Australia to 4.8-years-old in Tasmania). In addition, children that underwent adenoidectomy in South Australia were younger than most other states (except Western Australia). Despite this, there were underlying similarities in the sex-specific profiles of the children who underwent these procedures. For example, across all states, tonsillectomy alone was more frequently performed on girls, with a consistent predominance of adolescent girls that underwent this procedure seen for all the states. Similarly, across Australia, boys underwent adenotonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion much more frequently than girls. There were also differences in the hospital sector usage and the funding of procedures, but with little noticeable pattern in the socioeconomic status of the children between the states. By investigating the incidence of these procedures in depth, it has become clear that there are underlying relationships between these surgical interventions and the determinants of health. In this case, these are age, gender, access, and economic inequity. These points will be henceforth discussed in more depth.

Variations in Age

The lack of a clear reason for South Australia's incidence undoubtedly leads to further questions on why South Australian children underwent these procedures in such frequency. In fact, almost twice as many infants residing in South Australia underwent myringotomy with/without tympanostomy tube insertion compared to other states. And while in all but New South Wales, the greatest frequency of this procedure occurred in one-year-old children, children aged four to five-years-old also appeared to have a propensity to undergo the procedure. These ages correspond closely to the ages at which children are most commonly exposed to, and are infected with, ear and respiratory infections. But while the mechanisms of infection can explain the young age of these surgical patients; including initial disease exposure at the commencement of childcare,[315] preschool,[312] and school;[313, 314] and the anatomical and physiological anomalies of the infant Eustachian tube[344, 345] and airways;[346] these reasons cannot be extended to explain the vast variations between states.

There was no obvious age-year that could singularly explain the 'excess' incidence seen in South Australia. That is, the cumulative incidences gave no clear evidence of a particular age when more children underwent the procedures within South Australia; instead all the states had a similar pattern of increase in incidence. However, it was clear that there was an age-shift for children undergoing the procedures in South Australia. Adenotonsillectomy was performed at an earlier age in South Australia than in the other states. This age-shift also occurred, to a lesser extent, in Western Australia. Similarly, there was an age-shift in the incidence of adenoidectomy in South Australian and Western Australian children who underwent the procedure at a younger age than in most of the other states. This may suggest that there are yet-to-be-determined similarities in the patient populations, disease exposure, or treatment practices of these two states. In addition to these more obvious age-shifts, there were a greater number of younger children that underwent tonsillectomy in South Australia compared to the other states, and likewise for myringotomy with/without tympanostomy tube insertion.

Variations in Gender

Tonsillectomy alone was consistently more often performed in girls regardless of the state of residence. Additionally, the results provide further evidence of the predominance of tonsillectomy alone to be performed on adolescent girls, reaffirming the results presented in Chapter 3. The sex-specific profiles of the remaining procedures were different to that of tonsillectomy. Adenotonsillectomy was more frequently performed in boys, the bulk of children who underwent the procedure were aged between two and seven-years-old. Nearly 60% of adenoidectomies were performed on boys, a consistent finding for all five states. The proportion of boys who underwent myringotomy with/without tympanostomy tube insertion ranged from 57.8% to 60.6% across the five states. This reflects the literature which cites between 58 to 66% of myringotomy with/without tympanostomy tube insertions are performed on boys.[213, 234, 249]

Variations in Residential State

The incidence of the procedures varied considerably between the states. The most notable was for adenotonsillectomy, which had an incidence that ranged from 1.67 to 4.92 per 1,000 children, and myringotomy with/without tympanostomy tube insertion, which had an incidence that ranged from just 3.88 up to 11.00 per 1,000 children. Internationally, the incidence of myringotomy with/without tympanostomy tube insertion has been reported to range from 4.3 to 11.1 per 1,000 children.[249, 258-262] So the incidences seen across Australia were comparable with those reported in the literature.

However, while international variations might be anticipated due to societal, economical and medical differences; differences within the same country are less expected. The incidence rate ratios of the procedures of each state relative to South Australia highlighted the size of the variations between the states. For tonsillectomy alone, the incidence rate ratios for the states ranged from 57% to 76% relative to South Australia, with South Australia persisting to have the highest frequency of the procedure throughout the study period. The incidence rate ratios of adenotonsillectomy relative to South Australia were much more varied – ranging from 34% to 94%. In fact, South Australia had the highest frequency of the procedure for the majority of the study period; although, the incidence in Western Australia overtook from 2007 onwards. In comparison, the states were more equitable for adenoidectomy with incidence rate ratios. However, surprisingly, the incidence rate ratios for myringotomy with/without tympanostomy tube insertion were very low for the other states compared to South Australia. These results show that South Australia had an incidence up to three times the size of some of the other Australian states.

Variations in Healthcare Provision

The frequency of surgery must be influenced, whether intentionally or not, by those that perform the procedures. Researchers at the *Dartmouth Atlas Project* have long argued that geographical variations in healthcare delivery is the result of "supply-sensitive care"[347] stating that "*where there is greater capacity, more care is delivered – whether or not it is warranted*".[348] More recently, the authors of the *Australian Atlas of Healthcare Variation* suggested that variations in tonsillectomy hospital admissions may be due to variations in the availability of otorhinolaryngology surgeons.[349] With this in mind, the otorhinolaryngology surgical workforce within Australia, and specifically within five states, was explored. The evidence suggests that there were disparities in both the number of otorhinolaryngology surgeons servicing Australian regions and the frequency of the paediatric otorhinolaryngology surgery performed therein. In South Australia there was both a greater frequency of paediatric otorhinolaryngology surgery and a higher proportion of surgeons per population compared to the other states; whereas Western Australia, despite also having higher frequencies of these surgeries, had the lowest proportion of surgeons per capita. While the high frequency of surgery in South Australia may be explained by the Dartmouth theory of "supply-sensitive care",[348] the results for Western Australia cannot. Furthermore, the distribution of otolaryngological surgeons across Australia reflected the pattern of distribution for general practitioners across Australia (Figure 5-19). Specifically, South Australia was a state with a high proportion of general practitioners per population, while Western Australia had a low proportion.

Figure 5-19: General Practitioners per 100,000 Population, by State/Territory, 2002.

Table 9: Number of GPs (headcount) and GPs per 100,000 population, by state/territory, 2002

State/ Territory	Number	% of total number	% population	DPR*	GPs per 100,000 pop'n
		AIHW (2002)			
NSW	8,085	34.9	33.8	1:821	121.9
Vic	6,030	26.0	24.7	1:805	124.2
Qld	3,560	15.4	18.9	1:1,042	95.9
WA	2,132	9.2	9.8	1:903	110.8
SA	2,013	8.7	7.7	1:755	132.5
Tas	613	2.6	2.4	1:771	129.7
ACT	443	1.9	1.6	1:726	135.4
NT	306	1.3	1.0	1:649	154.0
Australia	**23,182**	**100.0**	**100.0**	**1:847**	**118.0**
		Medicare (2002)			
NSW	7,149	32.9	33.8	1:929	107.7
Vic	5,389	24.8	24.8	1:904	110.6
Qld	4,081	18.8	18.9	1:908	110.1
WA	2,064	9.5	9.8	1:934	107.1
SA	1,866	8.6	7.7	1:815	122.7
Tas	598	2.8	2.4	1:791	126.5
ACT	345	1.6	1.6	1:940	106.3
NT	243	1.1	1.0	1:815	122.7
Australia	**21,735**	**100.0**	**100.0**	**1:905**	**110.5**

Source: AIHW 2004, DoHA 2004 and ABS 2003

* DPR is doctor: population ratio

Source: Reproduced from AMWAC Report 2005.2 [350]

While "supply-sensitive care" may seem an unlikely phenomenon given that surgeons practice within common guidelines – whether formally stated or implicitly learned – for surgical interventions, proponents of this theory suggest it as a plausible mechanism underpinning any geographical variation in healthcare spending and use.[347, 348, 351] However, Coyte *et al.*[259] suggest that it is not the opinions of otolaryngologists that influence variation in surgical incidence between regions, but the opinions of general practitioners that were most influential. Furthermore, research has shown that the management approaches of general practitioners and paediatricians differ for children presenting with similar otolaryngological symptoms.[352, 353] Geographical variations in surgical rates may not be simply a case of "more surgeons, more surgeries" but of differences in practice and opinion. For example, research has shown that geographical differences in treatment of otitis media are associated with differences in medical training,[354] years of experience,[355] and medical practice caseload.[355] Differences in antibiotic prescribing for pharyngitis has been shown to be associated with differences in how physicians assess the clinical characteristics of patients.[356] These geographic variations in healthcare utilisation are important to identify, as it has been argued that increases in healthcare expenditure is not reflected by improvements in the quality of care provided,[351, 357] although argument to the contrary does exist.[358] Therefore, improving general practitioner behaviour, rather than surgeon behaviour, through increasing their understanding of otorhinolaryngology disease management, has been suggested as an approach to reduce unnecessary referrals.[354, 359]

Recent developments in Australian healthcare research have seen an increased focus on addressing issues of inappropriate healthcare. Strategies to improve diagnosis, treatment choices, decision-making processes, and integration of care across all clinical settings have been proposed.[360] Critically, the recent launch of Choosing Wisely Australia[361, 362] and the

Evolve programme[363] within Australia both aim to encourage patients and clinicians to have an open dialogue about the appropriateness and quality of healthcare provision. It is through these programs, as well as research projects such as *CareTrack Kids*[364-366] - a project investigating the appropriateness and safety of healthcare received by Australian children - that improvements to healthcare equity will inevitably occur. Furthermore, that the authors of the Australian Atlas of Healthcare Variation found significant variations in the standardised admission rates for both tonsillectomy and myringotomy across Australian states and territories highlights the ongoing need to investigate the underlying reasons for these variations.[349, 367] Indeed, as the author of this thesis has suggested, authors of the Australian Atlas of Healthcare Variation likewise propose that the influence of surgeons, private health insurance, and the accessibility to private hospitals may play an important role in the geographical variation of these two common childhood surgical conditions.[349, 367]

Variations in Socioeconomic Status

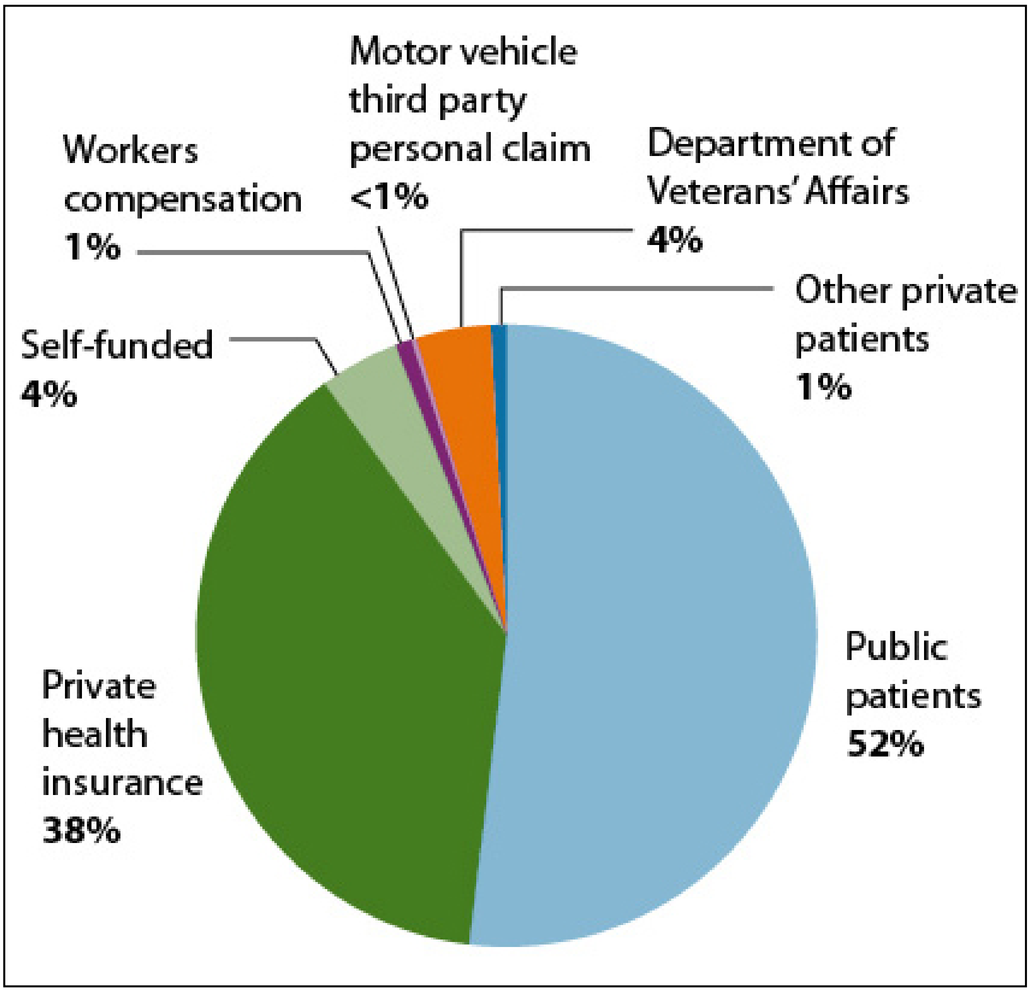
There was evidence that socioeconomic disparities for the procedures existed. Firstly, the socioeconomic profiles of the paediatric population that underwent the procedures differed between the states; and secondly, that the socioeconomic profiles were different for each of the procedures within the states. There was some evidence that tonsillectomy alone and adenotonsillectomy were more frequently performed in the lowest socioeconomic group, while adenoidectomy alone and myringotomy without/without tympanostomy tube insertion were predominantly performed in children with less disadvantage. A potential explanation of these variations is that the incidences of the underlying medical conditions are likely to similarly vary by socioeconomic status.

There was limited explanation for the large inter-state incidence discrepancies gained by the examination of the hospital sector where the procedures were performed. South

Australia had similar proportions of cases performed in public and private sector hospitals. In contrast, the other states were more reliant on one hospital sector compared to the other. In Victoria children underwent procedures more often in public sector hospitals, whereas in the other states there was a propensity for children to attend private sector hospitals. Both Western Australia and New South Wales had a much higher usage of the private sector, and this was reflected by the much higher frequency of funding by private health insurance both of these states. While the results presented herein did not explain the South Australian incidence, the results do show that there is an obvious propensity for paediatric ENT surgery to be performed in private hospitals that does not reflect the overall Australian profile of hospital sector usage.[368] Indeed, as discussed in the previous section, the authors of the *Australian Atlas of Healthcare Variation* suggest that the influence of private health insurance and access to private hospitals may play a vital role in the incidence of both tonsillectomy and myringotomy.[349, 367] They support investigating the role of surgical waiting times in the public healthcare sector, suggesting that these could be an indicator of unequal healthcare access.[349, 367]

Interestingly, a greater proportion of South Australian children underwent self-funded surgery. The proportion of self-funded adenotonsillectomy in South Australia (17.3%) was much higher than in the other states (6.3% to 12.3%). Similar differences were seen for tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion. However, the national data suggests that only 4% of hospital separations are self-funded (Figure 5-10).[368] This implies that the parents/caregivers of South Australian children opted to pay “out-of-pocket” more often than their interstate counterparts. However, despite this, in South Australia there were a greater proportion of children who resided in one or other of the lowest socioeconomic status areas. Furthermore, in all but South Australia, there was an obvious underrepresentation of children from higher socioeconomic populations suggesting that this procedure is more often performed in disadvantaged children. This seems at odds to the propensity for "out-of-pocket" payments and alludes to some other underlying economic, yet to be confirmed, explanation. While it could be posited that longer waiting times for surgery would influence parents to seek alternative options, reports of waiting times for the period 2010-11 suggest that the surgical waiting times for South Australian public hospitals were comparable to the other states. In 2010-11, South Australians waited a median of 38-days, compared to 47-days in NSW, 38-days in Tasmania, 36-days in Victoria, and 29-days in Western Australia.[369] A more recent report states that for myringotomy the median waiting list for South Australia is 56-days, compared to 135-days in Tasmania, 78-days for NSW, 65-days in Western Australia, and 47-days in Victoria;[370] while for tonsillectomy the median wait in South Australia is 76-days compared to 260-days in NSW, 219-days in Tasmania, 118-days in Western Australia, and 106-days in Victoria.[370] These low waiting times in South Australian public hospitals for tonsillectomy and myringotomy have persisted since the data commenced being reported in 2011,[371] so it seems unlikely that waiting times play a role in the variations in private surgery use between the states.

Figure 5-10: Proportion of Separations by Principal Source of Funds, 2009–10.



Source: Reproduced from AIHW (2012)[368]

Limitations

This research relies on the accuracy and comprehensiveness of the data collated from the data sources. It is assumed that data from the AIHW would be reliable and complete since reporting hospital-based data by the individual state and territory government bodies to the centralised agency is a requirement of budgetary funding from the Federal Government. However, data sourced from the ASOHNS may be less reliable. While surgeons practicing in Australia typically register with the Royal Australasian College of

Surgeons, as well as the Medical Board in their state or territory, not all surgeons register with an organisation representing their subspecialty (should one exist). For ENT surgery (otorhinolaryngology) there are several organisations, with ASOHNS being the most prominent and all-encompassing. Members of ASOHNS may also be members of other groups such as the Australasian Society of Paediatric Otorhinolaryngology[372] and the Society of Country ENT Surgeons.[373] However, it is possible that the list of registered surgeons used in this research may have been inaccurate – for example, surgeons retiring or commencing work within the study states without having been added to the database – however, it was assumed that specialists would keep their information current. Furthermore, there is also a subset of surgeons working in Australia that do not belong to ASOHNS for a number of reasons, including not being eligible due to being overseas graduates who are not eligible to join or eligible members who choose not to join. Therefore, it is acknowledged that a small proportion of surgeons will not be included in the data received from ASOHNS. However, it is an assumption that the majority would be registered with ASOHNS.

Conclusions

Marked differences were observed in the epidemiology of tonsillectomy and/or adenoidectomy, and myringotomy with/without tympanostomy tube insertion across five Australian states. There were disparities in the frequency of, and the ages at which, children underwent these procedures in the five states. There was some evidence that suggests that there were underlying socioeconomic variations, with different sources of funding used across the states, and different populations of children being under- or over-represented. The state in which a child lived, their age and sex, were clearly associated with the likelihood of undergoing these common ENT procedures.

CHAPTER 6
A Spatial Analysis of South Australia

6.1 INTRODUCTION

The preceding chapter showed that the South Australian paediatric population consistently had a much greater incidence of tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion when compared to other Australian states. Furthermore, the results showed that within South Australia, these surgical procedures were more commonly performed on younger children and that there was a greater proportion “self-funded” procedures compared to the other states. Based on these findings it was deemed that in order to better understand South Australia’s higher incidences, an analysis of the geographical distribution of these children within South Australia was warranted. Such an analysis would provide a level of understanding not previously available and an insight into where children undergoing these surgical procedures reside. In order to achieve this, a study was conducted to investigate the geographical distribution of these surgical procedures across South Australia.

6.1.1 Aims and Objectives

The aim of this study was to describe and compare the spatial epidemiology of tonsillectomy alone, adenoidectomy alone, adenotonsillectomy, and myringotomy with/without tympanostomy tube insertion across South Australia. The following objectives were set for this study:

1. To estimate the sex-specific standardised admission ratios (SAR) of the surgical procedures across South Australia.

2. To describe the spatial variability of the sex-specific SAR of the surgical procedures across South Australia.
3. To develop hypotheses of explanatory factors that may underpin or contribute to the spatial variability of these surgical procedures across South Australia.

6.2 METHODS

6.2.1 Study Design

A retrospective cross-sectional study was used to assess the SAR of paediatric ENT surgical procedures across South Australia between 1 January 2001 and 31 December 2007. The data used in this phase of research was a subset of the data collected as part of the study described in Chapter 3. To reiterate, that study assessed the age and sex-specific incidence of ENT surgical procedures within the South Australian paediatric population between 1997 and 2007.

Data extracted from the SA Health Integrated South Australian Activity Collection (ISAAC) and the Australian Bureau of Statistics (ABS) Census of Population and Housing (the "Census") were used to provide a visual representation of the locality of children who underwent ENT surgery. This required four stages of data handling: 1) data extraction, 2) data manipulation, 3) database compilation, and 4) data visualisation (Figure 6-1). Data were presented visually as choropleth maps – a thematic map where regions are shaded in proportion to a statistical variable, in this case, SAR.

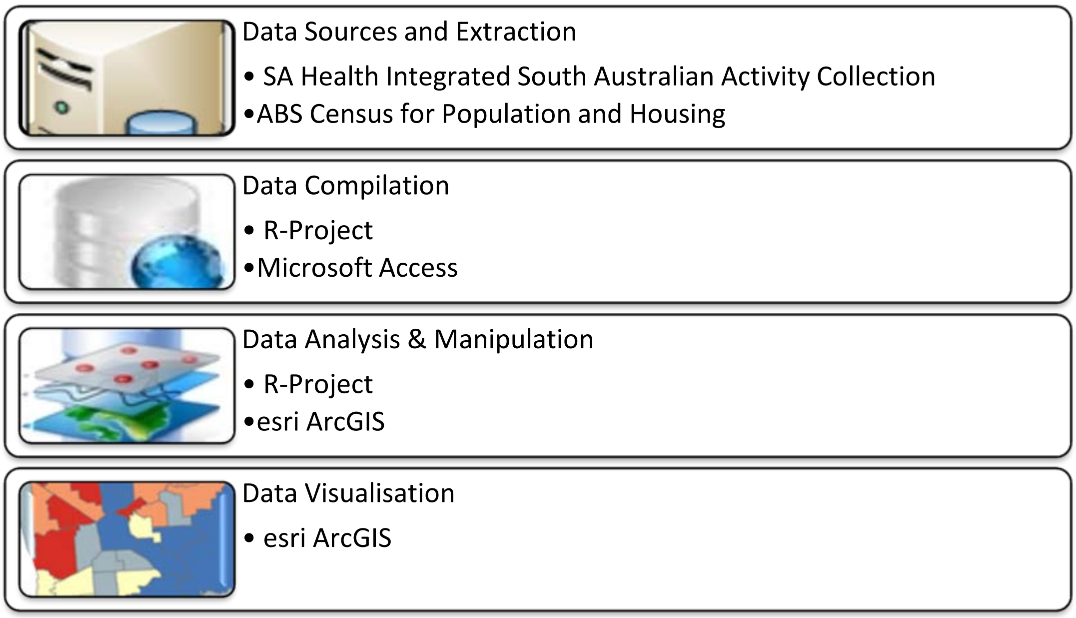


Figure 6-1: Study Process

6.2.2 Research Setting

On the night of the 2006 Census, there were 1,514,337 persons residing within South Australia,[374] with 417,191 (18.5%) children aged between 0-14-years-old.[375] In this age-group, there were 222,395 (53.3%) male children and 194,796 (46.7%) female children.[375] These South Australian children lived across an area that constitutes 12.7% of the land mass of Australia, covering 983,482km.[2,376] This geographical area can be divided into a number of different spatial units, defined by the Australian Standard Geographical Classification (ASGC).[377, 378] The two spatial units used throughout this research were the statistical local areas (SLA) and statistical divisions (SD).

A *Statistical Local Area* (SLA) is a standardised Australian spatial unit classification.[377, 378] They are the smallest geographical spatial unit, the areas do not overlap, and they provide seamless cover across Australia. Where possible, the SLAs are based on the boundaries of the incorporated local government. Land that is not administered by an incorporated local government is allocated to an unincorporated SLA. In 2006, there were 128 SLAs located within South Australia (Figure 6-2). Of these, there were 10 unincorporated SLAs and one SLA for persons who were “Offshore/Migratory”. Persons who are off-shore (e.g. oil rig, drilling platform) or who were in transit (e.g. on vessels in/between Australian ports, on-board long distance trains/bus/aircraft) on the night of the Census were listed in this SLA.

A *Statistical Subdivision* (SSD) is a standardised spatial unit that is comprised of an aggregate of SLAs. The SSDs are “socially and economically homogenous regions characterised by identifiable links between the inhabitants”.[377] There are 21 SSD units within South Australia (Table 6-1), with each of these allocated to one of eight Statistical Divisions. A Statistical Division is a large spatial unit - the largest within the States and Territories. These spatial units are the most stable and are only altered every 15 to 20 years.[377] They are more representative of regional areas and are an aggregate of SLAs within a geographically similar region.

Figure 6-2: South Australian Statistical Local Areas

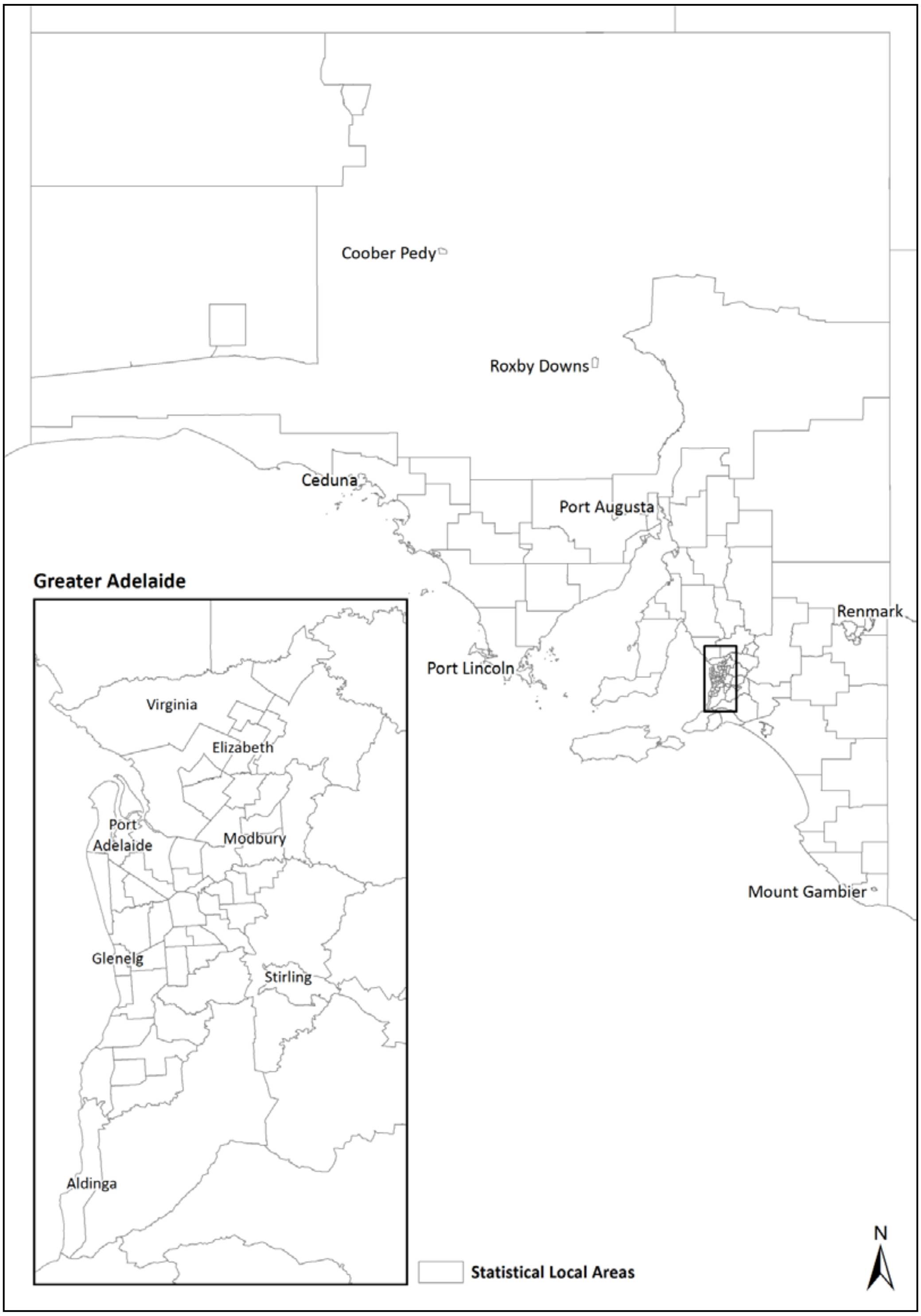


Table 6-1: South Australia Statistical Divisions and Subdivisions.

Statistical Divisions	Statistical Subdivisions
Adelaide	Northern Adelaide
	Western Adelaide
	Eastern Adelaide
	Southern Adelaide
Outer Adelaide	Barossa
	Kangaroo Island
	Mt Lofty ranges
	Fleurieu
Yorke and Lower North	Yorke
	Lower North
Murray Lands	Riverland
	Murray Mallee
South East	Upper South East
	Lower South East
Eyre	Lincoln
	West Coast
Northern	Whyalla
	Pirie
	Flinders Ranges
	Far North
Off-Shore Areas and Migratory	Off-Shore Areas and Migratory

6.2.3 Data Extraction

All hospital separations recorded in the ISAAC database for the study period, and that met the inclusion and exclusion criteria, were included in the study. The inclusion and exclusion criteria were previously described in Section 3.2.3. The method used to extract data from the ISAAC database was previously described in Section 3.2.3. The extracted dataset included the fields as previously described in Section 3.2.4, as well as the child's residential Statistical Local Area. Age and sex-specific population data for the 2001 and 2006 Census were downloaded from the ABS website for each South Australian Statistical Local Area (SLA). A number of SLAs had a very low population count on the night of the Census and because of this the ABS did not make the data available for these locations (Table 6-2). As a result, these areas could not be included in any further analyses.

Table 6-2: Statistical Local Areas with Census Data Unavailable.

SLA Code	SLA Name	Census Year with Unavailable Data
405108899	Unincorporated Western	2001, 2006
415058969	Unincorporated Yorke	2001, 2006
420109109	Unincorporated Murray Mallee	2001, 2006
430059179	Unincorporated Lincoln	2001, 2006
435254000	Maralinga Tjarutja (AC)	2006, SLA not used in 2001 Census
485019779	Off-Shore Areas	2001, 2006
499999499	No Usual Address	Not included in this study

AC - Aboriginal Council

There was little change in the number, size and definition of SLAs between the 2001 and 2006 Census. There was an increase from 124 SLAs in 2001,[378] to 128 SLAs in 2006.[377] Table 6-3 provides a summary of these changes. To facilitate the calculation of the inter-Censual population estimates, the new 2006 SLA areas were combined back into the regions they were created from. These researcher-derived 2006 "SLAs" were geographically comparable to the 2001 equivalent, which allowed for the interpolation described in Section 3.

Table 6-3: Summary of Changes to Statistical Local Areas from 2001 to 2006.

SLA Code	SLA Name	Nature of Change
435250250	Anangu Pitjantjatjara (AC)	Created from Unincorporated Far North [2001 SLA 435259589]
535254000	Maralinga Tjarutja (AC)	Created from Unincorporated Far North [2001 SLA code 435259589]
405105896	Port Adelaide Enfield - Park (C)	Created from Port Adelaide Enfield - Port (C) [2001 SLA code 405105898]
405105897	Port Adelaide Enfield - Port (C)	Recoded from 405105898
499999499	No Usual Address	New code

AC - Aboriginal Council, C - Cities

6.2.4 Database Structure

A database was created that included details of each South Australian SLA (except as previously described, where an SLA was combined back into the region it was created from); sex-specific procedural data (observed cases, expected cases, SAR); accessibility data (ARIA); and socioeconomic data (IRSD scores, deciles and percentages). The database was created using Microsoft Access 2010 (Microsoft Corporation Pty Ltd, Redmond, Washington, USA).

6.2.5 Data Manipulation and Analysis

Age and sex-specific incidences were calculated for each surgical procedure using matched denominators from the ABS Census. The observed and expected number of hospital separations within each SLA was calculated. Standardised admission ratios were calculated for each SLA within South Australia. These analyses were performed using R-

Project (Version 2.14.1, 22 December 2011, The R Foundation for Statistical Computing, Vienna, Austria). Calculations of the 95% confidence intervals were calculated using the method described by Breslow and Day (1987),[379] as follows:

$$\text{Lower Limit} = \left[1 - \frac{1}{9 \cdot O} - \frac{z_{\alpha/2}}{3\sqrt{O}}\right]^3 \frac{O}{E} \cdot 100$$

$$\text{Upper Limit} = \left[1 - \frac{1}{9 \cdot (O+1)} + \frac{z_{\alpha/2}}{3\sqrt{O+1}}\right]^3 \frac{O+1}{E} \cdot 100$$

where O is the observed value, E the expected value, and $Z\alpha/2$ is 1.96, that is, the number of standard deviations of the mean wherein 95% of the area of a normally distributed curves lies. Tabulated sex-specific results for each procedure (observed, expected, SARs, 95%CI) within each SLA are attached in Appendix E.

As previously discussed, there were a number of new SLAs created for the 2006 Census. However, to allow for accurate interpolation of the SLA populations, these new SLAs were “rolled into” to a 2001-equivalent SLA. Table 6-4 outlines the data manipulation performed to ensure comparability of the 2001 and 2006 population data.

Further data manipulation was performed in esri® ArcGIS™, a geographical information system (GIS) software package (Version 10.0, 2010, esri®, Redlands, CA, USA). A GIS is used to capture, store, manipulate, analyse, manage, and present spatially referenced data. The esri® GIS software stores the geometry, relationships, location, and attributes of spatial features.

Table 6-4: Summary of Data Manipulation Performed to Statistical Local Areas

SLA Code	SLA Name	Data Manipulation
435250250	Anangu Pitjantjatjara (AC)	Rolled into Unincorporated Far North [SLA code 435259589]
435254000	Maralinga Tjarutja (AC)	Rolled into Unincorporated Far North [SLA code 435259589]
405105896	Port Adelaide Enfield - Park (C)	Rolled into Port Adelaide Enfield - Port [SLA code 405105898]
405105897	Port Adelaide Enfield - Port (C)	Rolled into Port Adelaide Enfield - Port [SLA code 405105898]
420059039	Unincorporated Riverland	No ISAAC data, deleted from dataset

AC - Aboriginal Council, C – Cities

6.2.6 Data Visualisation

Chloropleth maps were generated using esri® ArcMap™, a component of the esri® ArcGIS™ suite of software. For the purposes of this research, a set of feature classes for South Australia were created by taking a subset of the Australian data readily available from the ABS.[340] The geocentric system used for this research was the Geocentric Datum of Australia (GDA94).[380] This datum is a set of geographical coordinates, that is, latitudes and longitudes, which are based on a global datum but fixed specifically to Australian reference points.

There were five choropleth classes (“groups”) used for mapping the SARs as defined in Table 6-5. Where there were fewer than 5 expected hospital admissions, or where the SAR was zero, the SLA was excluded from the map. The classes were depicted with a ‘blended hue progression’. In this case, blue (low values) and red (high values) were used as the endpoint hues, with related hues used to blend these together.

Table 6-5: Choropleth classes for data visualisation.

Standardised Admission Ratio	Choropleth Class
0.1 - 75.00	Greater than 25% lower than expected
75.01 - 95.00	Lower than expected
95.01 - 105.00	Expected
105.01 - 125.00	Higher than expected
>125.01	Greater than 25% higher than expected

6.3 RESULTS

6.3.1 Study Population

Between 2001 and 2007, there were a total of 40,805 paediatric hospital separations at South Australian hospitals that included a tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion. Unsurprisingly, as established in earlier chapters, the majority of these hospital separations were for boys. In this dataset, 22,347 (54.8%) boys had at least one of the surgical procedures during the study period.

This study population is a subset of the study population reported in detail in Chapter 3 and the age- and sex-specific incidences will not be discussed in depth here. However, a brief description of the study population that underwent each procedure in presented in Table 6-6. The characteristics of the population, including age, sex and hospital usage, closely resembles the more extensive dataset previously reported. Therefore, the author assumes that this sub-population is representative and comparable to, and that the age- and sex-specific incidence profiles would closely resemble those of, the 1997 to 2007 cohort.

Table 6-6: Demographic Profile, South Australia, 2001-2007.

	Tonsillectomy Alone [48901-00]	Adenotonsillectomy [48901-01]	Adenoidectomy Alone [41801-00]	Myringotomy +/- TTI [31626-00/1, 31632-00/1]
N	4,876	10,701	5,357	25,920
Age (mean ± SD, years)	11.39 ± 4.78	6.13 ± 3.30	6.08 ± 3.48	4.45 ± 3.03
Sex (n, %)				
Girls	3,061 (62.8%)	5,024 (46.9%)	2,183 (40.8%)	10718 (41.4%)
Boys	1,815 (37.2%)	5,677 (53.1%)	3,174 (59.2%)	15,202 (58.6%)
Separation Election (n, %)				
Publicly Funded	2,286 (46.9%)	4,268 (39.9%)	1,943 (36.3%)	9277 (35.8%)
Privately Funded	2,590 (53.1%)	6,433 (60.1%)	3,414 (63.7%)	16643 (64.2%)
Hospital Locality (n, %)				
Metropolitan hospitals	3,526 (71.3%)	9,166 (85.7%)	4,558 (85.1%)	22,039 (85.0%)
Country hospitals	1,350 (27.7%)	1,535 (14.3%)	799 (14.9%)	3881 (15.0%)
Hospital Sector (n, %)				
Public Hospital	2,646 (54.3%)	6,060 (56.6%)	2,539 (47.4%)	11,946 (46.1%)
Private Hospital	2,230 (45.7%)	4,641 (43.4%)	2,818 (52.6%)	13,974 (53.9%)
Length of Stay (median, hours) †	27.0 [4.0-75.2]	26.0 [2.0-75.0]	21.0 [1.0-40.0]	4.0 [3.0-76.0]
Incidence (per 1,000 child-years)	2.02	4.4	2.2	10.8

Notes:
Adenotonsillectomy, tonsillectomy and adenoidectomy are mutually exclusive.
Myringotomy ±TTI is not mutually exclusive – Myringotomy ±TTI may have been performed in combination with adenoidectomy (n=3161, 12.2%), adenotonsillectomy (n=2400, 9.3%) or tonsillectomy (n=488, 1.9%).
† Range reported is the shortest stay to the 99th percentile.

6.3.2 Metropolitan Adelaide

Within metropolitan Adelaide, the SARs of tonsillectomy were predominantly the same as, or lower than, that expected for both boys and girls (Map 1, Map 2). There was no pattern to where children that underwent a higher than expected frequency of tonsillectomy resided, instead SLAs with higher than expected admissions were randomly spread across Adelaide. There were only five SLAs that had a higher than expected number of admissions for boys, while girls residing in only two SLAs underwent higher than expected frequencies of the procedure.

In contrast to tonsillectomy, there was a distinct pattern in the residential locations of children that underwent adenotonsillectomy. These SLAs were predominantly in the northern and western areas of Adelaide for both boys and girls. The only exceptions were for two additional SLAs - SLAs *Holdfast Bay - South* and *Walkerville* - where boys had a higher than expected SAR, as they did for tonsillectomy alone. In comparison, the SARs for girls living in these two SLAs were lower than expected. Eastern and southern Adelaide had a frequency of adenotonsillectomy that was at, or lower than, the expected frequency (Map 3, Map 4).

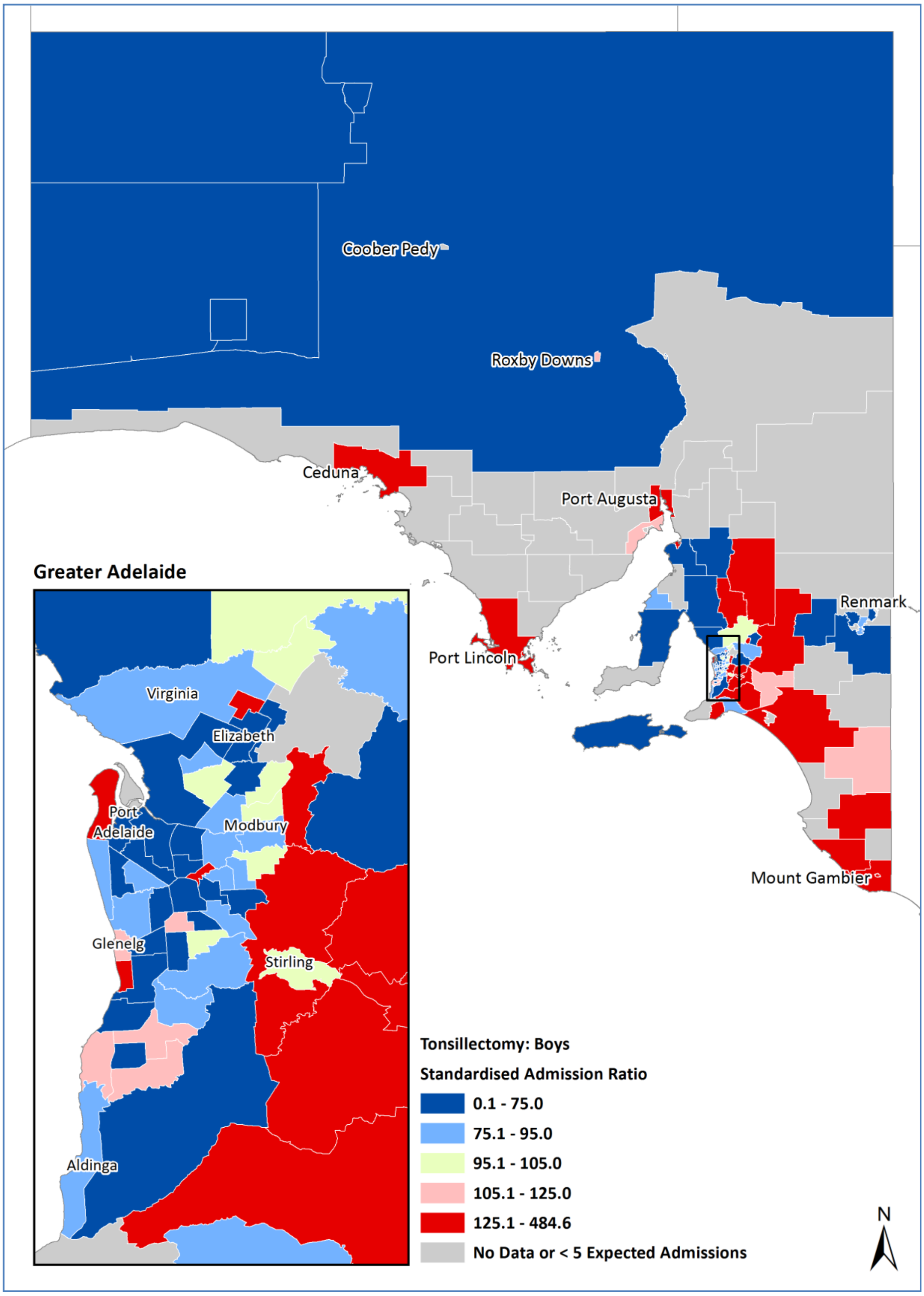
Both adenoidectomy and myringotomy with/without tympanostomy tube insertion were performed at a higher than expected frequency on children living within SLAs widely distributed across Adelaide. Predominantly, north-eastern Adelaide had higher than expected SARs of adenoidectomy performed on boys (Map 5), while for girls this occurred in south-eastern Adelaide SLAs (Map 6). In comparison, myringotomy with/without tympanostomy tube insertion was performed at a higher than expected frequency within a large number of Adelaide SLAs. However, it is visually clear that many of these SLAs are in north-eastern and south-eastern regions of Adelaide (Map 7, Map 8). Areas where both boys and girls had a higher than expected SAR were the southern areas of *Onkaparinga* -

Woodcroft and *Onkaparinga - Reservoir*, the eastern areas of *Adelaide Hills - Central* and *Unley - West*, and the western areas *Holdfast Bay - North* and *West Torrens - West*. In addition, to the north of Adelaide, the SLAs of *Port Adelaide Enfield - East*, T*ea Tree Gully - North*, *Playford - Hills*, and *Adelaide Hills - North* all had higher than expected frequencies of the procedure for both boys and girls. In contrast, the SLAs encompassing the suburbs in and around Port Adelaide and Woodville had lower or near expected SARs for both boys and girls.

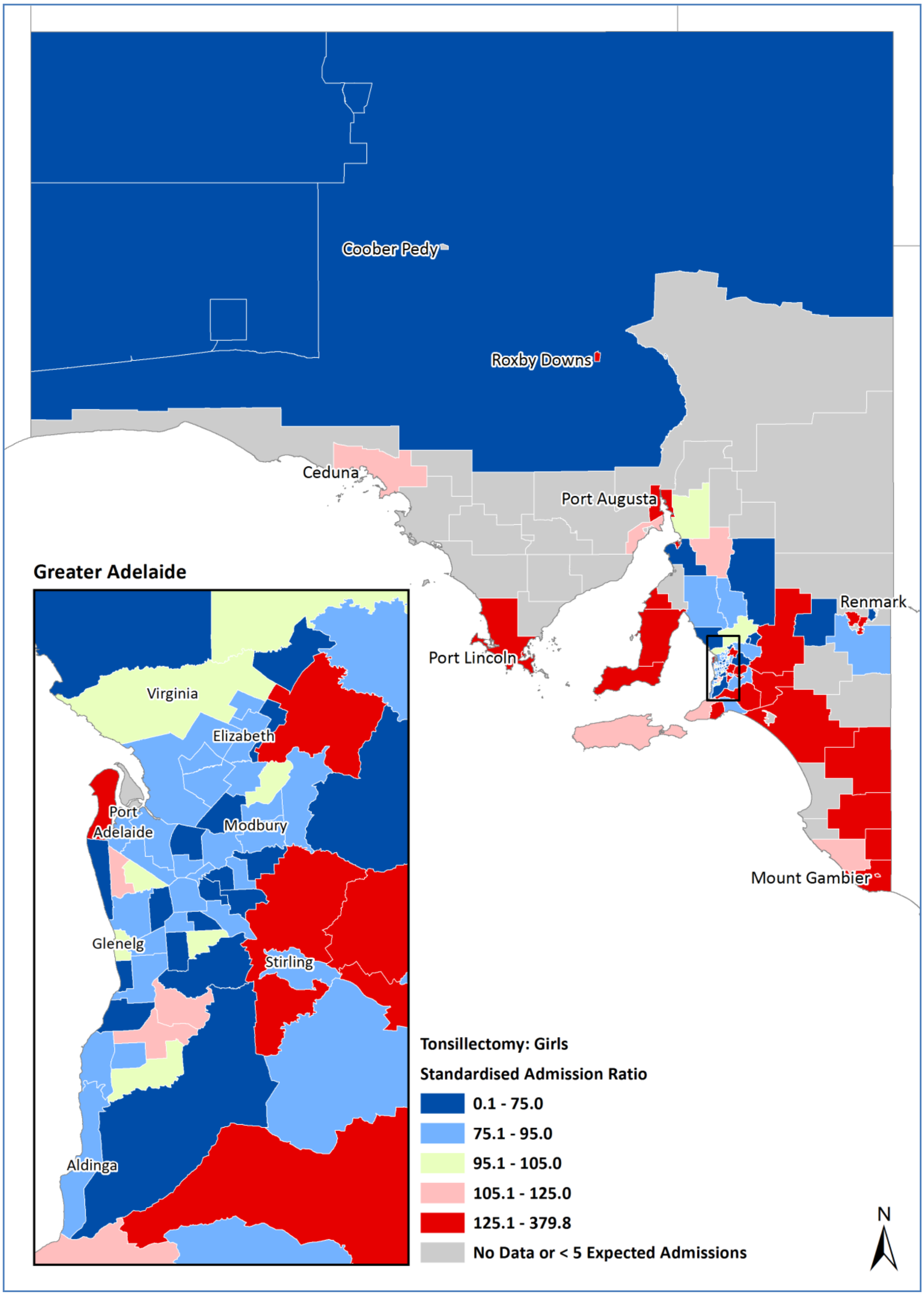
Of the Adelaide SLAs where these paediatric surgical procedures were performed, there were two where the SAR was more than 200 for one or more of the procedures. The first was the western Adelaide area of *Port Adel. Enfield (C) – Coast* where girls underwent tonsillectomy twice as often as expected. The second SLA of note was the northern Adelaide area of *Playford (C) – Hills* where the SAR for adenoidectomy, adenotonsillectomy, and myringotomy with/without tympanostomy tube insertion was more than double for both boys and girls. In fact, adenotonsillectomy and myringotomy with/without tympanostomy tube insertion was performed three times more frequently than expected for both boys and girls in this area.

Within Adelaide there were only a few areas where the SAR of tonsillectomy, adenoidectomy or adenotonsillectomy were at or lower than 75. There were no areas within metropolitan Adelaide were the frequency of myringotomy with/without tympanostomy tube insertion was substantially lower (SAR$\leq$75) than expected. The areas where adenoidectomy was much less than expected were predominantly in the eastern areas of Adelaide.

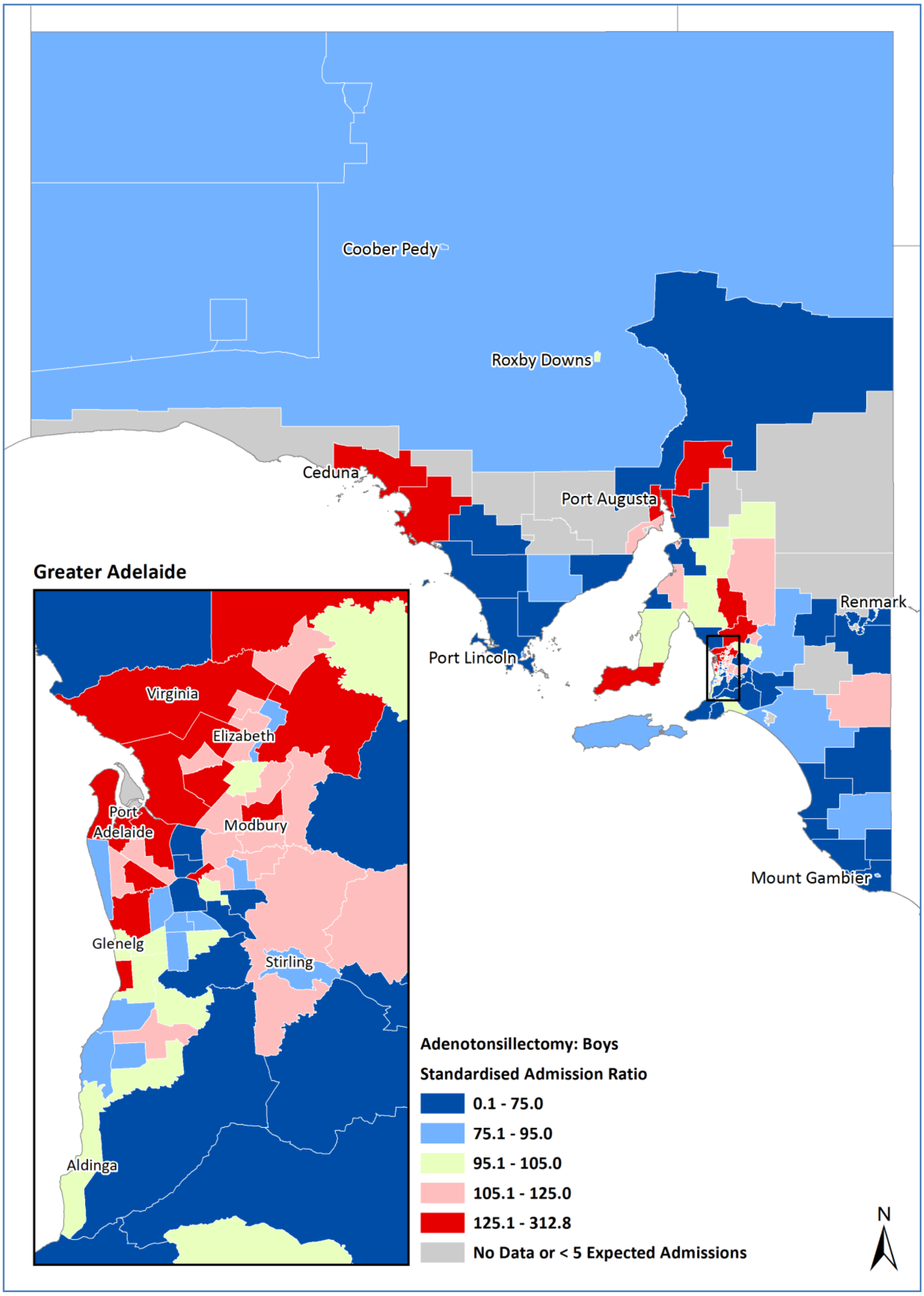
Map 1: Tonsillectomy alone - Standardised admission ratios for boys.



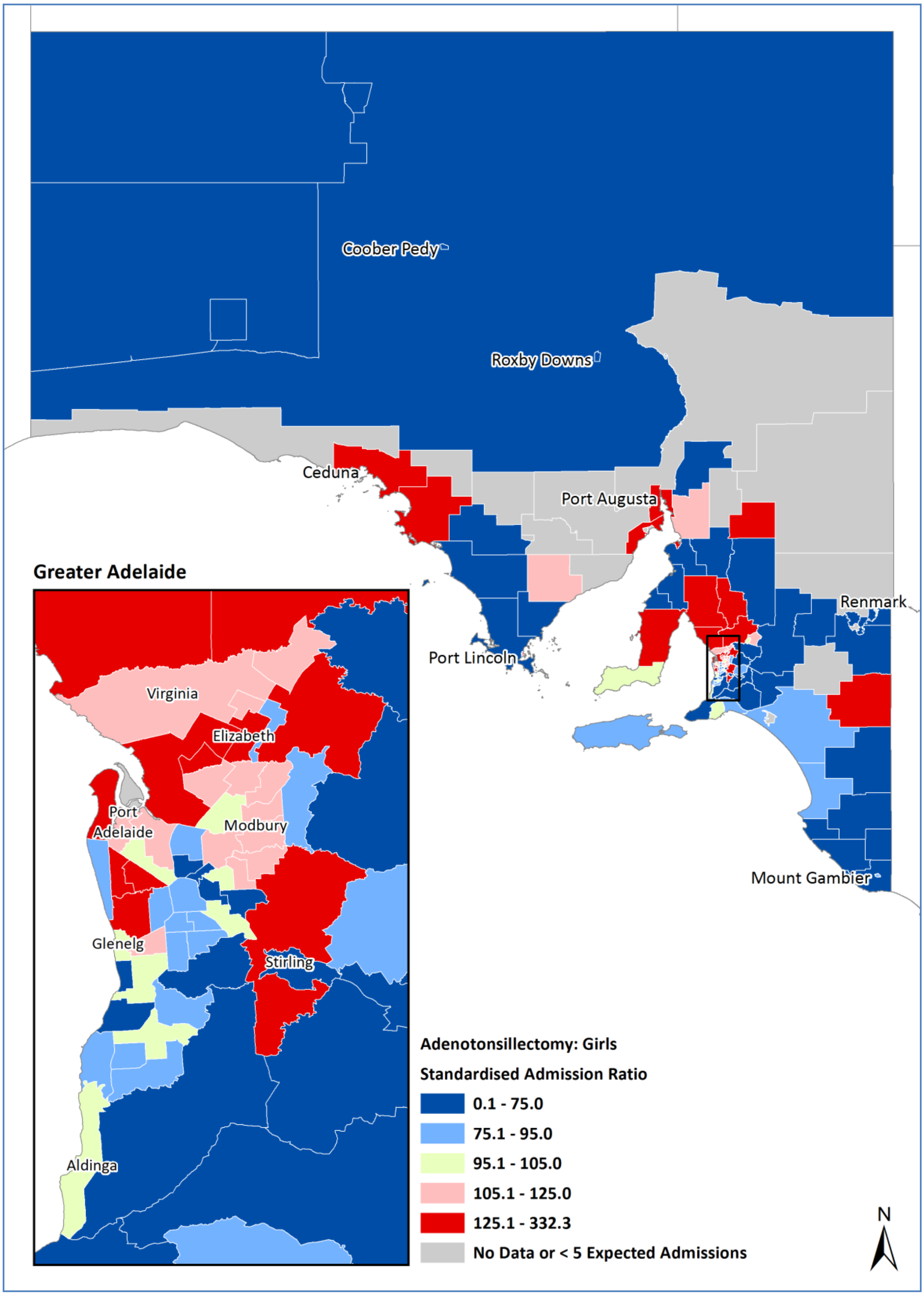
Map 2: Tonsillectomy alone - Standardised admission ratios for girls.



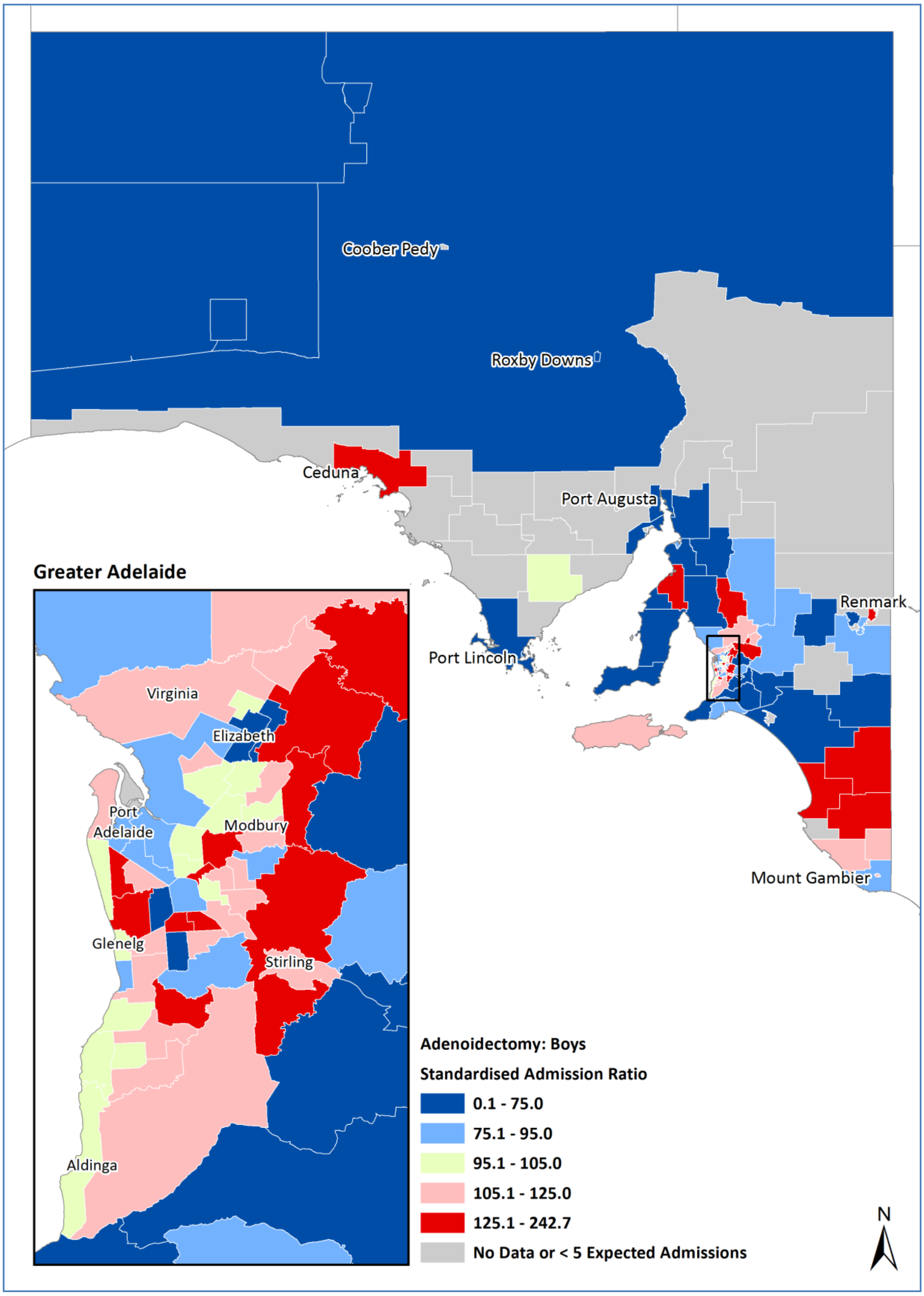
Map 3: Adenotonsillectomy - Standardised admission ratios for boys.



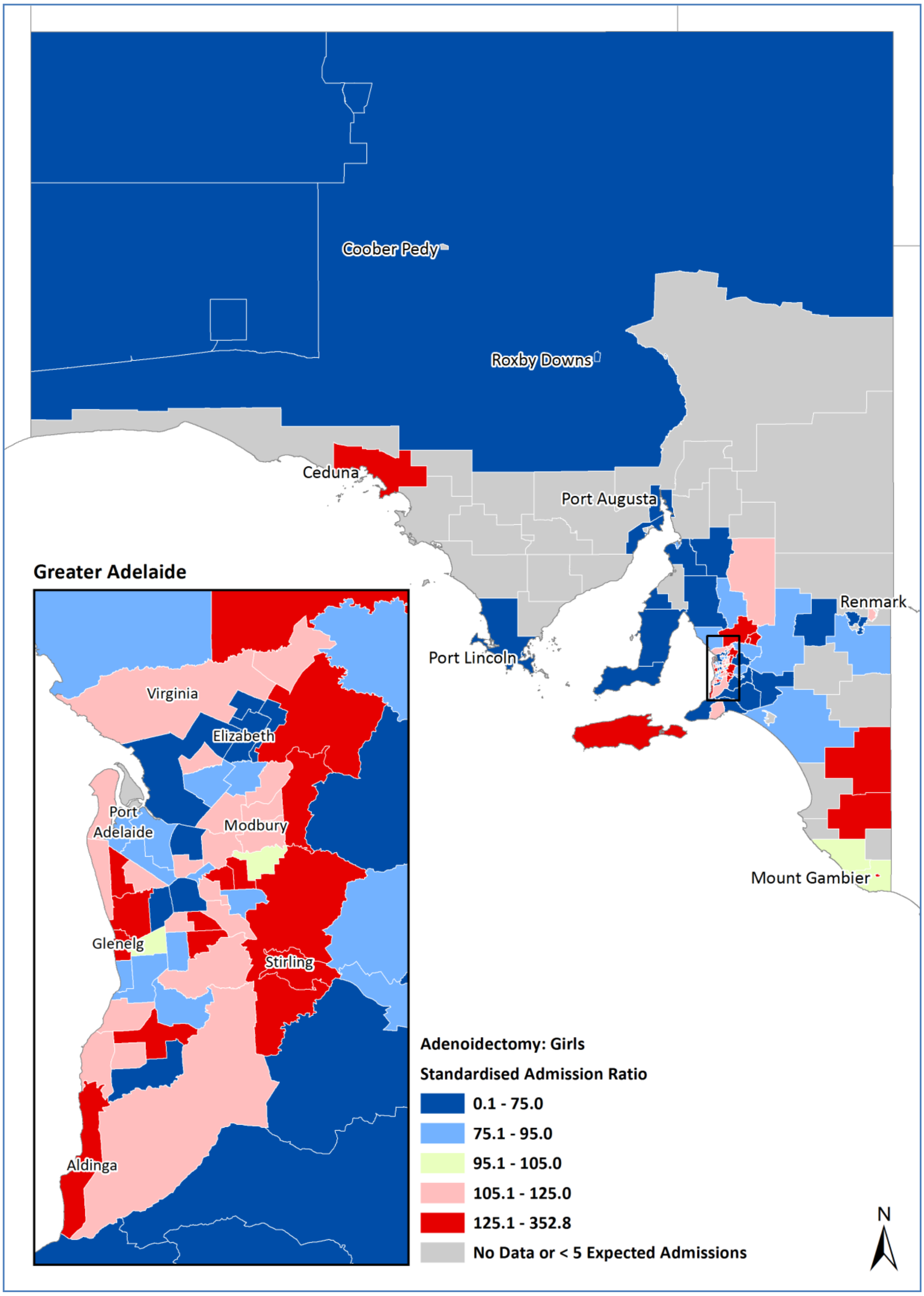
Map 4: Adenotonsillectomy - Standardised admission ratios for girls.



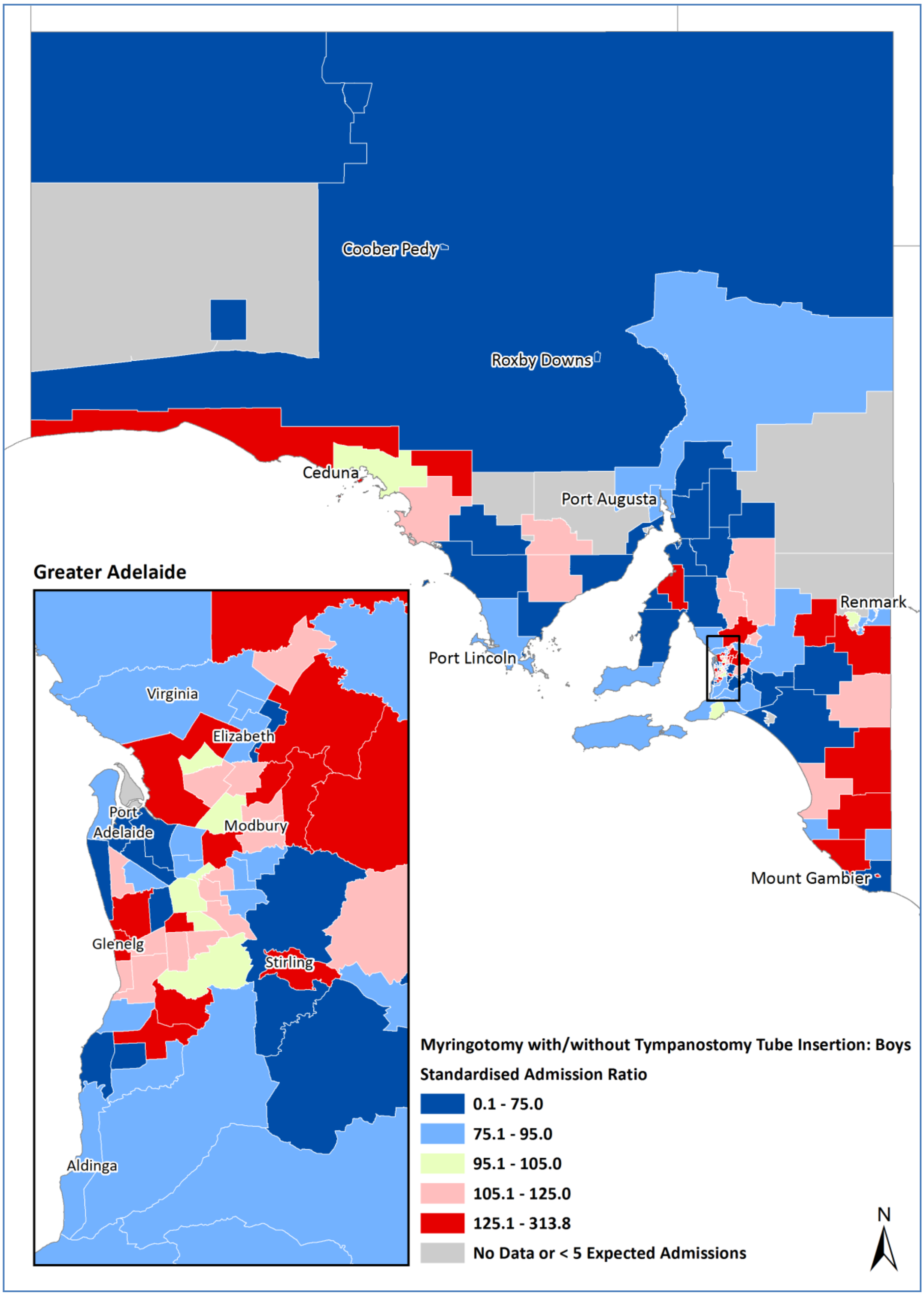
Map 5: Adenoidectomy alone - Standardised admission ratios for boys.



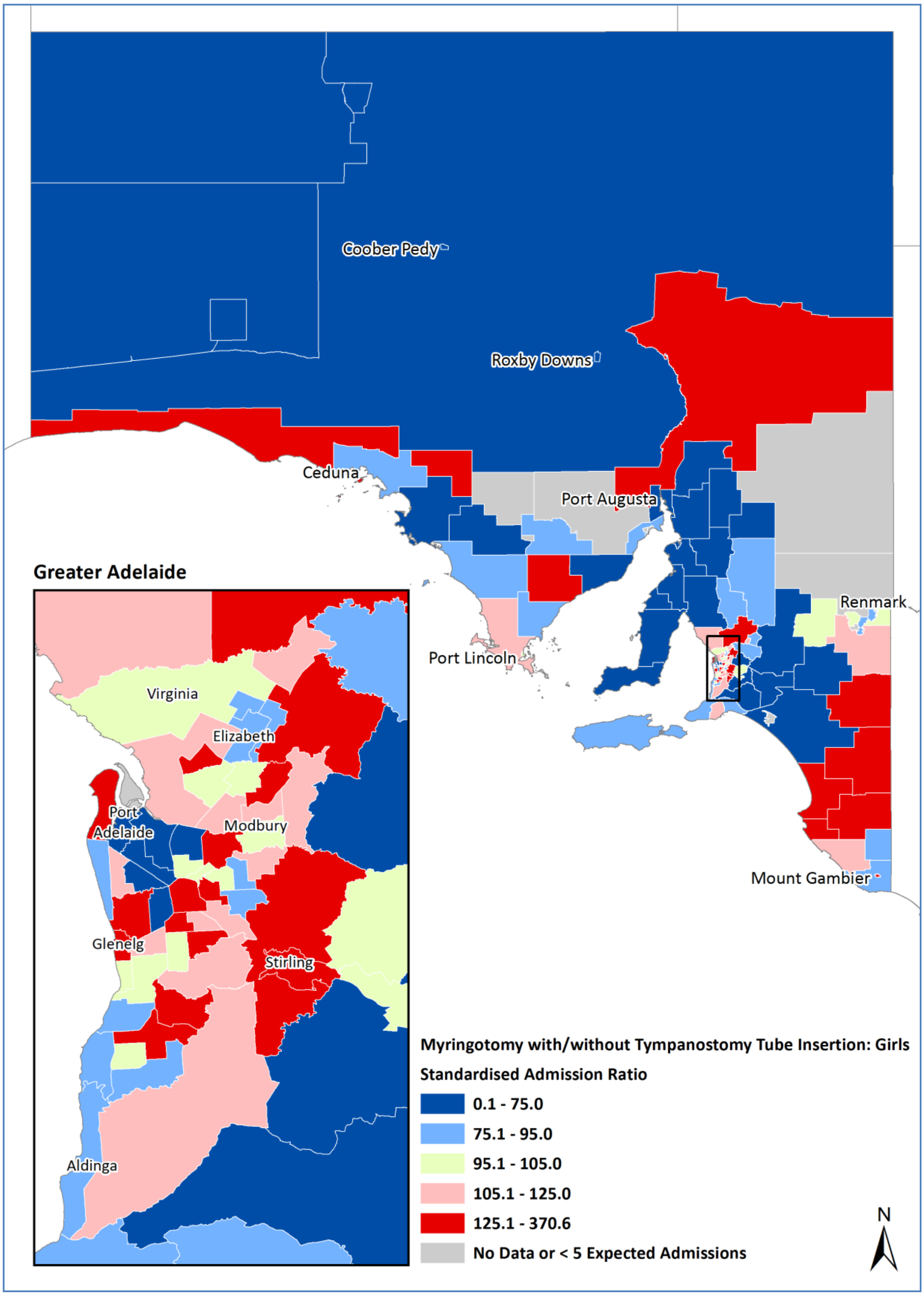
Map 6: Adenoidectomy alone - Standardised admission ratios for girls.



Map 7: Myringotomy with/without tympanostomy tube insertion - Standardised admission ratios for boys.



Map 8: Myringotomy with/without tympanostomy tube insertion - Standardised admission ratios for girls.



6.3.3 Rural and Remote South Australia

In contrast to metropolitan Adelaide, tonsillectomy alone was more frequently performed on children from rural South Australia. Boys living in the Mount Lofty ranges and Tanunda, up to the Lower North (which encompasses the Clare Valleys) had a higher frequency of the procedure, as did boys living in the rural towns of Ceduna, Port Lincoln, Port Pirie or Port Augusta (Map 1). Boys living in on the Fleurieu Peninsula, along the Coorong and down towards the South East also had higher than expected SARs. While the spatial distribution was similar for girls - with many of the same SLAs having higher than expected SAR for tonsillectomy alone in girls – the involvement of rural areas was more extensive (Map 2). Specific differences were that girls living on the Yorke Peninsula had higher than expected admission ratios of tonsillectomy alone, as did girls living in Roxby Downs and the small Riverland region surrounding Berri and Barmera. However, the high tonsillectomy frequency seen for boys in the Lower North was not seen for girls.

The spatial distribution of adenotonsillectomy was visibly different to that of tonsillectomy alone. Noticeably, and unlike for tonsillectomy alone, there were no SLAs in the south-east of the state where the SAR of adenotonsillectomy was higher than expected. In contrast, there were definitive regions within South Australia where adenotonsillectomy was performed with more frequency. Boys living on the West Coast, in the Flinders Ranges, at the southern end of the Yorke Peninsula, and across the Lower North (including the Clare and Barossa Valleys) underwent adenotonsillectomy more frequently than expected (Map 3). While the same areas of South Australia were involved in the higher SARs for girls, the extent of the areas involved was broader (Map 4). In addition to the regions mentioned, girls in Whyalla and Port Pirie to the north and the Murray Mallee to the east also had a greater frequency of adenotonsillectomy.

The SAR for adenoidectomy alone was greater than expected in only a few distinct rural locations for both boys and girls. For boys these locations were Ceduna on the west coast, upper Yorke Peninsula, the Clare and Barossa Valleys, Renmark in the Riverland, and the far South East (Map 5). Similar regions – the Barossa, South East and Ceduna – also had higher than expected admissions for girls, however Kangaroo Island was seen to be a region where girls had a greater than expected frequency of adenoidectomy than would be expected (Map 6). The SAR of myringotomy with/without tympanostomy tube insertion for boys was more than 25% greater than expected in 14 rural South Australian SLAs. These were located in the Barossa, the Yorke Peninsula, on the West Coast, and in the South East (Map 7). The Riverland town of Loxton had a higher than expected frequency of the procedure, whereas it did not for girls. While there was a similar spatial distribution for girls, there was a greater number of SLAs in the South East where the frequency was higher than expected (Map 8). In addition, the SLAs *Southern Mallee*, *Cleve* on the Eyre Peninsula, and *Unincorporated Flinders Ranges* also had a higher frequency of the procedure.

Closer inspection of the SARs identified a number of SLA in rural South Australia where the procedures were performed more than twice as often as expected. The *Lower Eyre Peninsula* was a SLA where the frequency of tonsillectomy in both boys and girls was more than twice that expected, as was *Mount Barker – Central*. In the south-east of the state, there were several SLAs where tonsillectomy and adenoidectomy had a SAR that was more than double expected for one or both of the sexes. However, the only SLA where adenotonsillectomy was performed at more than twice the ratio expected was in *Ceduna* for both boys and girls. This is a SLA on the west coast of South Australia that encompasses a number of small townships including Ceduna, Koonibba, Nunjikompita and Smoky Bay. Myringotomy with/without tympanostomy tube insertion, while performed at greater than expected frequencies in a large number of SLAs across the state, was only performed at twice the expected frequency in the SLA *Unincorporated West Coast*. However, this SLA has only a small population, as reflected by the small expected number of admissions, so this may be an over-estimation of the admission ratio.

6.4 DISCUSSION

In this chapter, a spatial representation has been presented of the SARs of tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion in South Australian children. Surprisingly, there were clearly distinguishable patterns in the residential locality of the children that most frequently underwent these procedures. Tonsillectomy was more often performed on children from rural South Australia, particularly throughout the Murray Mallee and the South Eastern region of the state. In contrast, adenotonsillectomy was not performed in great frequency in the South East, instead being more often performed on children living in the northern suburbs of Adelaide. For both procedures, Ceduna and Port Augusta were locations where more procedures were performed than would be otherwise expected, while Port Lincoln had a higher than expected admission frequency of tonsillectomy but not adenotonsillectomy.

Generally, adenoidectomy alone and myringotomy with/without tympanostomy tube insertion had similar geographical distributions. Both procedures were performed at a higher than expected frequency in the lower South East of the state and across metropolitan and outer Adelaide. However, Ceduna had a higher frequency of adenoidectomy, but not myringotomy with/without tympanostomy tube insertion. Port Augusta and Port Lincoln were not locations where myringotomy with/without tympanostomy tube insertion was performed frequently; however, tonsillectomy was performed at a very high frequency in both these major rural centres. In contrast, adenotonsillectomy was performed at a very high frequency in Port Augusta, but not in

Port Lincoln. These variations between these two major rural townships may be due to differences in the underlying populations and socioeconomic structure of the two localities.

Finally, there was one geographical area - *Playford - Hills* - that consistently had SARs for both boys and girls that were higher than expected for all the studied surgical procedures. *Playford – Hills* is a region to the north-east of Adelaide located in the foothills and encompassing the suburbs One Tree Hill, Humbug Scrub, Uleybury, and Bibaringa. This SLA largely consists of rural bushland and agricultural industry. In 2006, *Playford - Hills* was recorded as having a SEIFA IRSD score of 1086, making it one of the least disadvantaged areas of the state.[381] Despite this, the region had a moderate unemployment rate of 5.9% and had a relatively low average annual taxable income of $35,223.[382] This region would lend itself to a focussed investigation of the sociological and economic factors influencing healthcare utilisation.

The results presented in this chapter have clearly highlighted that the geographical distribution of the patient populations that underwent these procedures during the study period were concentrated to certain regions of South Australia. The reasons for geographical variations in hospital admissions for surgical procedures remain unexplained and a topic of much debate. Indeed, recently the *Australian Atlas of Healthcare Variation* published tonsillectomy and myringotomy admissions to hospital per 100,000 population using data sourced from the Australian Institute of Health and Welfare's *Admitted Patient Care National Minimum Data Set* for the 2012-2013 period.[349, 367] The report showed ongoing wide variations, with the number of tonsillectomy admissions in children aged 17-years and under ranging from 388 per 100,000 children in the Northern Territory to 898 per 100,000 South Australian children.[349] Likewise, myringotomy admissions for children aged 17-years and under ranged from 384 per 100,000 children in the Northern

Territory to 1,046 per 100,000 children in South Australia.[367] Across Australia, when the number of hospital admissions were calculated for smaller regions (using the geographical unit Statistical Areas Level 3, SA3), the number of hospital admissions for both procedures were over six times higher in the area with the highest incidence compared to the lowest,[349, 367] further illustrating that high variability across Australia exists for these common childhood surgeries. Of great concern is that while only one South Australian SA3 region was amongst the ten regions with the highest tonsillectomy admission rate (Limestone coast, 1,528/ per 100,000 children),[349] of the ten regions with the highest myringotomy admission rates, nine were located in South Australia.[367] In fact, the nine regions were all in the metropolitan Adelaide region with admission rates ranging from 1,149 per 100,000 children in the Barossa to 1,398 per 100,000 children in the Onkaparinga.[367]

While ongoing debate considers the potential reasons for such stark variations, thus far, the reasons have not been discussed in the literature within the context of South Australian healthcare delivery. Therefore, these results, and the subsequent discussion, may assist in identifying factors that underpin these geographical variations and that, thereby, influence the high incidence of paediatric ear, nose, and throat (ENT) surgery seen in South Australia.

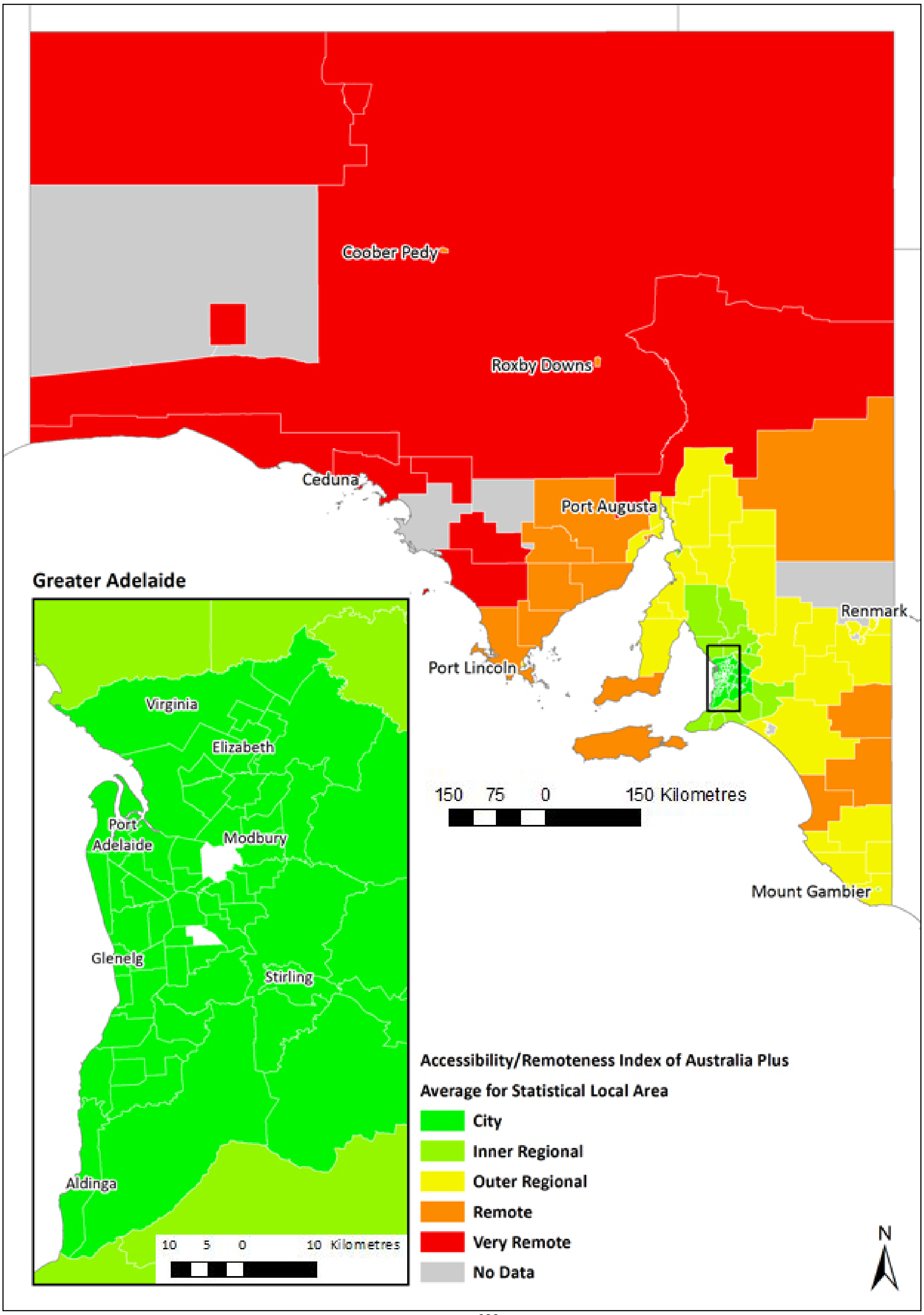
Access to Medical Care

There is a growing body of literature that examines access to medical care, and how access to care influences uptake of care. Access to medical care is a multi-factorial phenomenon influenced by geography,[219, 220] socioeconomic status,[219-224] ethnicity,[224] family structure,[222] patient perception,[219, 223, 225] and health status.[219] Furthermore, it is the interplay of these factors that ultimately influences healthcare use, making access to health care a complex issue. This complexity is further compounded by the suggestions by

Wennberg and colleagues[351, 383] that the provision of medical care is influenced by both patient and physician preferences (preference-sensitive care), and by access to and supply of medical services (supply-sensitive care). Patient-perceived barriers to healthcare include cost,[223] delay in obtaining an appointment,[223] and the necessity to leave work to attend appointments.[223] The interaction of these factors, plus the ever-evolving role of the patient and the patient-physician relationship,[384] and the complex nature of health seeking behaviour,[384, 385] add to the challenges in providing appropriate access to and use of the healthcare system.

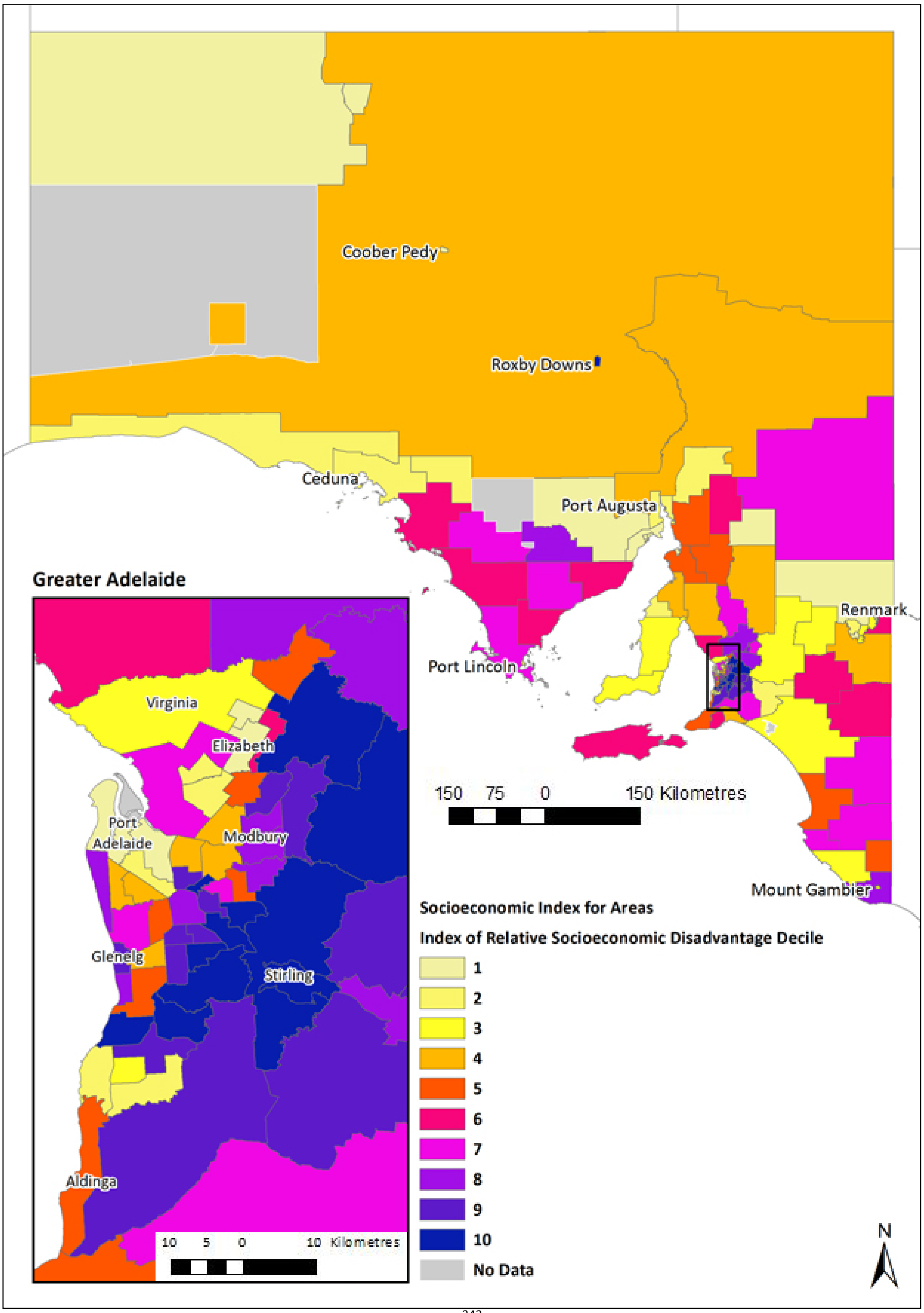
When considering these factors in relation to the results presented in this chapter, we must consider how they impact on ENT surgical procedures, and the frequency of these, within the South Australian paediatric population. Tonsillectomy alone was more often performed in outer regional and rural locations that are geographically limited in their proximity to medical care. The lack of accessibility of these regions is clearly shown by the Accessibility/Remoteness Index of Australia,[386] a purely geographical index which utilises road distance measures to provide a quantitative indication of a region's accessibility (Map 9). Furthermore, these geographical locations have a greater number of disadvantaged persons, as seen by the socioeconomic status of the region. Both of these factors – distance and disadvantage – appear to be linked, with outer regional and remote regions having low to mid-range socioeconomic status.

Map 9: Accessibility and Remoteness of South Australian Statistical Local Areas, 2006.



Source: Accessibility/Remoteness Index of Australia (2006)[386]

Map 10: Socioeconomic Status of South Australian Statistical Local Areas, 2006.



Source: ABS SEIFA Index of Relative Disadvantage (2008)[343]

As established in previous chapters, tonsillectomy alone is more often performed for upper respiratory tract infections, particularly tonsillitis; furthermore, these conditions have been long held to be associated with socioeconomic status.[387] One explanation is that there may be an inherently greater frequency of upper respiratory tract infections and tonsillitis amongst the populations in these high admission ratio regions. Furthermore, there is some evidence to suggest that the incidence of ENT disease may be greater in rural regions compared to urban centres.[388] However, the same research found that these regions had greater proportion of socioeconomic disadvantage, making it unclear what the unique contributions of proximity to care and socioeconomic status are to healthcare usage, as rural geographic location may be confounded by one or both of these factors. Furthermore, to date, there has not been any dedicated geographical analysis of the frequency of tonsillitis within Australia, let alone across South Australia. This may well be largely due to difficulties in accessing data – both from general practitioners, patients, and registries – but also because not all patients seek medical intervention resulting in incidence underestimates. Despite this, the *Better the Evaluation and Care of Health* (BEACH) program[116] – a study of general practitioner workloads and the reasons for patient visits – does provide some insight into the frequency of tonsillitis amongst the Australian population. Published results from the BEACH program show that for general practitioners in remote Australian locations, tonsillitis is a more frequently managed problem than for general practitioners in major cities.[389] Similarly, the frequency with which general practitioners managed cases of acute otitis media increased as remoteness increased. General practitioners in outer regional areas treated a greater frequency of patients with acute otitis media than those in major cities or inner regional areas, while those in remote and very remote regions of Australia treated otitis media with even greater frequency again.[389] In a similar vein, the data presented herein showed that outer regional and rural areas had higher than expected admission ratios for the surgical treatment of otitis media.

Since geographically rural locations have high frequency of surgery for infectious conditions, it is reasonable to propose that this may purely be because there is a higher prevalence of the infectious conditions in the rural communities. There are a number of reasons why this may, in fact, be the cause of the increased surgical incidence. Firstly, populations living in rural and remote Australia have lower socioeconomic status than those in major cities.[390] Socioeconomic status has been shown to be a risk factor implicated in upper respiratory tract infections in children, including increased tonsillitis,[180] acute otitis media,[130] and otitis media with effusion.[170, 174] In addition, cigarette smoking has been shown to be much more frequent in Australian populations with low socioeconomic status,[391] and in rural and remote Australian populations.[390] This is important since exposure to parental smoking has been repeatedly identified as a risk factor for tonsillitis,[180, 182, 183] acute otitis media,[123-130] and otitis media with effusion.[170, 171] The proposition is that exposure to passive smoke disrupts the normal microflora of the upper respiratory tract.[155, 156] Furthermore, houses in rural and remote regions are more likely to be crowded.[390] This results in increased opportunity for disease transmission between household members, with children living in crowded households at greater risk of contracting otitis media.[130, 170] Therefore, it may not be geographical location, but the living conditions that result in children from rural populations being at greater risk of upper respiratory tract infection, and thus requiring a greater level of surgical intervention.

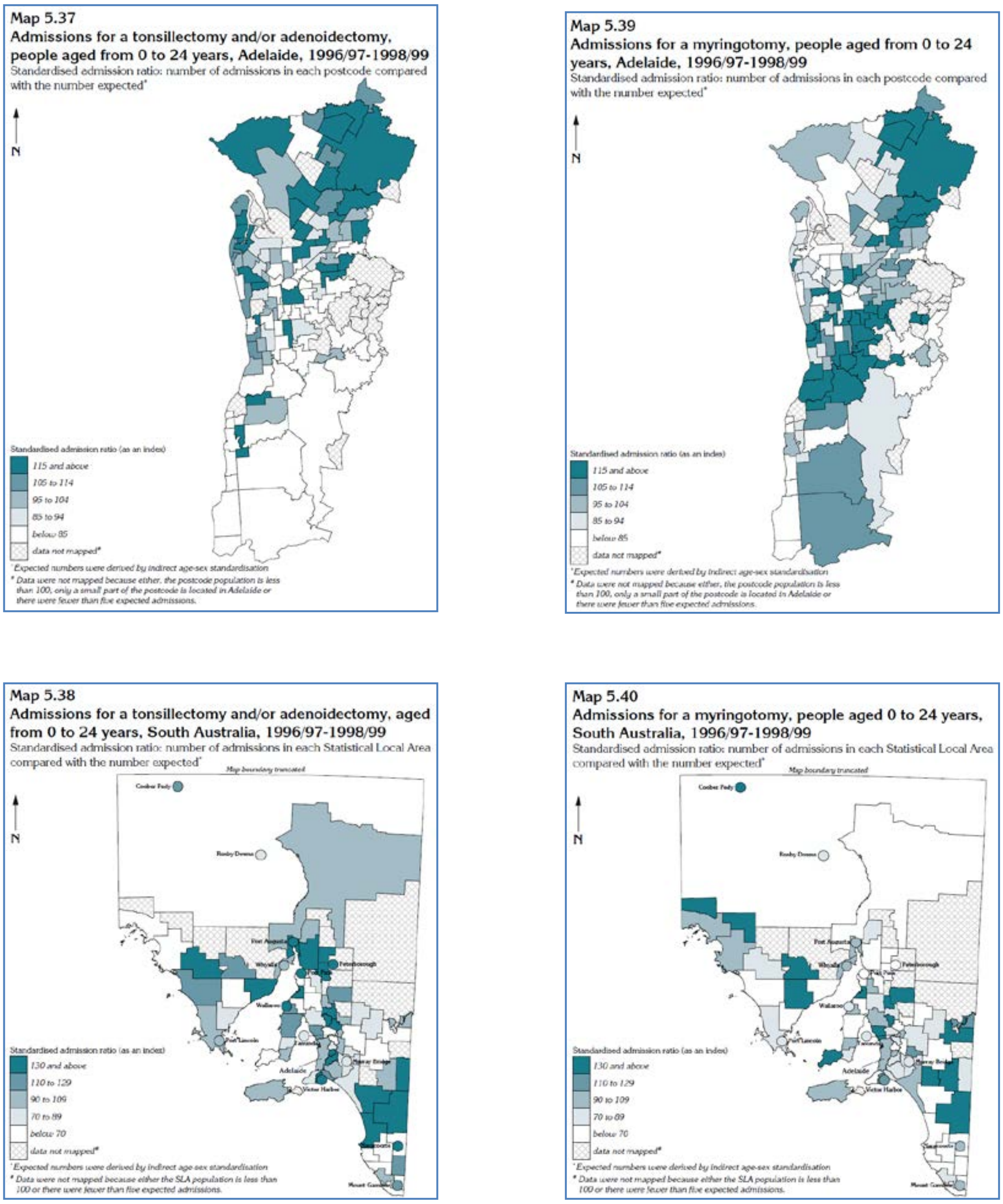
Alternatively, it could be proposed that for recurrent or chronic infectious diseases, such as otitis media and tonsillitis, the sheer distance of these patients from a regional centre could in fact be the reason for the higher incidence of surgery in these regions. To elaborate, the fact that there may be difficulty in accessing medical care, including repeated general practitioner visits and antibiotic usage, and the costs associated with these both, may well be the reason that a referral is prompted and surgical intervention performed. Surgical intervention would reduce the need to access medical care thereafter, and would reduce family and work disruption - an issue that could be of particular concern to farming families, particularly as farmers can experience a high level of financial stress.[392-394] Therefore, it could be postulated that poor access to medical care is the reason underpinning the increased surgical intervention seen in these localities – a concept that initially seems at odds with the standard concept that poor access to healthcare results in an underservicing.[348]

Geographical Variations

The research presented in this chapter has shown that outer regional and remote areas of South Australia had a frequency of tonsillectomy alone that was greater than anticipated. These results are in line with similar international reports. In the USA, a similar pattern has been shown with tonsillectomy (with/without adenoidectomy) performed in greater numbers in less urbanised counties.[395] Canadian children living in rural areas of Manitoba county are 28% more likely to have tonsillectomy (with/without adenoidectomy) than those living in metropolitan areas.[243] However, unlike these reports, in this chapter the maps were presented for tonsillectomy alone and adenotonsillectomy – a distinction that has proved that the procedures should be viewed as two discrete entities.

In 2003, a South Australian 'atlas'[5] was published that included choropleth maps for a variety of South Australian paediatric healthcare issues, including those presented in Figure 6-3. While these maps, in part, provided the impetus for this thesis, the results presented in this chapter reinforce that they are inadequate for the purposes of explaining geographical differences in these ENT procedures.

Figure 6-3: Choropleth Maps, 1996/7-1998/9



Source: Tennant S, Hetzel D, Glover J. A social health atlas of young South Australians. 2003.[5]

Firstly, the maps include persons aged 0 to 24-years, that is, the maps do not represent only the paediatric population. Secondly, and more importantly, the authors mapped tonsillectomy with/without adenoidectomy. By combining the procedures together on one map, while highlighting similar regions to the individual procedural maps of this chapter, there is a loss of critical detail. The results presented in this chapter show that there are definite differences in the geographical distribution of tonsillectomy and adenotonsillectomy across South Australia. Therefore, while the intention of the 'atlas' was to "*provide policy makers, practitioners and communities with information about the current health and wellbeing of South Australian children and young people*",[5] if used for this purpose for ENT surgery the data presented therein could be misconstrued.

When comparing the maps for myringotomy with/without tympanostomy tube insertion presented in this chapter to those published in the 'atlas',[5] there were both differences and similarities evident. A larger number of statistical local areas in the South East had a higher frequency of the procedure in this study compared to when the 'atlas' was produced. Furthermore, the southern end of Yorke Peninsula and Coober Pedy both had low frequencies in this research, whereas in the earlier 'atlas' they had higher than expected frequencies of the procedure. In 1996/7-1998/9, there appeared to be a marked north-east to south-west distribution of the procedure in metropolitan Adelaide, a pattern that was still apparent in the research herein but not as obvious. However, this is most likely due to differences in the choropleth gradient, with the authors of the 'atlas' defining higher than expected as a SAR over 115,[5] while in this chapter it was defined as over 125. Therefore, if the maps in this chapter were reformatted to the same choropleth gradient as that by Tennant et al.[5] then the maps may be more comparable. However, this author is of the opinion that an SAR 25% greater than that expected is more appropriate and less likely to highlight geographical regions as being high when they are only marginally so. Another important difference between the two sets of maps is that the 'atlas' was published using statistical local areas for the state level, and postcode areas for metropolitan Adelaide. This makes it difficult to compare the two maps within the publication but also to the maps published in this chapter. Finally, there are maps in this chapter for each sex, whereas Tennant et al.[5] prepared their maps without division of the sexes. As previous chapters have shown, there are differences in the underlying epidemiology of the boys and girls undergoing tonsillectomy and adenotonsillectomy – to refresh, more preschool boys underwent adenotonsillectomy than preschool girls, and adolescent girls underwent tonsillectomy in greater frequency – differences which may be important for practitioners and policy makers. The research in this chapter has shown that there were, in fact, differences in the geographical distribution of the sexes across South Australia. These were differences that the authors of the 'atlas' failed to identify because they presented maps for all children. More recently, the same research group have published an updated Social Health Atlas of Australia that is an online interactive tool.[396] This online tool is prepopulated with a set of standardised maps, as previously published in hard copy. And, while it contains an extensive array of maps and data, the maps for hospital admissions for tonsillectomy and myringotomy continue to display data for all children, not by sex. Furthermore, the maps displaying admissions to hospital for myringotomy include data for children aged 0 to 9-years only, while it is not clear what age groups are included in the tonsillectomy data.

Differences in medical practice, including uncertainties in the clinical indications for surgery,[353, 355, 356, 397] have been suggested to be the main cause of geographical variations. However, determining whether these geographical differences are due to variations in disease or differences in medical practice is difficult. Health geographers concede that differences in data sources,[398] diagnostic tests,[398] and physician practices[398] all influence the validity of geographical analyses. In fact, these concerns are warranted as research has shown that physicians from different geographical regions can vary greatly in their prescription of antibiotics[356, 399] and in their use of diagnostic testing.[400] Furthermore, in the USA, Medicare spending during the last years of life varies greatly between the states,[401] as does diagnostic frequency and subsequent death for chronic diseases.[402]

Limitations

Statistical local areas are a standardised Australian spatial unit classification which are large in size and may not offer the same level of precision as smaller geographical units. However, despite a preference for more detailed geographical data, such as collection district, the SA Health data custodians would not allow such detailed data to be released for concerns related to patient privacy. While provided residential postcodes, these are inaccurate units of spatial measurement because they are determined by the Australian postal service based on delivery requirements and are, therefore, unreliable and not standardised.

The investigation of the impact of industrial and environmental exposures, climate and terrain on the geographical distribution of these procedures was outside the scope of this thesis. However, it is possible that variations in these factors could contribute to the differences seen herein. Research has shown that factors, such as climate and terrain,[232] have been suggested to play a role in the geographical distribution and incidence of infections indications for surgery, such as otitis media. Therefore, it is possible that the higher frequency of the procedures along the Limestone Coast was due to the more temperate climate, the forestry industry, or the agricultural allergens that are part of the region’s landscape,[403] and that children may be exposed to.

With geographical analysis there are limitations to the interpretations that can be made. One of these is the 'ecological fallacy'[404] whereby the aggregated statistical value for a regions population is taken to represent individual persons living in that region. For example, the socioeconomic status of persons living within any one statistical local area cannot be assumed to equal the SEIFA IRSD value for the area as this is only an aggregated value. Another potential source of bias is the 'modifiable areal unit problem'[405] which results when point-based spatial measurements are aggregated into regions. The resulting summary statistics, in this case, incidences and SARs, are directly dependent on the choice of the regional boundaries used, herein, statistical local areas.

Conclusions

Clearly there are variations in the geographical distribution of tonsillectomy and/or adenoidectomy, and myringotomy with/without tympanostomy tube insertion across South Australia. These variations are most likely linked to difficulties in access to health care and to lower socioeconomic status, as well as geographical issues, such as climatic, industrial and environmental exposure.

SECTION III: PARENTAL EXPERIENCES AND EXPECTATIONS

No matter what happens, or how bad it seems today, life does go on,
and it will be better tomorrow.

Maya Angelou

Reflexivity Statement

When I commenced this research project I was a mother of a healthy three-year-old who had never had any substantial medical complaints - the occasional common cold aside. I had no insight into the experience of living with a child with an ear, nose, or throat condition, nor had I any friends or family with children who had, or required treatment of, ear, nose or throat conditions. Professionally, having worked in clinical trials for many years, I had substantial experience in the hospital setting and was comfortable with my unprejudiced approach to interacting with patients. It was within this framework, that the interviews with parents/caregivers of children attending the ENT outpatient department were conducted. After the interviews were completed, and the initial data analysis performed, a first draft of the results of was written.

Now, as I reflect upon my research, I am a mother of two – an eleven-year-old and a six-year-old - and have become a mirror of the parents/caregivers interviewed for this thesis. While I maintained to interpret the results with impartiality, I must explicitly state that at age 18-months my second child underwent adenoidectomy with bilateral tympanostomy tube insertions. This occurred after a six-month period of increasingly worsening upper respiratory tract infections, language delay and imbalance; with the three-months preceding surgery requiring almost constant antibiotic treatment for persistent bilateral otitis media with effusion. The following year, at age 2.5-years, this same child underwent an adenotonsillectomy for obstructive sleep apnoea syndrome that had precipitated failure to thrive, enuresis, language delay, and behavioural problems. During the course of the 12-month period between procedures, the child also experienced frequent tonsillitis, although not sufficient episodes to fulfil the Paradise criteria.[20]

On reflection, since walking the same path and having similar experiences, I can now empathise with, and relate to, those parents I interviewed in 2009/10. Their experiences were my experiences; their expectations mine also. As primary caregiver in our household, I longed for reprieve just as they did – endless sleepless nights, retrievals from childcare, and trips to and fro to the general practitioner were all taking their toll. I adopted the role of 'parent', and let my general practitioner and surgeon provide medical recommendations as they deemed appropriate. Both heeded the Clinic Practice Guidelines and intervention occurred within the recommended timeframes. And thankfully, and happily, I can inform the reader that both procedures resulted in symptom resolution.

CHAPTER 7
Pilot Study

7.1 INTRODUCTION

The purpose of this chapter is to present the results of the pilot study conducted to inform the qualitative research component of this thesis, as reported in Chapter 8. The outcomes of the pilot study are considered.

7.1.1 Aims and Objectives

The aim of this pilot study was to test the data collection methods to be used in the qualitative research study.

The objectives of this pilot study were:

1. to assess the phrasing of the interview questions;
2. to assess the data collection tool and ensure that the data to be collected were relevant and comprehensive; and
3. to refine interview technique.

7.2 METHODS

During the pilot study, the researcher tested a set of semi-structured questions (Table 7-1) that had been developed through several iterations of discussion between the researcher and supervisory panel. Once the general content and structure of these questions were determined, they were tested within the framework of the pilot study. Semi-structured interviews were conducted with a cross-sectional cohort of parents/caregivers who had a child recently added to the Women's and Children's Hospital ENT Department surgical waiting list for tonsillectomy, adenoidectomy, and/or myringotomy with tympanostomy tube insertion. These interviews were conducted in order to test and refine the question set to be used in the qualitative research component of this thesis. The researcher assessed the ease of verbal delivery of the questions, and the ease with which parents/caregivers understood the study questions. The interview questions, and interviewing technique, were assessed by a combination of face-to-face and telephone interviews. Through this iterative process the questions were refined until a set of questions were developed that formed the final set of semi-structured interview questions used in the qualitative component of this thesis. In addition, pilot interviews conducted over the telephone were audiotaped for the duration of the semi-structured interview question set; that is, the introduction, consent process, and the administration of the quantitative data collection tool were not audiotaped. The interviews conducted as part of this pilot study were not themselves thematically analysed, nor were they included in the thematic analysis described and discussed in the following chapter.

In addition to the semi-structured interview questions, the quantitative data collection tool was tested. A copy of the data collection tool is available in Appendix D. The data collection tool was developed to collect demographic variables on both the interview participant and their child. The variables included in the tool were inferred from the epidemiological research reported in Chapters 4 to 6. The data collected included age, sex, and living arrangements of the child, as well as, the age, sex, education level, and employment status of the interview participant (parent/caregiver). A detailed list of the demographic data collected is outlined in Chapter 8. The collection of this information facilitated the description of the study population. The tool was tested for ease of use, including the order of the demographic data collection, and the proposed multiple choice answers included on the form. No alterations were made to the data collection tool as a result of the pilot study.

Table 7-1: Semi-Structured Interview Questions: Pilot Study

Pilot Question	Outcome	Reason for Decision	Final Question Structure
What led to [child's name] being seen in clinic yesterday?	Rephrased, Expanded	Early responses to this question highlighted the variety of ways that children came to be seen in the ENT clinic. Further detail about the way children move through the health system was important.	When we met, was that the first time that [child] was seen in the ENT clinic?
			Does [child] see other doctors at the Women's and Children's Hospital?
			Who referred [child] to the ENT clinic?
			Have you ever taken [child] to your general practitioner in regards to the problem he/she been having?
			How many times have you seen the general practitioner?
			Is that back to the same general practitioner each time?
			Can you tell me what's been happening with [child]?
What did the doctor say needs to be done for [child's name]?	Removed	Redundant. Answered in the course of the previous questions.	
Did they tell you when your child is going to have an operation?	Removed	Redundant. Answered in the course of later questions.	
Before coming to the Women's and	Retained, Minor	Interviewees asked for clarification	Before coming to the Women's and

Pilot Question	Outcome	Reason for Decision	Final Question Structure
Children's Hospital today, did you think about going to a private clinic?	alteration.	on terminology. Changed 'clinic' to 'specialist'. Moved to later in the sequence.	Children's Hospital, did you think about going to see a private specialist?
How do you feel about [child's name] being on the waiting list?	Retained	No change	
It's not too long to wait?	Removed	Leading. Redundant. Answered in the course of later questions.	
How has [child's name] medical problem been affecting the family life?	Rephrased, Merged	Interrelated questions. Questions answered in an interrelated way by respondents. Questions merged.	How does [child's] medical problems been affecting his/her usual activities and the family?
How has [child's name] medical problem been affecting his/her day-to-day activities?	Rephrased, Merged		
How you think the operation will help?	Retained	No change	
How have you found the referral process and did you have to wait long before you got an appointment in the outpatient clinic?	Rephrased, Expanded.	Early responses to this question highlighted the variety of experiences that families had when moving through the health system. Further detail about the experience was important.	How happy have you been with the service that you've received so far from the hospital?
			How happy were you with the referral process from your general practitioner through to the hospital?
			Was it the doctors' [general practitioner or specialist] decision, or your decision, to

Pilot Question	Outcome	Reason for Decision	Final Question Structure
			get [child] referred to the ENT clinic?
Do you have any other comments about the hospital or the service you've received?	Rephrased	Leading.	Do you have any other comments about your experiences?
I'd like to speak to you again in 6 weeks to see how you and [child's name] are doing, will that be okay?	Removed	Follow-up was determined to be outside the scope of the thesis. Uncertain surgery dates and waiting list durations made this untenable.	

7.3 RESULTS

The pilot study consisted of eight participants (parents/caregivers) recruited from the 1 to the 4 September 2008. One participant was lost to follow-up. As a result, seven interviews were conducted: one face-to-face interview conducted in the outpatient clinic and six telephone interviews conducted at a time suitable for the interview participant. In the following sections, the results of the pilot study will be described.

7.3.1 Review of the Question Set

During testing of the question set, it became evident that several questions were either redundant or required rephrasing (Table 7-1). Five questions were rephrased and/or expanded, four were deemed redundant and removed from the question set, and three were retained unaltered. In addition, questions were added to the question set. The reasons for these alterations are given in Table 7-1. In summary, questions determined to be leading were removed, interrelated questions were restructured and combined, and one question on follow-up was deemed to be outside the scope of this research. Redundant questions were answered by participants through answering earlier questions in the question set.

Responses to the opening question highlighted that children came to be seen in the ENT clinic through a variety of referral channels. Further detail about the child’s healthcare service interactions that preceded the current outpatient appointment was important. Therefore, a series of questions were added to the beginning of the interview to gather information about the referral pathway. These questions would provide further insight into the course of the child’s referral and the medical history leading to addition to the surgical waiting list. These questions also identified whether participants had previously attended the outpatient clinic with their child prior to the current appointment at which they were consented for surgery. It became clear that children may not be new to the outpatient clinic. They may have been treated conservatively by the ENT specialist staff during a period of “watchful waiting” to determine if the child’s symptoms would resolve spontaneously without surgical intervention. Alternatively, a child may have a longstanding history of care at the hospital through other outpatient clinics for concomitant medical conditions, with these experiences influencing the child’s and family’s expectations of the ENT outpatient clinic.

The preliminary intention was to conduct face-to-face interviews with parents/caregivers at the time of consent in the outpatient clinic. However, the feasibility of doing this was tested and quickly found to be unmanageable for a number of reasons. Firstly, it quickly became evident that parents/caregivers were time-limited following the outpatient appointment, and while happy to consent to participate in an interview, conflicting commitments and time constraints were prohibitive. Secondly, this procedure would mean that the researcher would be unavailable to all other outpatient appointments while conducting interviews. This would impact on the enrolment of potential participants, as recruitment would be severely affected by the absence of the researcher during the best time to commence the informed consent process. Also, to conduct interviews during the outpatient clinic impacted on clinic space since a room was used for interviewing and, thus, not available for doctors, nurse, and audiologists treating or assessing patients. Finally, the researcher anecdotally observed that the outpatient clinic was not an environment amenable to good interview responses, since potential participants were often distracted with caring for their children (they often had siblings with them, as well as the child in question), distracted by the noise and chaos of the waiting room (one of the busiest outpatient clinics in the hospital), concerned with expiration of parking allowances (much of the parking surrounding the Women’s and Children’s Hospital is time-limited to 2-hours), and concern about delays in the appointment and the impact of this on subsequent planned activities (such as going to work, or taking children to school). As a result, it was decided that the researcher would consent potential participants during outpatient clinic sessions and conduct interviews at a later time via telephone at a time convenient to the interview participant.

During the pilot study, the researcher reflected on the interviewing technique. It was recognized that there was a need to remain impartial during the interview process, by ensuring questions were asked without a preconception of the answer, and without the use of leading adverbs and determiners. The questions, while pre-determined and semi-structured, might require minor modifications during each interview to ensure situational and cultural relevance to the interviewee. Flexibility would be important to allow for the exploration of new concepts raised by interviewees, by using additional prompt questions such as “Can you please explain that further?” or “How did that make you feel?” This flexibility would be important since it became clear during the pilot study that the answers given to questions were often cues that further discussion was warranted.

Finally, the pilot study provided insight into the potential duration range of the semi-structured interviews. Pilot study interviews were taped for the duration of the semi-structured question set, with the length of interview ranging from 3 minutes, 56 seconds to 15 minutes, 52 seconds. The median duration was 8 minutes, 19 seconds. This information was use to aid project management for the qualitative research study.

7.3.2 Demographics of the Pilot Study Participants

There were seven pilot participants. The participants were the parent/caregivers of three (43%) children with otitis media with effusion, three (43%) with sleep disordered breathing, and one (14%) with tonsillitis. On average, children were approximately 3-years-old and most were male children (Table 7-2). All the children were elected as public patients and came from English-speaking households. The majority lived with two biological parents. The median number of children in the family was two with most of the children being the eldest child in the family. Most children spent two days at childcare each week.

Four (57%) of the children were referred from general practitioners while the remaining three (43%) had been referred from within the CYWHS. Surgery was booked for five (71%) at the time of the outpatient appointment. The surgery was performed a mean/median of 97 ($\pm$ 112) days after the outpatient appointment. Three (43%) had bilateral TTI, three (43%) had adenotonsillectomy and one (14%) child had both adenotonsillectomy and bilateral TTI performed.

The mean age of the participants (parents/caregivers) was 29 years with the majority of participants the mother of the child (six mothers *cf*. one father) (Table 7-3). The majority were in married/de facto relationships (57.1%). All participants identified as Caucasian and spoke English as their main language. The majority had never been smokers (71.4%). Most participants had completed high school or higher education. Six (85.7%) were employed (two were currently on maternity leave). Five participants identified that the child had another main caregiver who was the father in four (80.0%) cases and the grandmother for one case. The mean age of the second caregiver was 36.40 ($\pm$ 12.52) years.

Table 7-2: Pilot Study - Child Demographics

Variable		
Age (years, mean + SD)		2.96 (+ 2.27)
Male (n, %)		4 (57.1%)
English-speaking background (n, %)		7 (100.0%)
Living arrangements of child (n, %)	Two biological parents	4 (57.1%)
	Mother alone	2 (28.6%)
	Father and grandparents	1 (14.3%)
Children in family (median, range)		2 [1-5]
Position within siblings (median, range)		1 [1-5]
Number of days at childcare (median, range)		2 [0-5]

Table 7-3: Pilot Study – Participant (Parent/Caregiver) Demographics

Variable		
Age (years, mean ± SD)		29.14 (± 4.45)
Mother of child (n, %)		6 (86.7%)
Marital status (n, %)	Married/De Facto	4 (57.1%)
	Never married	2 (28.6%)
	Separated/divorced	1 (14.3%)
Smoker (n, %)	Never smoked	5 (71.4%)
	Previous smoker	1 (14.3%)
	Current smoker	1 (14.3%)
Highest level of education (n, %)	University or TAFE	2 (28.6%)
	High school completed	4 (57.1%)
	High school not completed	1 (14.3%)

7.4 DISCUSSION

The decision to use semi-structured interviews was influenced by the epidemiological research conducted in earlier chapters of this thesis. While other interview techniques exist and were considered, the semi-structured interview allowed the incorporation of both open-ended and theoretically-driven questions.[406, 407] These questions were developed to elicit detail from the participants (parents/caregivers) about the experiences leading up to, and including, the most recent outpatient appointment that resulted in the child being recommended for surgical intervention. However, while data gathered during semi-structured interviews are representative of the participants' experiences, the data is also influenced by the pre-existing cultural and societal constructs in which the research is conducted.[406] Therefore, the development of the question set used to guide the interview is a critical phase of the research process. The development of the questions requires consideration of question style, language, length, and framing,[408] as well as the order of the questions within the question set,[409] necessitating considerable review and 'trial and error'.[406] This often time consuming process is a key step in the qualitative research method, since the way questions are constructed can influence the quality of the responses received. The importance of using open-ended questions, avoiding leading questions, and letting the interviewee lead the conversation are key to good qualitative interviewing.[406-410]

While the semi-structured interview must be guided by a question set, the interview technique is not entirely constrained. The key to successfully eliciting detailed responses is the use of probes. During the pilot study, the researcher practiced the use of probes, such as the silent probe (remaining quiet and waiting for the interviewee to continue),[408, 409] the echo probe (repeating the last concept discussed and asking the interviewee to continue),[408, 409] the affirmative probe (making affirmative comments such as 'uh-huh' and 'okay'),[408] and the expansion probe (asking for more detailed about a concept or idea).[408, 409] These probes would need to be successfully utilised in the qualitative research study to elicit additional detail during interviews.

Face-to-face interviews are the standard technique of data collection in qualitative research.[408, 410, 411] This tried-and-tested method has the benefit of adding body language and physical cues to the repertoire of probes to help facilitate the interview.[411, 412] Furthermore, the personal nature of the face-to-face interview assists in the development of rapport, maintenance of interest in the interview, and a reduced potential for misunderstandings to develop.[413] Furthermore, emotions are more readily perceived and understood in a face-to-face interview,[413] an often important factor in interviews that delve into sensitive or distressing topics. There is no delay in the interaction between the interviewee and researcher, as they participate in 'synchronous communication of time and place' during the face-to-face interview.[412] Furthermore, face-to-face interviews allow the opportunity to interview people who may not otherwise be able to be interviewed (such as the elderly, illiterate, or disabled),[411] and may be a more appropriate way to interview people from different cultural backgrounds.[412, 414] However, the pilot study quickly proved that face-to-face interviews would not be feasible for the purposes of this research. While there are disadvantages to telephone interviews, such as the loss of visual cues, there are many benefits. Telephone interviews allow access to participants from a wide geographical region, as well as, hard to reach participants, such as stay-at-home parents.[412] And while more economical and convenient,[411] there is evidence to suggest that interviewee fatigue is more likely to occur during telephone interviews.[413, 415] Given that research shows that the interview length is not simply linearly related to the number of questions being asked, but is also influenced by both the interviewee and researcher,[416] the researcher plays a pivotal role in ensuring the success of the telephone interview. Inevitably, the researcher needs to use their 'phone personality' traits to ensure that the interviewee does not 'hang up';[411] and should anticipate interviews taking no more than 20-minutes, only allowing them to go for longer if it occurs organically and at the discretion of the interviewee.[411] Given that the primary drawback of telephone interviewing is the loss of visual cues and potential lack of rapport, these would be somewhat ameliorated by conducting the consent process at the time of the outpatient clinic, thus allowing the researcher to lay the rapport building groundwork prior to the telephone interviewee.

For more than a century, researchers in the fields of anthropology, linguistics, psychology and education have explored the differences, and relationship, between spoken and written language.[417] The grammatical error rate, pronunciation variations, and informality are greater with spoken language.[418] Certainly, the interview questions developed herein were developed for speech, rather than a written survey. Ensuring that the questions were amenable to a telephone conversation was an important element of the successful interview technique. Clumsy or rigid questions would not lend themselves to building rapport and helping interviewees feel 'at ease' – both important in encouraging an interviewee to share detailed personal information with the researcher.[409] When conducting semi-structured interviews, the researcher often has only one opportunity to conduct the interview due to time constraints on the part of the interviewee.[408] Therefore, semi-structured interviews are fitting in situations when the interview participant is time-poor since the method efficiently elicits detailed responses.[408] As a result of these time constraints, building rapport quickly is essential. In fact, during the interview, the researcher and interviewee move through a series of stages of rapport - apprehension, exploration, co-operation and participation.[419] In order to support this process, the less sensitive, less important questions should be asked first,[408, 410] as was done in the question set developed herein. In addition, questions should start with more concrete concepts moving to more abstract concepts as the interview progresses, with questions grouped by topic or concept.[406, 408, 410] These consensus approaches were adhered to in the development of the question set tested herein.

In conclusion, through the pilot study important insight and awareness was gained that helped shape the conduct of the qualitative research study. These pilot interviews allowed for the expansion and refinement of the question set, the testing and refinement of the telephone interview technique, and gave the researcher an understanding of key elements necessary for the management of the qualitative research study.

CHAPTER 8
The Experiences and Expectations of Parents/Carers

8.1 INTRODUCTION

In previous chapters, an in-depth examination of the epidemiology of tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion has been presented. From these results it is clear that the children who most frequently undergo these procedures are young children – the only exception being tonsillectomy alone which is most commonly performed on adolescent girls. It is now clearly evident that South Australia performs a disproportionately higher frequency of these procedures compared to other Australian states. As demonstrated in earlier chapters, there is also a higher-than-expected tendency for South Australian children to have their surgery self-funded, suggesting that South Australian parents/caregivers may be more willing to pay "out-of-pocket" to have surgery performed on their children than their interstate counterparts. Finally, the results suggest that socioeconomic status may play a role, with children from more affluent families undergoing adenoidectomy and myringotomy with/without tympanostomy tube insertion than would be otherwise expected, and a greater proportion of disadvantaged children undergoing tonsillectomy with/without adenoidectomy. The reasons for these discrepancies remain unknown.

While medical practitioners make recommendations for surgical intervention, ultimately the decision is made by the child's parents/caregivers. Understanding what prompts these decisions may provide insight into the underlying reasons for the high South Australian incidence of these procedures. The purpose of this chapter is to provide an in-depth insight into the experiences that parents/caregivers have while caring for a child with an ENT condition. Exploring these experiences helps ‘paint a picture’ of the motivations that underpin the surgical decision-making pathway - ultimately culminating in the child undergoing one or more of the surgeries presented in this thesis. Through interviewing parents/caregivers, valuable insight can be gained; this approach has been generally overlooked by previous research that has tended to rely on validated, multiple choice questionnaires to assess quality of life.

Building on from the previous chapter, which presented the pilot study that tested the qualitative methodology used here; in this chapter the results of a series of interviews will be presented. These interviews were conducted with parents/caregivers to elicit the ‘story’ that precedes surgical intervention – a ‘story’ that clearly has as much influence on the decision to seek surgical intervention as the clinical signs and symptoms that are used as the medical indication for surgical treatment.

8.1.1 Aims and Objectives

The aim of this study was to understand the experiences, perspectives, and expectations of parents/caregivers of children on the waiting list for surgical intervention for the management of ear, nose, and throat (ENT) conditions.

The objectives of this study were:

1. to explore the impact of the child’s ear, nose, or throat condition on the child;
2. to explore the impact of the child’s ear, nose, or throat condition on the child’s family;
3. to identify prompts for referral seeking by parents/caregivers to an ENT specialist clinic; and

4. to explore parent/caregiver's expectations of the referral to the ENT specialist clinic.

8.2 METHODS

8.2.1 Study Design

This was a cross-sectional, cohort study using semi-structured interviews analysed using qualitative methodology. The interviewees were parents and caregivers with a child who was recently placed on the Women's and Children's Hospital ENT Department surgical waiting list. The study was approved by the Human Research Ethics Committee of the Women's and Children's Health Network (previously known as the Children, Youth and Women's Health Service at the time of the research).

8.2.2 Research Setting

The Women's and Children's Hospital is a tertiary teaching hospital located in North Adelaide, South Australia. It is the main provider of specialist healthcare to South Australian children. This site was selected because the epidemiological profile of ENT surgery in South Australia (Chapter 5) showed that the majority of children with common ENT conditions are treated at this hospital.

8.2.3 Participants

All consecutive parents and caregivers who met the inclusion and exclusion criteria, and who had a child that attended an appointment in the ENT Department Outpatient Clinic at the Women's and Children's Hospital between the 1 September and 10 November 2008, were invited to participate in the study. For each child, one parent/caregiver was recruited to participate. The recruitment process discussed in detail below.

After patients were seen by an ENT Consultant and consented for surgery, they were seen by an ENT Outpatient Nurse to discuss the preadmission requirements for surgery. The ENT Outpatient Nurse identified potential candidates who met the inclusion and exclusion criteria, and subsequently introduced the research project and the researcher. The researcher provided further information about the study to potential participants, answered any questions, and obtained written informed consent. Written informed consent was obtained at the time of the outpatient appointment. In accordance with the International Committee on Harmonisation and National Health and Medical Research Council Guidelines for Good Clinical Practice, a copy of the signed consent form was provided to the study participants. These were sent to participants via the standard Australia Post mail service. The process for the recruitment of study participants was reviewed by members of the ENT Outpatient Department (ENT surgeon, Mr Mark Schembri and Registered Nurse, Maureen Thorpe), who continued to oversee the recruitment process throughout the research project.

Parents and caregivers who agreed to participate were asked to indicate the most convenient day, time and telephone number for the researcher to use to contact them. In situations where there was more than one parent/caregiver (e.g. mother and father), parents/caregivers were asked to nominate which adult would be contacted for interview. All interviewees were informed, as part of the informed consent process, that the interview would be audio-recorded and transcribed. Interviews were conducted as soon as possible, and within a four-week period, after obtaining consent at the ENT outpatient appointment. When the researcher was unable to contact the participant during a pre-specified time for two consecutive weeks, the researcher attempted to contact the participant outside the specified times. At least two attempts were made to contact the participant at alternative times throughout the week, including evenings and weekends. If the researcher was not able to contact the participant during the four-week period, the participant was considered lost to follow-up.

Inclusion Criteria

Parents/caregivers were eligible to participate in the study if they met all of the following criteria at the time the child was placed onto the surgical waiting list:

1. Their child was 10-years-old or younger; and
2. They were proficient in written and spoken English and able to provide written informed consent; or
3. They were able to provide written informed consent and participate in the interview via a certified Interpreter.

The age limit selected was based on the results of the epidemiological research, which showed that the majority of ENT surgical procedures are performed on children under 10-years-old (Chapter 5). The Women's and Children's Hospital treats a wide spectrum of patients from Adelaide and the wider South Australian community, including both public and private patients, refugees and immigrants. Therefore, to restrict the eligibility criteria to only those persons proficient in written and spoken English would result in the exclusion of a potentially important group of participants and result in an unrepresentative sample.

Exclusion Criterion

Parents or caregivers were ineligible for inclusion in this study if their child had a pre-existing medical condition, including craniofacial congenital abnormalities or Down's syndrome, which increased the likelihood of ENT surgical intervention. Evidence has shown that children with these conditions require more specialised and intensive ENT care that is not representative of the general population.[420-424]

8.2.4 Data Collection

Demographic data was collected from the interviewee, including information about themselves, the child, and the child's second main care-provider (Table 8-1). A copy of the data collection form is included in Appendix D. In addition, clinical data were provided by the ENT clinical nurse, who extracted the data from the Women's and Children's Hospital electronic patient database. This data included the child's date of surgery (if surgery was performed at the Women's and Children's Hospital) and the primary indication for surgery (coded by hospital staff using the ICD-10-AM coding system).

Interviews

Interviews were conducted using a standardised set of questions as the topic guide (Table 8-2). However, issues raised during interviews deemed relevant to the study were explored with the participants. The interview questions, including the sentence structure and wording use, were determined after trialling them during the pilot study. Interviews were conducted via telephone from a private room in the Public Health Research Unit at the Women's and Children's Hospital. Interviews lasted between five and 45-minutes, and at the time of the interviews participants were located at their home, workplace, or in their parked car. If participants indicated that it was inconvenient to participate at the time of the initial telephone call, they could nominate a more convenient time for the interview to take place. A conference telephone was used to allow recording of the interview.

Participants were recruited until it was determined that no new information emerged during interviews, that is, until data saturation had been reached. The interview questions were developed as described in the previous chapter. Topics covered in the interviews included the parent's experiences, quality of life of the child and family members, the impact on the child and family members, and the decision-making process for surgery.

Data Definitions

For the purposes of this study the following definitions were used:

- *Index child* is the child who was added to the surgical waiting list and who is the child of the parent/caregiver.
- *Participant* is the parent/caregiver who was present at the outpatient appointment and provided consent to participate in the study.
- *Tonsil disease* is defined as any case where the ENT specialist indicated either sleep disordered breathing or tonsillitis as the primary indication for surgical intervention; and
- *Ear disease* is defined as any case where the ENT specialist indicated that either recurrent acute otitis media or otitis media with effusion was the primary indication for surgical intervention.
- *Tonsillitis* is an inflammatory disease of the palatine tonsils.
- *Sleep-disordered breathing* is a condition that disrupts sleep due to breathing difficulty and includes obstructive sleep apnoea syndrome.
- *Tonsillectomy* is the surgical removal of the palatine tonsils.
- *Adenoidectomy* is the surgical removal of the adenoids.
- *Tympanostomy tube insertion* is the surgical insertion of tympanostomy (ventilation) tubes.

Table 8-1: Data collected about the participants and their child

Variable
Child's Demographics
Date of birth
Sex
Household Structure
The number of children in the household
The birth order of the child
The number of days per week that the child attended childcare
Child's living arrangements for the majority of the week
e.g. mother alone, mother and father, mother and step-parent
Family structure, including the relationship between the interviewee and the child
The main language spoken in the home
Parent Demographics
Age
Country of birth
Employment status
Highest education level
Smoking history
Marital status
Operation Information
Planned surgery
Indication for surgery
Date of surgery
Operation performed (ICD-10-AM coding)
Indication for surgery (ICD-10-AM coding)
Date of and reason for readmission to hospital within 30-days postoperatively

Table 8-2: Semi-Structured Interview Questions

Questions
When we met, was that the first time that [child] was seen in the ENT clinic?
Does [child] see other doctors at the Women's and Children's Hospital?
Who referred [child] to the ENT clinic?
Have you ever taken [child] to your general practitioner in regards to the problem he/she been having?
How many times have you seen the general practitioner?
Is that back to the same general practitioner each time?
Can you tell me what's been happening with [child]?
How do you feel about [child] going onto the waiting list?
How does [child's] medical problems been affecting his/her usual activities and the family?
How do you think the operation will help with all of this?
How happy have you been with the service that you've received so far from the hospital?
Before coming to the Women's and Children's Hospital, did you think about going to see a private specialist?
How happy were you with the referral process from your general practitioner through to the hospital?
Was it the general practitioner's decision or your decision to get [child] referred to the ENT clinic?
Do you have any other comments?

8.2.5 Data Management and Analysis

Quantitative Data Analysis

Mean values were calculated for normally distributed data, such as age and interview duration, and these are reported with one standard deviation (SD). Differences in continuous data were tested for significance with the Student's t-test. Medians were calculated for skewed data and are reported with a range.

Categorical data are presented as proportions. Frequencies were calculated for demographic and operative data of the children and for the demographic data for the parents/caregivers: for example, child's sex (male vs. female), hospital sector (public vs. private hospital), and parent's/caregiver's marital status (single vs. married/defacto). Proportions were tested using Pearson's chi-square test. Any additional data provided during closed questions, excluding yes/no answers, were considered during the qualitative interview process.

All data manipulations and analyses were performed using R© (Version 2.14.1, 22 December 2011, The R Foundation for Statistical Computing, Vienna, Austria). All statistical tests were two-tailed, with a $p<0.05$ deemed statistically significant.

Qualitative Data Analysis

Digital audio recordings were transcribed verbatim into separate transcripts as soon as possible after each interview. Typed transcripts were reviewed to check for transcription and typographical errors, and to ensure the interviewee's meanings were understood. Data analysis was conducted using an iterative process utilising a thematic analytical approach to describe and interpret the participant's views. Thematic analysis involves systematically searching for patterns to provide a description and insight into the phenomenon being studied, in this case, the experiences preceding ENT surgical intervention.[425] It is an approach that can be applied regardless of the theoretical and epistemological standpoint of the researcher.

The data analysis proceeded through several phases. The interview transcripts were read and preliminary codes identified. The coded information was then organised into categories of related codes. These categories were refined by testing the categories against the interview transcripts and recoding was performed where required. This process was repeated until no new codes or categories were identified as emerging from the transcriptions. Once this was achieved, categories were assembled into a theme matrix. Each theme was reviewed to ensure that it accurately and adequately encapsulated the codes and categories ascribed to it. A theme description was developed that summarised the main concepts that arose from the interviews.

The initial phase of data analysis was performed using hard copies of the transcripts. However, once categories had been identified and compiled into the theme matrix qualitative data management software (NVivo8, 2009, Version 8.0.335.0 SP4, QSR International Pty Ltd, Doncaster, Victoria, Australia), this was used to aid in the organisation of the themes and interview excerpts.

8.3 RESULTS

Between Monday, 8 September and Monday, 10 November 2008, the researcher attended 27 consecutive outpatient clinics from which 210 new paediatric patients were added to the surgical waiting list (Figure 8-1). Of these, 108 of these paediatric patients were either not eligible for the study or their parent/caregiver declined to participate The first 8 consecutive parents/caregivers to consent were interviewed as part of a pilot study (as previously reported in Chapter 6). The remaining 94 patients' parents/caregivers consented to participate in a telephone interview with the researcher. A number of these participants withdrew, were lost to follow-up, or excluded from analysis. Those excluded were parents/caregivers of children with uncommon surgical indications or were enrolled in error (i.e., child met exclusion criteria). Of those who were eligible to participate, there was not a statistically significant difference in the age of the parents/caregivers who consented, and those who declined participation (Table 8-3). Nor was there a statistically significant difference in the proportion of male children in either group. The final cohort was comprised of 80 parents/caregivers.

Table 8-3: Consented participants compared to those that declined to participate.

Variable	Consented	Declined	p-value
N	102	32	
Age (mean + SD)	4.22 + 2.72	4.74 + 2.09	0.318 *
Males (%)	65.69%	62.50%	0.742 †

* Student's t-test
† Pearson's chi-squared test

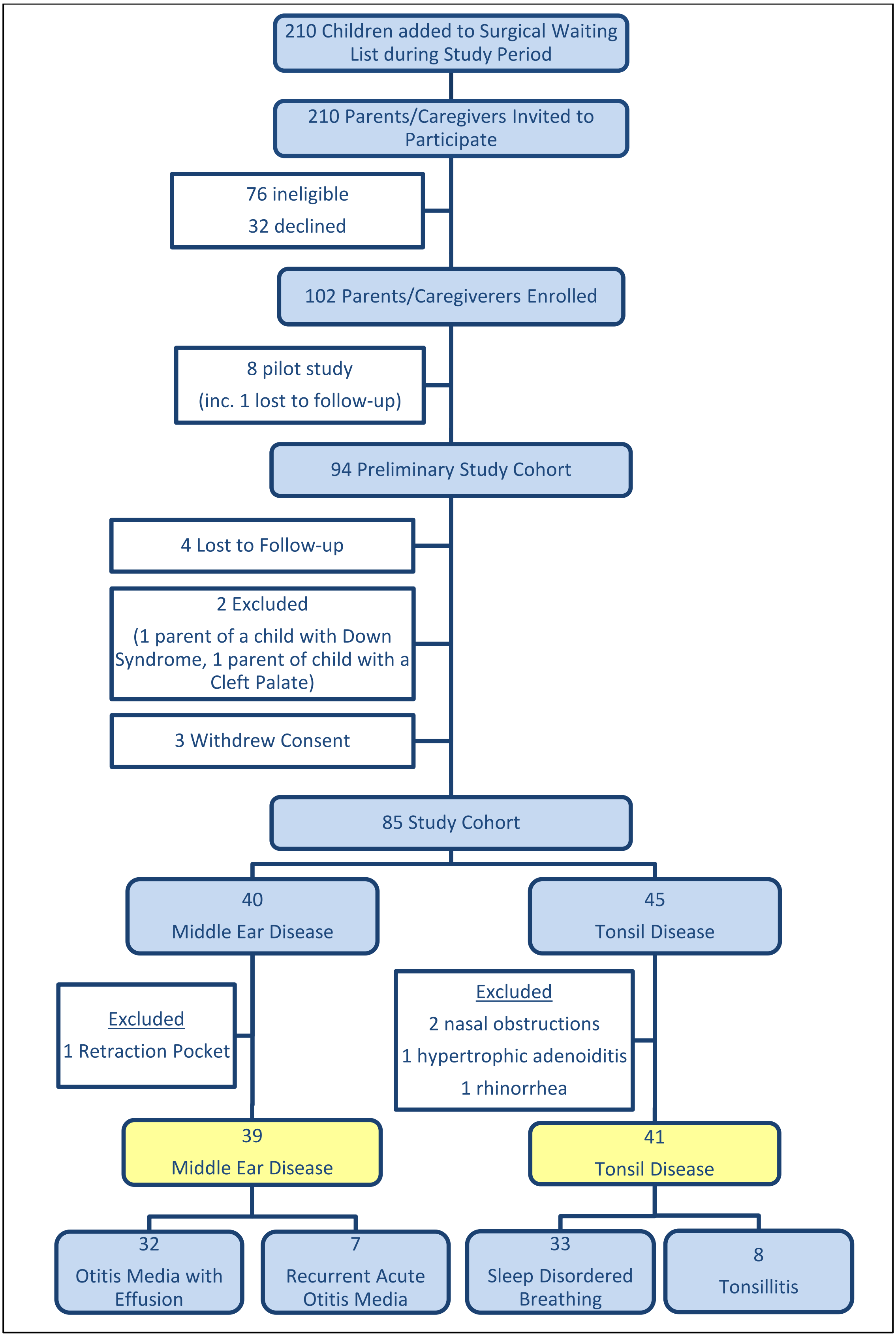


Figure 8-1: Study Cohort Enrolment and Exclusions

8.3.1 Demographic Characteristics: Children

The mean age of the children was 4.2 ± 2.4 years. More than 66% were boys and most were to be admitted as public patients (Table 8-4). English was the main language spoken at home for most children. The majority lived with their two biological parents. There was a median of two children in the family unit, although family size ranged from one to twelve children. In addition, there were typically two children living in the household, however this was not always the case with anywhere between one and eight children living in the household on a regularly basis. Within the family structure the child was usually the second child, but children ranged between being the family's first to tenth child. On average, children spent at least 4 days per week at childcare or school; with the majority of children in the study cohort residing in the northern suburbs of metropolitan Adelaide.

Children who had tonsil-related conditions were older than children with ear-related conditions ($p<0.001$) (Table 8-5). However, there were not statistically significant differences in the proportion of children with ear-related vs. tonsil-related conditions who were male ($p=0.473$), public patients ($p=0.628$), or who spoke English as the main language in the home ($p=0.159$). There was no statistically significant difference in family structure, with most children living with their two biological parents (p0.393).

In Table 8-6, the demographic characteristics of the index children who were on the waiting list for surgery are presented according to the primary indication for surgery, that is, either otitis media with effusion, recurrent acute otitis media, sleep disordered breathing, or tonsillitis. A number of children who were on the waiting list for surgery with an alternative indication for surgery are not presented in this table's data. Most of the children were to undergo surgery for otitis media with effusion (n=32) or sleep disordered breathing (n=33), with smaller numbers of children due to undergo surgery for tonsillitis (n=8) or recurrent acute otitis media (n=7).

A large proportion (58.8%) of the child were referred to the Ear, Nose, and Throat Department at the Women's and Children's Hospital by their general practitioner. At the outpatient appointment, the majority of children were referred for adenotonsillectomy or bilateral tympanostomy tube insertion (Table 8-7). On the day of the outpatient appointment, less than a third of the children had a date booked for their surgery. Children diagnosed with ear-related conditions were more likely to have their surgery booked at the time of the outpatient appointment: 13 (33.3%) children with ear-related disease vs. 10 (24.4%) children with tonsil-related disease. Furthermore, children with ear-related disorders had a shorter waiting period for surgical intervention than children with tonsil-related disorders; however, the difference was not statistically significant. Overall, the average waiting time between the outpatient appointment at which the child was added to the surgical waiting list, and the time of surgery, was 118.5 [8 – 729] days.

Table 8-4: Demographic characteristics of index children.

Variable		N (%) or median [range]
n		80
Sex	Male	53 (66.3%)
	Female	27 (33.7%)
Hospital Election Status	Public patient	77 (96.3%)
	Private patient	3 (3.7%)
Main language spoken at home	English	72 (90.0%)
	Other	8 (10.0%)
Living arrangements of the child	Two biological parents	46 (57.5%)
	Mother alone	24 (30.0%)
	Mother and others [a]	9 (11.25%)
	Grandmother	1 (1.25%)
Residential Region	Northern Adelaide [b]	52 (65.0%)
	Western Adelaide	7 (8.75%)
	Southern Adelaide	10 (12.5%)
	Adelaide Hills	3 (3.75%)
	Country South Australia	6 (7.5%)
	Interstate	2 (2.5%)
Childcare/School (days/week)		4 [0-5]

a includes child's grandparents or mother's partner/spouse
b includes 11 residing in north-eastern Adelaide, 9 residing in north-western Adelaide

Table 8-5: Demographic characteristics of index children by location of ear, nose, and throat condition, regardless of indication for surgery.

Variable	Tonsil	Ears	p-value
N	45	40	
Age (years) (mean, SD)	5.04 (2.45)	3.32 (2.13)	P=0.001 †
Male children (n, %)	27 (60.0%)	27 (67.5%)	P=0.473 ‡
Publicly funded patient (n, %)	43 (95.6%)	39 (97.5%	P=0.628 §
English main language spoken at home (n, %)	37 (82.2%)	37 (92.5%)	P=0.159 *
Living with two natural parents (n, %)	24 (53.3%)	25 (62.5%)	P=0.393 **

† Student's t-test
‡ Pearson's chi-squared test of homogeneity: $\chi 2=0.514$, df=1, p=0.473
§ Pearson's chi-squared test of homogeneity: $\chi 2=0.235$, df=1, p=0.628
* Pearson's chi-squared test of homogeneity: $\chi 2=1.985$, df=1, p=0.159
** Pearson's chi-squared test of homogeneity: $\chi 2=0.729$, df=1, p=0.393

Table 8-6: Demographic characteristics of index children by indication for ear, nose, and throat surgery.

Variable [a]	OME	rAOM	SDB	Tonsillitis
n	32	7	33	8
Age (years) (median, range)	2.9 [0.5 – 8.1]	1.7 [1.1 – 3.0]	5.0 [1.3 – 10.4]	5.0 [3.5 – 9.5]
Sex				
Males	22 (68.8%)	5 (71.4%)	22 (66.7%)	4 (50.0%)
Females	10 (31.2%)	2 (18.6%)	11 (33.3%)	4 (50.0%)
Patient election status				
Public patient	31 (96.8%)	7 (100.0%)	32 (96.9%)	7 (87.5%)
Private patient	1 (3.2%)	0	1 (3.1%)	1 (12.5%)
Main language spoken at home				
English	29 (90.6%)	7 (100.0%)	28 (84.8%)	8 (100.0%)
Other	3 (9.4%)	0	5 (15.2%)	0
Number of children in the family				
1	7 (21.9%)	3 (42.9%)	10 (30.3%)	0
2	14 (43.8%)	3 (42.9%)	10 (30.3%)	3 (37.5%)
3 or more	11 (34.4%)	1 (14.2%)	13 (39.4%)	5 (62.5%)
Number of children living in household				
1	7 (21.9%)	3 (42.9%)	11 (33.3%)	0
2	14 (43.8%)	3 (42.9%)	10 (30.3%)	4 (50.0%)
3 or more	11 (34.4%)	1 (14.2%)	12 (36.4%)	4 (50.0%)
Childcare/School (days/week) (median, range)	**4 [0-5]**	**2 [0-4]**	**4 [0-5]**	**4 [0-5]**

OME – otitis media with effusion, rAOM – recurrent acute otitis media, SDB – sleep disordered breathing
a Children with an indication that was not AOM, OME, tonsillitis or obstructive sleep apnoea syndrome were excluded from this analysis

Table 8-7: Referral to the Otorhinolaryngology Outpatient Clinic

Variable	N (%) or Median [range]	p
Referral source		
General practitioner	47 (58.8%)	
Internal within Women's and Children's Hospital	18 (22.5%)	
External ear, nose, and throat specialist	10 (12.5%)	
Other	5 (6.2%)	
Surgery booked during outpatient appointment		
Yes	23 (28.8%)	
No	57 (71.2%)	
Planned surgery		
Adenotonsillectomy	37 (46.2%)	
Tympanostomy tube insertion, bilateral	35 (43.8%)	
Tympanostomy tube insertion, unilateral	1 (1.2%)	
Tonsillectomy	3 (3.8%)	
Adenoidectomy	4 (5.0%)	
Time to surgery (days)		
Tonsil-related disorders	113.0 [8 – 729]	<0.001 †
Ear-related disorders	65.5 [12 – 218]	
Time to interview (days)		
Tonsil-related disorders	7 [1 – 35]	0.862 †
Ear-related disorders	7 [1 – 25]	

† Wilcoxon rank sum test with continuity correction

8.3.2 Demographic Characteristics: Interviewees

The mean age of the interviewees was 31.7 + 6.0 years. The majority of interviewees were the mother of the child (71, 88.8%). The remainder were either the father (8, 10.0%) or the legal guardian (1, 1.2%). Predominantly, interviewees were married or in a de-facto relationship (49, 61.3%) and considered themselves Caucasian (70, 87.5%). The majority had been born in Australia (66, 82.5%). None of the interviewees in the final dataset required the use of a translator during the interview, although they were offered a translator if English was their second language (8/80, 10.0%). Languages spoken in households where English was the second language were Bari, Creole, Farsi, Kirundi, Kurdish, Malayalam, Mandarin, and Turkish. Less than half the interviewees were currently employed (37, 46.3%). The interviewees' level of educational attainment ranged from not completing high school (31, 38.8%) through to university education (7, 8.8%). The majority either currently smoked (31, 38.8%), or previously smoked (15, 18.8%). However, 34 (42.5%) stated they had never been a smoker. There were no statistically significant differences in the demography of the interviewees across the child diagnosis groups (Table 8-8).

Table 8-8: Demographics of interviewees by child's indication for surgery (n=80).

Variable	OME	rAOM	SDB	Tonsillitis	p-value
n	32	7	33	8	
Age of interviewee (years) (mean, SD)	30.5 ± 2.1	30.1 ± 0.6	32.5 ± 2.4	34.1 ± 2.3	0.300 *
Relationship to child					
Mother	29 (90.6%)	7 (100.0%)	27 (81.8%)	8 (100%)	0.510 †
Other [a]	3 (9.4%)	0	6 (18.2%)	0	
Marital status					
Married/defacto	20 (62.5%)	5 (71.4%)	18 (54.5%)	6 (75.0%)	0.726 †
Never married/Separated/Divorced	12 (37.5%)	2 (28.6%)	15 (45.5%)	2 (25.0%)	
Ethnicity					
Caucasian	28 (87.5%)	7 (100.0%)	27 (81.8%)	8 (100.0%)	0.639 †
Other	4 (12.5%)	0	6 (18.2%)	0	
Currently a smoker					
Yes	9 (28.1%)	2 (28.6%)	15 (45.5%)	5 (62.5%)	0.230 †
No	23 (71.9%)	5 (71.4%)	18 (54.5%)	3 (37.5%)	
Highest level of education					
Did not complete High School	11 (34.4%)	2 (28.6%)	15 (45.5%)	3 (37.5%)	0.936 †
High School	10 (31.2%)	2 (28.6%)	10 (30.3%)	3 (37.5%)	
Tertiary Education [b]	11 (34.4%)	3 (42.8%)	8 (24.2%)	2 (25.0%)	
Currently in paid employment					
Yes	14 (43.8%)	4 (57.1%)	17 (51.5%)	2 (25.0%)	0.542†
No	18 (56.2%)	3 (42.9%)	16 (48.5%)	6 (75.0%)	

OME – otitis media with effusion, rAOM – recurrent acute otitis media, SDB – sleep disordered breathing
a father or guardian
b Technical, trade or TAFE certificate, or university degree
* Anova
† Fisher's exact test

From the interviews, three key themes were identified. These were the impact on the family (theme 1), the cues to seek intervention (theme 2), and the expectations of the healthcare system (theme 3). Through the first theme we get a sense of how the child and their family is affected by the child's ENT condition – socially, emotionally, financially, and physically; and how the family copes with these impacts. Through the second theme, we come to understand the cues that led parents/caregivers to decide to engage in health seeking behaviour, including the influence of the healthcare providers and the family's past medical history. And finally, through theme 3, the expectations of the outpatient appointment, waiting lists, and surgery are explored. The results of the interviews and the thematic analysis will be discussed in detail in the following sections.

8.3.3 Theme 1: Impact on the Family- "It turns her into a little bitch"

Participants described the way their child's illness impacted on the family and discussed this in relation to three domains: a) the disruption the child's illness caused to the family's day-to-day function, b) the disruption to the physical, emotional and social wellbeing of the child, and c) the adaptations that the family had made to compensate for these disruptions.

Disruption to the Family's Day-to-Day Functioning

The child's ENT condition impacted heavily on the family's ability to function in day-to-day activities. There were several ways in which this occurred. The main disruption that parents/caregivers discussed was their inability to work effectively due to sleep deprivation and the loss of income due to work absences in order to care for the child. There were also disruptions to the family's social activities, with parent/caregivers describing how the family changed or modified their activities to compensate for the child's illness.

Parents are often required to take time from work to look after their sick child. This time away from paid employment usually resulted in a reduced income for the family that was often compounded by having to still pay for childcare costs for these days. This out-of-pocket expense is a result of a popular policy in most childcare centres to charge a fee (either the whole, or a portion of, the normal fee) for any booked day, regardless of the presence or absence of the child. Essentially parents/caregivers must pay to retain the childcare place; otherwise they risk the childcare placement being reallocated to another child.

> *We don't go, you know, if he's got a fever and stuff, to childcare, … he usually stays with my next-door neighbour if he can't go to childcare and I still have to pay for the childcare and I pay her as well, so I pay double really. – Participant 24*

Surprisingly, there were instances when the child's repeated absence from childcare, or the child's elevated level of care requirement, led to the childcare management requesting the child be permanently removed from their centre. Another parent/caregiver reported that the childcare centre requested a child be permanently removed from their care because they were unable to provide care to the child who had recurrent ear infections draining from a perforated tympanic membrane.

> *Childcare wouldn't take him anymore and so I had to take [him] out of that childcare and find somewhere else to go which was really frustrating. – Participant 10*

For many parents/caregivers, repeated time away from work to care for the child created tension at the workplace. Parents/caregivers described how employers became unhappy with their repeated or prolonged absences from work.

> *I've had to take time off work because I've got to be home looking after him, so my employers aren't very happy about that. – Participant 25*

In some instances, parents/caregivers stated that they felt they had no other option but to resign from employment because of the strain caused by the workplace.

> *Both of us have basically had to resign from previous jobs because of the time we've had to take off to spend with him. – Participant 101*

Those parents/caregivers that continued working in paid employment described how lack of sleep caused by caring for their child resulted in a less enjoyable working day.

> *When I get to work I'm ultra-tired too which, you know, doesn't make an enjoyable day for me and then I come home I've got a screaming child, so it's very difficult. – Participant 72*

Tiredness was further compounded by returning home at the end of the work day to continue caring since there is 'no-one that I can hand him over to'. Lack of sleep also impeded on the parent/caregiver social life, with parents/caregivers using time previously spent doing social activities to 'catch up on sleep' or to do 'things that I would normally do during the week'.

Parents/caregivers spoke about how they would modify the family's day-to-day activities in response to the child's ENT condition. This was particularly apparent for families where the child had a condition, i.e. either recurrent acute otitis media or tonsillitis, typically caused by an infectious illness, such as an upper respiratory tract infection. This behaviour modification was an attempt to prevent the child acquiring a new episode of the illness or to prevent an exacerbation of a current episode of their illness. Parents/caregivers spoke about restricting social interactions where the possibility of exposure to respiratory disease was possible.

> *Just worrying about trying for him to not get colds from other people, and not really wanting to take him anywhere. – Participant 47*

The weather was another common concern, with parents/caregivers restraining the family from participating in activities during cold weather, during the evening, or at night. Examples given by parents/caregivers included restrictions to participating in out-of-school hours' sport during winter and in attending outdoor family functions held at night-time or in the evening.

> *We just sort of lay around the house because I can't trust getting a cold with her, you know, and if it was a nicer day than this we should do something but, yeah, I'm not going to make these big plans, you know, for her health's more important. – Participant 50*

The family's mealtime was commonly disrupted. Parents/caregivers discussed how they would prepare different meals for the child compared with the remainder of the family. Ways in which this occurred included modifying the family's menu by pureeing difficult to swallow foods, by omitting or substituting foods from the family's menu, or by preparing an entirely different menu for the child. These mealtime modifications were in response to parental/caregiver experiences of the child having difficulties swallowing food or, in some cases, foods becoming trapped in the inflamed or enlarged tonsillar crypts. However, some parents also modified the foods that their child consumed in an attempt to prevent disease onset. The following excerpt provides an example of parent/caregiver attempts to prevent upper respiratory tract infections, in this case tonsillitis, by restricting the child's consumption of cold snacks at social events.

> *The other kids, they want to eat ice-cream or drink cold drinks then when he's see (sic) any kind of ice-cream or cold drinks he wants to jump [in] and drink [but] we don't allow him because when he have (sic) it he is getting sick the next day. Yeah, very sick. – Participant 66*

For several families, the child's ENT condition resulted in a holidays being cancelled, delayed or disrupted. While a holiday cannot be considered a day-to-day activity, the disruption to such a family activity can have negative repercussions to the family both socially and financially.

> *She got a really bad ear infection three days before we were supposed to go on a holiday on an aeroplane. And she couldn't go, so we had to cancel the holiday because she couldn't fly. – Participant 34*

The financial implications of cancelled or delayed holidays included fares and payments that could not be recouped, additional fees for rebooking flights and accommodation, and additional costs of treatment provided by healthcare providers at the holiday destination. The disappointment of not being able to holiday, especially that of other children in the family, was of concern to parents/caregivers. The onset of illness while on holiday also resulted in the family being separated during holiday activities. The following excerpt provides an insight into the impact that was experienced by one family when their child developed an episode of tonsillitis while on an overseas holiday.

> *We were actually overseas in New Zealand. He became unwell, had tonsillitis, became so bad he couldn't tolerate anything to eat, anything to drink, couldn't even tolerate taking the antibiotics, he was throwing up and, yep, they hospitalised him. I think he had IV antibiotics, if I remember correctly, he was in hospital for roughly a week and then while he was in hospital he was, he contracted a Staph infection and he was out of hospital, if you're lucky, 24 hours before he had to go back again ... I actually had to stay in New Zealand longer because he was not able to fly, because the Staph infection and where it ended up being, I don't know, [pus was] coming out his ear, so it actually wasn't safe for him to fly because of, like they were worried about hearing. – Participant 101*

Emotional and social disruption also impacted on the household's daily functioning. A common thread throughout the interviews was that the child's ENT condition created tension between family members. This tension not only occurred between the child and parent, but also between the child and their siblings, and between the parent and their co-parent (the child's father, the parent's partner). There were several reasons offered as to why this tension arose, including that it was a result of family members being over-tired, and that it occurred in response to the child's behavioural changes associated with the ENT condition. Parents/caregivers felt that these relationships were affected because of they were often unable to cope due to lack of sleep combined with the stress and worry of caring for a child with an ENT condition. In the following excerpt a mother discusses how her responsibility for the overnight care of the child has repercussions for her relationship with her husband.

> *When I'm tired then I'm less tolerant with my husband and with her. I really need my sleep so that's the way that I've felt the impact. It's very stressful, just the whole lack of sleep. I can see why some relationships break up really early on, you know, if you're drained with this. I found it quite difficult to put the time into my relationship with my husband. … Parenting probably at its best has a lot of trials but [after] 15-months [of] waking up every night, you know, repeatedly, it's very draining. – Participant 40*

Most parents/caregivers described themselves as 'frustrated' and 'stressed' when discussing how the child's ENT condition impacted on them personally. Other parents/caregivers described their situation as 'scary', or that they were 'afraid' for their child, especially those who had children with sleep disordered breathing. Parents/caregivers all stated that they were 'worried' and 'concerned' about their child. Clearly, there is an emotional debt to those caring for children with ENT conditions.

Interferences in the family's social and emotional relationships were not confined to the household members. The child's ENT condition disrupted relationships with those outside the immediate family unit, including the relationships within their social network and extended family. In the following excerpt a mother discussed how the child's ENT condition affected the child's relationship with their grandparents. There was disappointment that the child's interactions with the grandparents had typically occurred while the child was ill, and there was concern that this created a false impression of the child's personality.

> *It impacts on not just us, it impacts on the rest of our family who see [name] and, and sometimes when he sees his other grandparents they only ever see him when he's sick. You know, they've never really seen him when he's not had an ear infection. And that's, and that's rather disappointing because they don't actually see the beautiful, wonderful kid that he is when he's not got an ear infection. – Participant 72*

Parents/caregivers often felt unsupported by, and isolated from, family and friends outside the immediate household. They discussed how they felt these people often did not understand the difficult demands of caring for a child with an ENT condition. Friends and extended family, who are often relied on in society as a support network, failed to fulfil this role. Parents/caregivers felt their support network did not fully understand how the ENT condition impacted on the child and their family.

Disruption to the Physical, Emotional and Social Wellbeing of the Child

The child's ENT condition affected not only their physical health, but also their emotional and social wellbeing. Parents/caregivers gave examples to illustrate how the ENT condition disrupted the child's wellbeing and described their perception of the impact that the condition had on the child. These disruptions to the child's wellbeing occurred in many ways, including emotional and behavioural changes, absences from school or childcare, and limited participation in sporting or social activities.

As one might expect, sick children are not themselves. This manifests as altered behaviour and mood, including aggression, depression, and inattention. Parents/caregivers used language such as 'grumpy', 'crabby' or 'ratty' to describe the child's altered mood during episodes of acute otitis media or tonsillitis. This irritable disposition was also associated with displays of ill-tempered behaviour. Children were inclined to display both verbally and physically aggressive behaviour towards siblings and other household members.

> *It makes her a little bit crabbier than she'd normally be, like when she's not feeling 100% she gets a lot more ratty (sic) and a bit more agro with the other kids. – Participant 16*

In addition to pain associated with the acute infection, daytime somnolence was often believed to be the main underlying cause of the irritable behaviour, particularly towards the end of the day as children became more tired. Parents often described mid-afternoon as a 'tipping point' when the child finally became so tired that they started exhibiting this undesirable behaviour.

> *She's always grumpy. Come 3 o'clock she's grumpy as. Fighting all the time because she's so tired ... [her illness] turns her into a little bitch. There's no other way to say it. – Participant 14*

Children with sleep disordered breathing were often described as restless sleepers that snored loudly and breathed through their mouth during their sleep. Parents/caregivers were often not overly concerned about the impact of the snoring on the child, but more focussed on the disruption to the sleep of the other household members. However, there was particular concern if the child had apnoeic episodes with one parent stating that 'he snores and he breathes really loud and if I do not hear him, I am so used to him being like that, being able to hear him, if I don't hear him I have to get up and see him.' Parents/caregivers also described their child's tired and irritable behaviour throughout the day, but often thought that this behaviour was typical for the child's age. For some parents/caregivers, the link between the poor sleeping pattern and the behavioural issues was not obvious until suggested by a medical practitioner.

Aggressive behaviour was often a result of the child's own frustration with their ENT condition. One of the prompts for this frustration was communication difficulties. For the children in this study, these difficulties tended to be caused by either enlarged tonsils inhibiting pronunciation, or because hearing was impeded by otitis media.

> *They sort of fight every now and then, because [he] can't get across how he's feeling. He can't get across what he wants to say, so he'll hit instead or, you know, he'll push or he'll start crying because he gets upset, he can't explain why. – Participant 10*

Parents/caregivers of children with acute ENT conditions, such as otitis media or tonsillitis, described the child's distress at being in pain and discomfort. The behaviour that the children display was described by parents/caregivers as being out of character and as a result of, and an expression of, their pain and discomfort.

> *I've constantly got her sitting on my lap and being sooky and crying and all that kind of stuff because she's in lots of pain from it. – Participant 58*

> *I walked into the lounge-room and [he's] been hysterically screaming two seconds before, and I've come back into the room and he's been smashing his head into the couch. I'll say 'what are you doing?' because I was so worried for him, and he'll just say my head is so sore mum. It doesn't make any sense to me why you'd hit you head if it's that sore but, you know, he just doesn't know what else to do. – Participant 75*

In addition, children were described as being uninterested in their usual activities. This disinterest was discussed in association with descriptions of lethargy and sleepiness. Children with either sleep disordered breathing or recurrent acute infection (otitis media or tonsillitis) had increased daytime somnolence, which parents found concerning. In the following excerpt, a parent describes the behaviour of a child with sleep disordered breathing, expressing that the behaviour is upsetting and unexpected.

> *She's always lethargic. She's very tired all the time. She gets in depression mode. She doesn't want to do anything. She'll just lay on the lounge or she'll go and lay on her bed*

> *and she'll go to sleep. She's always tired. She doesn't want to eat. Yeah, it's just depressing to see a four, well, now five-year-old child being like this. – Participant 96*

In contrast, parents/caregivers of children with otitis media with effusion did not exhibit the same level of concern as parents of children with sleep disordered breathing or recurrent acute infections. The behavioural changes that they described were related to hearing impairment, primarily inattentive behaviour. They often stated that they did not realise that this behaviour was resulting from the ENT condition, ascribing it to 'typical toddler' behaviour. That is, parents/caregivers were often unaware that there was a medical problem until childcare workers or teachers highlighted that the inattentive behaviour was not normal.

> *We had a lot of problems with his behaviour for a while because he couldn't hear what was happening and we didn't realise that he couldn't hear, so we had a lot of behavioural problems. – Participant 23*

While parents/caregivers of these children discussed the behavioural issues caused by hearing impairment, it was often in the context of the delayed diagnosis. That is, they focussed and reflected on the revelation that the hearing impairment was the cause of the inattentive behaviour, with relief that the behaviour was not part of their character.

When parents/caregivers discussed the impact on the ENT condition on the physical wellbeing of the child, they commonly mentioned multiple interrelated symptoms. Most commonly mentioned were snoring, hearing impairment, speech delay, and obstructed breathing. For parents/caregivers of children with enlarged tonsils, there was particular focus on issues related to eating. Loss of appetite, difficulties in swallowing, and loss of weight were all frequent topics. Most commonly parents/caregivers expressed concern over the child's inability to eat, particularly if it was resulting in a loss of weight.

> *She's been losing a lot of weight since July... [She is] losing so much weight. She's now under 14 kilograms. – Participant 96*

However, parents/caregivers also expressed their sympathy with the child regarding the difficulties in swallowing food, with the following excerpt illustrating this.

> *He's just not eating, he's not eating, he's got no appetite, he doesn't want to eat, and I don't blame him, I wouldn't either. – Participant 25*

Many parents expressed a sense of helplessness at being unable to fix their child's condition, or to provide the child with a reprieve of their symptoms.

> *Sometimes he gets really, really sick. We have to put him on antibiotics and there's nothing we can do about it. – Participant 77*

Parents/caregivers of children with acute otitis media tended to focus on the pain that the child experienced and related this to those issues already discussed, including disrupted sleep and daytime irritability. However, they also had similar concerns as parents/caregivers of children with otitis media with effusion, including the child becoming 'clumsy' and 'off balance' during an episode of illness. This was of concern to parents/caregivers because there was the potential for the child to injure themselves, for example, by falling off play equipment. Parents/caregivers also expressed concern at observing that their child had hearing difficulties. This was observed as either the child turning up the television, or the parent needing to speak in a raised voice to be heard. In some instances, children were unable to hear their teacher in the classroom, impacting on their school work. Children with either ear- or tonsil-related conditions were described as experiencing difficulties in speech development or pronunciation.

> *He mumbles and he, basically he knows exactly what you're saying but it's like he is trying to get it out but he can't. – Participant 26*

> *People can't even understand what she's saying. They ask her a simple question, it's not real, real bad, but they do struggle with her speech. – Participant 44*

There were concerns expressed about the impact of these speech delays on the child's learning. Parents/caregivers were particularly concerned if their child had missed large amounts of kindergarten or school due to their ENT condition. For children who were not yet at school, there was an urgency to get the condition treated before the commencement of the child's formal education.

Adaptations and Coping Strategies

Parents/caregivers discussed many methods of coping with the impact of the child's ENT condition. Coping usually took the form of modifying or adapting current activities to compensate for the impact that the ENT condition was having. A good example of this behaviour modification consistently occurred for children with otitis media with effusion. For these children, the main method of adaptation was to increase the volume on the television. This simple, yet effective, adaptation was performed by both children and parent/caregivers. In addition, parents would liaise with teachers and childcare workers to ensure the child was sitting up the front of class and/or was given more time to listen to instructions. To compensate for perceived speech delays parents spent more time reading with their child than they might have done under normal circumstances.

> *We have to, you know, talk louder to him and then I spend a lot of one-on-one time with him reading books and going through picture books and things like that so that to help him learn some vocabulary that he might be missing normally just from everyday life or from kindy. – Participant 25*

The primary method for coping with eating difficulties was to prepare alternative meals for the child. As previously mentioned, parents/caregivers modified the family menu as they deemed appropriate. This resulted in either substitution of difficult to swallow foodstuffs with more palatable items or by modifying the foodstuffs, most commonly by finely dicing or pureeing foods.

> *I have to cook different food for [child's name] because she can't eat certain foods. – Participant 19*

While this method of coping may address the main issue – meal time angst – it does not provide long-term resolution. Preparing, or purchasing, different meals may be costly and time-consuming. Also, consistently consuming pureed foods may lead to another set of health consequences, including lack of muscle development in the jaw. Restricting difficult-to-swallow foods may be effective in preventing distress while eating, but has the potential to lead to nutritional deficiencies. An example would be meat, which can be difficult to chew and swallow, the restriction of which could lead to iron deficiency. Another potential outcome of restricting food items from the menu could be social exclusion. The following excerpt provides an example where a parent/caregiver restricts the consumption of cold or frozen items by his son.

> *We don't allow my son to eat any ice-cream or any cold drink or anything ... because when he have it, he is getting sick the next day. Yes, very sick. – Participant 66*

It could be argued that by restricting the consumption of 'treats' at social occasions the child is being socially isolated from an activity in which his/her peers are participating. That the consumption of food is a social activity – we gather together with friends at parties and barbeques – and that restricting the consumption of 'treats', such as ice-cream, may have negative consequences for the child's morale. However, it is also true that the restriction of such foods may be more nutritionally responsible, as ice-cream and soft drinks are sugar loaded, low nutrition foodstuffs. Of more concern, this excerpt indicates that parents/caregivers may benefit from additional education on disease causation. This parent has incorrectly linked the consumption of cold foodstuffs to the onset of upper respiratory tract infections, in this case tonsillitis.

Often the overnight care of the child was the sole responsibility of one parent/caregiver. This was usually an attempt to ensure that other parent got a greater amount of sleep, particularly if they were the main incomer earner or if they were a shift worker. However, while this was a short-term coping strategy, it typically 'took its toll' after a time, leading parents/caregivers to feel exhausted and stressed.

> *My husband works different shifts too which leaves the [care to me]. I'm the sole person to get up to him and to, you know, look after him and things like that. You know, my husband needs to sleep too, and yeah, it gets a bit stressful sometimes. – Participant 72*

To compensate for the disparity in the amount of sleep attained by household members each night, parents/caregivers would seek support from their spouse and family. In households where one parent/caregiver was a shift worker, the other parent/caregiver would take responsibility for overnight care of the child. However, the shift worker would provide some relief during their days off by sharing the overnight care. Parents/caregivers spoke of taking 'naps' to gain extra sleep during the day to compensate for late or long nights spent caring for the child. They also acknowledged the importance of spending dedicated time with the other household members, including ensuring good communication with their spouse.

> *And he [husband] has been very patient with me and it's lucky that we've got good communication skills because I can see why [relationships fail]. – Participant 40*

In addition, parents discussed difficulties they had ensuring that they spent enough time with the other children in the family.

> *When you've got so many kids like ours, sort of, you know, we sort of shuffle, shuffle them all around, you know, and sort of give everyone the attention they need. – Participant 19*

These results indicate that for parents/caregivers there is a constant balancing act between caring for the child and their needs, and spending time looking after themselves and the other members of the family unit.

8.3.4 Theme 2: Cues to Seek Intervention - 'Enough's Enough'

Parents/caregivers discussed the influencers of their decision to seek intervention as a) the level of concern of the healthcare providers, and b) the past medical history of the child and family. The resultant outcome was a result of c) different responses of families to the same disease profile and d) different doctors providing different interventions.

Influence of Healthcare Providers

Parents/caregivers were frustrated at the cyclic nature of tonsillitis or otitis media, and many expressed frustration at the limited treatment options. They discussed how general practitioners 'just put [them] on antibiotics'. It was clear that over time parents/caregivers no longer accepted this treatment option. There was concern over repeated or prolonged exposure to antibiotics, and many were concerned about the child's development of, or potential to develop, antibiotic resistance.

> *We had to keep putting him back on the antibiotics, and then he had a point where he actually created an immunity to the antibiotics. So we had to bump him up to a stronger antibiotic so it would work. Because we actually had him on, for two weeks straight, on one antibiotic and it just didn't do anything. So we had to put him on the stronger one and that finally knocked it on the head for a little while. – Participant 75*

The frustration associated with the repetitive antibiotic treatment was amplified if the benefit was no longer apparent.

> *They [the infections] were starting to get worse and longer, the antibiotics stopped working. – Participant 72*

> *The medication's not helping her at the moment. I'm sick and tired of buying her antibiotics because of they don't seem to being doing anything to help her ... You know that she's not feeling the best but there's nothing you can do. You try to give her Panadol but you don't want to keep on pumping drugs into a child all the time so they shouldn't have to have that. – Participant 96*

Many parents/caregivers were not content with conservative management by general practitioners. However, it can be assumed by their accounts that these general practitioners were implementing current guidelines for the treatment of tonsillitis and otitis media, including 'watchful waiting' and number of episodes per year.

> *He didn't seem to think that three or four times warranted him having to have his tonsils out at a young age. He was more inclined to see how he continues on over the next few years and see whether it's a continual persistent problem or not. – Participant 52*

Parents/caregivers placed value on the opinion of the specialist ENT surgeons. Despite expressing concern at the prospect of their child undergoing surgical intervention, most were accepting of the advice for surgery. Acceptance was directly influenced by the perception that surgeons were an authority.

> *And he said, Dr [name] said that it can cause permanent damage and that's what I was worried about, but I think the grommets are the only way to go. – Participant 76*

Parents/caregivers used phrasing such as 'they're the doctors, they know what they're talking about' and 'they know what they're doing, I guess' to describe their understanding that surgeons were 'experts' regarding treatment. They compared the ability of general practitioners to that of the surgeons.

> *Local GPs they only do certain things when it comes to ears. I've had lots of doctors come to my house, you know, like your locums, and they tell me she's got an ear infection. I take her in and [surgeon] takes a look and goes 'no she hasn't'. She's on antibiotics for no reason. A waste, you know. They just don't look into the ears properly; they just don't*

know what they're looking at. So, if you've got a problem with your kids it's always best to go to somewhere that specialises in it, get the problem sorted out. – Participant 74

The ability of the general practitioners to adequately treat the condition was questioned. Some parents/caregivers discussed that treatment provided by a general practitioner was limited because they had limited facilities and knowledge.

Influence of Past Family History

The influence of the parents'/caregivers' past experiences influenced the urgency that they placed on getting a referral from their general practitioner. These experiences included both their own medical history and the medical history of their other children or spouse. They were often also influenced by the opinions of friends or family members outside the immediate family. Experiences where surgical intervention was perceived to have cured or reduced the occurrence of disease episodes influenced the parents/caregivers towards an acceptance of the surgical intervention for the current child. They would request surgical intervention as a preventive measure to circumvent repeated episodes or progression of the ENT condition.

He's going to keep getting it until he gets them out ... I had tonsillitis too as a child, bad. And I was like him, so I got mine taken out when I was seven. – Participant 25

In addition, parents/caregivers who perceived that there was related family medical history were accepting of surgery for their child.

I had my tonsils taken out when I was 13 because I had very bad tonsillitis. And his biological father had sleep apnoea when he was younger.... I am happy for him to have his tonsils out if it is going to help with his breathing. – Participant 92

Parents/caregivers who had heard of the benefits of surgical intervention were keen to seek the same treatment for their child's ENT condition. When their general practitioner was not forthcoming with a referral for surgical intervention, they sought referral elsewhere.

> *I heard other kids that get, the other children that get grommets and stuff for ears but our doctor said 'no, it wouldn't help him'.... so I sort of went 'I'm not sure' and I took him to a new one. – Participant 62*

In contrast, those parents/caregivers who had no prior experience with surgical intervention for the child's disease were less open to acceptance of surgical intervention. Some sought a second opinion before accepting that surgical intervention would be necessary.

Different Family – Different Response

Although the children in the study cohort often had similar symptoms and diagnoses, families responded differently to the conditions. The family household dynamic, individuals' personalities, financial circumstances, and their coping strategies and ability to cope all influenced the response to the ENT condition. Each parent/caregiver indicated that they reached a 'tipping point' whereby the equilibrium of caring for the child could no longer be balanced against the disruption to the family. It was at this point that 'enough was enough' and more definitive intervention was requested and, often, demanded.

> *I just said to Dr [name] 'look I've had enough' because he's just constantly, constantly being sick.... So finally, yeah, Dr X said 'alright, yep' and got the referral through. It took a while, took quite a while, took quite a few times of me screaming 'come on, please, his ears really aren't that good' so, but yeah, finally we got it. – Participant 51*

> *We pretty much pushed [for a referral] because her speech was becoming an issue. So we put it towards [the GP] and then we pushed it that we really wanted to get it looked at. - Participant 44*

> *I wasn't too happy. The doctor was going to take a little bit more of a laid down(sic) approach. He did the referral but took a while. [He] just [wanted to] leave it longer. – Participant 90*

Many parents spoke of having to convince the general practitioner to refer them to a specialist. They used words such as 'fight', 'push', and 'demand' when discussing getting a referral from their general practitioner. The results of this study indicate that the 'tipping point' differs between families and that it was underscored by parent/caregiver stress, fatigue, and an inability to continue providing an appropriate level of care to all family members. This difficult to quantify entity is a key driving force in parental surgery seeking behaviour.

Different Doctor – Different Outcome

Most parents/caregivers attended one regular medical clinic. However, it was commonly reported that they would see any one of the doctors that consulted in the clinic. Furthermore, it was common to have both a regular medical clinic, and a second clinic used when unable to get an appointment at the first. This situation was commonly reported by parents/caregivers of children with otitis media or tonsillitis, but not of those with children with sleep apnoea. Typically, the parents/caregivers of children with sleep disordered breathing received a quick referral and did not have the same protracted treatment and referral experience.

Parents/caregivers of children with otitis media and tonsillitis spoke about inconsistencies in the medical opinions they received regarding their child's infectious ENT condition. Generally, they were initially accepting of the treatment plan recommended by the general practitioner. However, there were numerous reports by parents/caregivers that they received alternative advice from a different doctor which led to a different outcome.

> *We kept taking her back to the doctor's and they just kept saying, you know, that she's got another throat infection. And then we went in because she had a fever and we went in one day and we went and seen the different doctor and he looked at her tonsils and said that she needed to get them out because they're just too big. And then suddenly we got referred. – Participant 14*

When this occurred they expressed dismay and anger that they had allowed the general practitioner to persist with conservative management, particularly if the management was over a prolonged period of time. Furthermore, these inconsistencies in medical advice led to questioning of the medical care provided by the general practitioner.

> *The doctor had said 'oh you know I just think he's a normal child saying what all the time' and things like that. So initially I wasn't very happy then because, I mean, I went away and thought 'well okay maybe he's right he's just being a normal child'. And then looking back on it now, you know, that this has all happened, it sort of makes me a bit angry that he didn't take it more serious. So, yeah, but I mean, in recent times going to another doctor it's all been, been fine and we've got the referrals. – Participant 23*

The reasons for seeing different doctors were varied, including moving house, medical care during holiday travel, and 'shopping around' for medical treatment. Parents/caregivers who were not happy with the interaction between the general practitioner and their child preferred to seek medical care elsewhere, despite both practitioners advising the same 'watch and wait' approach.

> *We were seeing the doctor about his hearing all the time and he kept checking his ears for ear infections and they said that he was having them quite often but he didn't suggest anything for them.... This new one [doctor] said we'll keep an eye on it and see what happens and he seemed to be really good with him. He was really friendly to [child] and everything. Our other doctor was a bit gruff with the children. – Participant 62*

Parents/caregivers often expressed that the doctor did not appreciate their knowledge on the severity of the child's condition – that as parents/caregivers they were the 'experts' on their child's health. When they did not get the desired outcome, that is, a referral for surgery, parents/caregivers would 'shop around' and seek out a doctor that would.

> *The first doctor did nothing. He was a dickhead. So I just had to take him back to see, I think it was, Dr [name] or something. Back to see a different doctor and he actually looked in [his mouth], and that's when he said 'look, he's got swollen tonsils'. – Participant 74*

> *I have seen a private specialist as well. And, so the coming to the Women's and Children's was a second opinion.... They've both given me two conflicting opinions so I'm a bit undecided as to whether to go for a third and kind of see.... see which is the best out of three, sort of thing. But one said to have tonsils, adenoids and grommets out and the hospital has said just to do the grommets. So, I don't know. But I'm a bit annoyed. – Participant 52*

Generally, the outcome of conflicting information and medical approaches from medical practitioners – whether different general practitioners, different specialists, or both – was that parents/caregivers were left feeling confused, unsure, and angry about the situation. The decision for their child to undergo surgery became more difficult as they tried to navigate the unfamiliar medical field.

8.3.5 Theme 3: Expectations of the Healthcare System - 'There's light at the end of the tunnel'

Parents/caregivers discussed a) the expectations of the outpatient appointment, b) expectations of the surgery, c) the experience of having to wait, and d) the options available to them.

Expectations of the Appointment

When discussing the duration between the referral and the appointment many parents/caregivers complained that the time was too long. Many recounted the number of additional episodes of tonsillitis or otitis media, or the number of days absent from kindergarten/school, that the child had during this time. Generally, they were less bothered if they had an appointment date issued soon after the referral, thus giving them a goal to work towards. Parents/caregivers expressed frustration when they were notified that their appointment was to be moved, or if they had limited notification about the date and time of the appointment.

> *We only found out about the appointment last Friday so I only had a couple of days' notice to the appointment and it just seemed a bit strange to be waiting that long and then only get a couple of days' notice about the appointment. – Participant 37*

Some parents/caregivers expected a long waiting time between referral and appointment, and were surprised when the appointment date was sooner than expected.

> *Six weeks ... I was actually surprised I got it that quick. I was actually surprised. – Participant 89*

Despite having to wait long periods between the referral and appointment, most parents/caregivers attempted to be empathetic of why these delays existed.

> *They sent a referral to the WCH [sic] and I didn't get an appointment for like 2 months later ... But I can understand because there's not just my child, there's lots of children that need stuff done. – Participant 88*

Many parents/caregivers spoke about the busyness of the outpatient clinic, often mentioning that their appointment time was delayed on the day of the appointment. However, as with waiting for an appointment date, many expressed empathy with the other clinic attendees and with the workload of the medical and nursing staff.

> *You can see in the clinic there there's so many people with the same problem, it's very sad. – Participant 28*

> *The doctors are busy.... [they] have to talk to the sick people or talk to the parents of the children giving them advice, so you will have to wait until your time. – Participant 64*

However, there were a number of parents that felt that the amount of time with the doctor was not sufficient. They mentioned that they felt the appointment was 'rushed', or that the doctor did not spend 'enough time' with the child. In the following excerpt a parent expresses concern over the brevity of the appointment, that there is some worry that the decision for surgical intervention may not be considered, and that she felt inadequately informed about the current health status of her child and the procedure the child was to undergo.

> *A very quick appointment at the ENT, so it was pretty much just in and out within a couple of minutes so I presume that there was still fluid there or something. I'm not 100% sure but we didn't have a very, umm, in depth conversation when we went there.... It's probably not his fault that he was like that it was just he was probably in a rush, and had lots of patients to see as well.... [I left] feeling confused. I went home and looked on the internet and sort of researched about it.... It just felt like I haven't had, like I haven't really had it explained to me as yet. – Participant 38*

By the time that the child had their appointment in the hospital's ENT Department, many parents/caregivers had come to expect that the likely recommendation would be that their child required surgery. For many parents/caregivers, the referrer (usually the general practitioner) had discussed the possibility of surgery at the time of the referral. However, some parents/caregivers were surprised to be put onto the surgical waiting list. These were predominantly parents/caregivers of children with otitis media with effusion who, despite acknowledging that their child had hearing problems, often did not realise the severity of the condition.

I wasn't expecting them to book him in to have that done straight away at all, so, yeah, it was a bit of a shock. – Participant 38

Nevertheless, the majority of parents/caregivers accepted that their child required surgery, stating that they had 'faith' and 'trust' in the surgeon's decision.

I have a bit of faith in surgeons, they are surgeons for a reason, you know. – Participant 35

It has to be done. I trust that, I trust what, umm, the doctor said. – Participant 47

Other parents/caregivers who expected surgical intervention were disappointed when doctors recommended a more conservative approach. When there was the possibility of the child requiring more than one procedure, parents voiced that their preference was for all procedures to be done simultaneously, rather than in a conservative step-wise approach. The following excerpt illustrates this.

The doctor was discussing his adenoids and the fact that he might have adenoid tissue that needs to be removed, umm, which, honestly, if like I said to him, if that was a contributing factor that I would prefer them do it straight away, but the senior doctor said that he was too young to remove it or do it or something, and I wasn't, you know, too impressed with that. – Participant 28

Ultimately, parents/caregivers were 'relieved' when they had been placed onto the waiting list for surgery. This provided them with a 'light at the end of the tunnel'. There was greater satisfaction expressed by parents/caregivers who had been provided with a date for surgery at the time of the appointment or soon thereafter. However, parents/caregivers were also satisfied when there was a timeframe provided.

Because her tonsils are so big they said that she's a category two which means they want her done, you know, the sooner the better. So we'll have to wait no longer than 3 months. – Participant 91

Most likely, a timeframe provides a sense that the ENT condition is finite; that there is a date to work towards. Although, the length of time that parents/caregivers were happy to wait varied, with some parents satisfied with longer timeframes so long as there was a plan to intervene. In addition, their satisfaction was dependent on their perception of the severity of their child's condition, which was sometimes disparate from the doctor's perception. Parents expressed disappointment when the child was placed on the surgical waiting list at a lower priority than they expected.

> *I'm relieved now to know that it's definitely been booked in. It's all set and done. I was just very upset that they thought that she wasn't priority higher than what she was, which was category 3, because as far as I was concerned I think she needed to be pushed a bit further. – Participant 96*

This suggests that there is a 'disconnect' between the experiences and understandings of parents/caregivers and their perceived need for intervention, and the clinical disease profile used by medical practitioners to determine intervention priority.

Expectations of the Surgery

All parents/caregivers expected the surgery to improve the child's quality of life. They believed that the surgery would improve eating, sleeping, and hearing; that the pain associated with the child's ENT condition would be reduced; and that the number and severity of the episodes of disease would be decreased. However, the amount of improvement expected varied amongst the interviewees. While some parents were unsure how much improvement to expect, others believed that surgery would cure their child and prevent any future relapse of disease.

> *I'm hoping it's gonna help her eat a little bit better, sleep a bit better, feel a bit more comfortable and be a little bit more up and outgoing again, and hopefully pick up where she used to be before she came down with these symptoms. – Participant 96*

I do not know much how the operation will help but since medical experts and doctors, they said if it is done then it will relief (sic) forever and then I think it will help much. – Participant 64

Despite the amount of improvement that parents/caregivers expected, most based their opinion on the information that the doctors provided.

He [the doctor] said it would be very dangerous for his health, and he say that it is not a very serious problem but he said if this continues to happen there are other side effects for it, inconveniences with his health and with his growth, his normal being will not be that right. – Participant 64

They're gonna fix him, that's what the doctors said yesterday. – Participant 77

The value that parents/caregivers place on the information that the doctors provide clearly indicates that this is a crucial time for information dissemination.

Experience of Waiting

Waiting was central to the experience for many parents/caregivers. They discussed waiting for appointments, waiting for treatment to work, waiting for a referral, waiting in the hospital waiting room, and, finally, the prospect of waiting for surgery. When it was difficult to get an appointment with their regular general practitioner, rather than waiting for an appointment parents/caregivers would seek medical care with other general practitioners at either the same clinic that they attended, or at another clinic in the area. Most parents/caregivers had seen a general practitioner on numerous occasions for treatment or discussion about the child's ENT condition. From parental/caregiver reports, children with sleep disordered breathing were referred much quicker than those with infections. Parents/caregivers tended to only see a general practitioner a few times before a referral was made for the child. In comparison, children with infections saw a general practitioner a greater number of times. The number of times that children saw a general practitioner prior to referral was often many more times than is currently recommended in international guidelines.

> *He's had about 14 courses of antibiotics [in a year]. - Participant 41*

> *Last year she had tonsillitis 26 times. The year before that she had it 24, and this year she's had it, she's on her 16th dose of it now. – Participant 58*

When parents/caregivers felt that treatment (usually antibiotics) was not working or that a referral was required, and their general practitioner did not provide the expected treatment or referral, they would shop around or get a second opinion. Parents/caregivers often expressed that the general practitioner did not appreciate the severity of the condition. And when parents/caregivers reached a 'limit' they demanded action.

> *I took him to the doctors and they said that nothing was really actually wrong with him.... Then after about a month or so or maybe even, yeah about a month and a half, I kind of jumped up and down and said that I wanted more action to be taken.... While all this was all happening I wasn't really happy with that doctor so then I moved to a different doctor. – Participant 75*

> *I just said to Dr [name] 'look I've had enough', because he's just constantly, constantly being sick.... so it took a while, took quite a while, took quite a few times of me screaming 'come on, please, his ears really aren't that good' so, but yeah, finally we got it, got it through. – Participant 51*

As previously mentioned, by the time children with infections were seen in the ENT outpatient clinic many parents/caregivers expected surgical intervention. Many expressed disappointment when doctors advised a 'watch and wait' approach, since most had already been 'waiting' with their general practitioner. Several parents/caregivers discussed having to wait longer for intervention if the child did not have active infection at time of the ENT specialist appointment.

> *The appointment before that, he'd only just had an ear infection and I actually got ear drops from the GP which they've never done before. It cleared up the discharge basically straight away and this was only a week before the appointment so when I took him into the hospital, they said "oh his ears look fine, there's nothing wrong with him" but I knew that he needed the grommets. – Participant 10*

When discussing extended waiting in the hospital waiting room, the main concerns were about parking costs and keeping young children occupied. At the time of this study, street parking surrounding the hospital was limited to two-hours, with stringent monitoring and issue of infringement notices by the governing council. Complaints were made about the lack of space available in the long-term parking facility, particularly by parents/caregivers with appointments in the afternoon (by which time the car park was full). Parents/caregivers suggested that if clinic times were running late, notification to arrive late would be of benefit.

> *We were waiting for like an hour and half before we saw [doctor] so I was just a bit upset, you know, I'd got an appointment time an hour and half different I would have rocked up then. – Participant 34*

There was a mix of opinions from parents/caregivers regarding the projected length of time that their child would wait on the surgical waiting list prior to surgery. As previously mentioned, many parents/caregivers were pleased to have a potential finality of the ENT condition. However, despite this, many were also disappointed at the projected length of the wait.

> *I wasn't very impressed with what the doctor had said, suggestions made, not for a 5-year-old child. I was very disappointed with the fact that she was put on a 6-month wait. – Participant 96*

There were concerns that the child's condition would be ongoing, or worsen, in the interim. Parents/caregivers expressed concern about the number of additional infections and courses of antibiotics that would be required during the time waiting for surgery. They spoke of concern about further lack of sleep, loss of weight, and 'who knows what could happen'.

> *It's a long waiting list. Up to six months that we could be waiting, which is a little bit long because he's just going to be having more and more courses of antibiotics so, [I'm] not too happy about it. – Participant 41*

Many parents begrudgingly accepted that having to wait for surgery was part of the public healthcare system.

> *It's to be expected… there isn't much I can do about it, I just have to wait. – Participant 23*

While many expressed that they were unhappy with having to wait, many conceded that waiting should be expected unless you were willing to pay or had insurance to cover surgery at a private hospital.

The Possibility of Other Options

While many parents/caregivers had considered the option of private surgery, either by seeking surgery at private hospital or electing their child to be a private patient at a public hospital, most stated they were not in the financial position to pursue this option. Some parents had previously had private health insurance but had to cancel it because of the financial burdens of caring for their child. Others simply stated that they had not considered private surgery because they knew they would get treatment through the public system.

> *We didn't think about the private person or the paying money side of things, because the Women's and Children's Hospital, that option was there. – Participant 45*

Despite having private insurance, some parents/caregivers still chose for their child to undergo surgery at the public hospital. This decision was made after consideration of the potential pros and cons, including the proposed waiting list time and the financial implication of private insurance. Even though a number of parents/caregivers had private insurance, they were necessarily able to afford to pay the ‘gap’ to utilise it.

> *We do have private health insurance. I thought about doing it, the only thing, I mean, they’re the same surgeons that do, you know, basically that do the public they go private.... I was told if you go public it’s a lot longer waiting list. I didn’t want to wait too long. You just don’t want to play around with these things. I’ve waited long enough to have them put in, but as it was they said “three months” and I was happy with that. Being a single mum, money’s always an issue and if I’m going to get the same sort of service, I figured I might as well go public. – Participant 51*

Nonetheless, many parents/caregivers stated that would keep their options open, and would explore the option of a private surgeon if they had to ‘wait too long’. However, when asked they were often unable to quantify the duration they would be willing to wait. Yet several parents/caregivers did cite 12 months as too long to wait. Instead, the cue to seek intervention was aligned to the severity of the child’s condition. Parents/caregivers usually said that should the child’s condition worsen during the waiting time, or if the time waiting for surgery became protracted, they would seek alternative arrangements.

> *There wasn’t a huge waiting period, yeah, we stuck with the hospital. I think if it had been like a 12 month waiting period I would have gone private because I can’t live like this for 12 months, with the sleep issues. – Participant 83*

Many based their decision on the information provided by the ENT surgeon seen at the time of the clinic appointment. Often, parents/caregivers said that they were advised there was little difference in the waiting list time for public and private patients. However, this did vary dependent on the child's indication for surgery.

> *He [doctor] said it wouldn't be much time difference. Yeah the waiting list wasn't much different so I could've paid the money to go private but it would've been about the same wait. – Participant 39*

Depending on the diagnosis and severity of the condition children were allocated to a 'category', with category 1 patients being more urgent than those in category 3. As previously mentioned, this was often at odds with the parents'/caregivers' perception of urgency. Furthermore, some parents/caregivers were angry that they were unable to access what was perceived as more prompt service through a private surgeon.

> *I think it's wrong because if I was a private patient I'd be done straight away and that, that sort of makes me angry. You know, not all of us can afford private self-cover. – Participant 89*

A number of immigrant parents/caregivers spoke of wanting to take their child back to their country of origin for medical care. They spoke of the unfamiliarity of the Australian healthcare system and the proposed surgical intervention. If they were not able to return to their country of origin, they would seek advice using alternative methods.

> *I have never heard such a surgery in India we just asked the doctor in India just through email.... I can't take him immediately to India, that's the problem. – Participant 59*

Based on the waiting time suggested by the ENT staff, a few parents had already made plans to attend a private surgeon.

> *I've made an appointment to see a private, someone privately, because I was told that it would be 12 to 18 months before he can get them out. – Participant 80*

Other parents/caregivers described how they 'shopped around' for surgery for the child, with one parent/caregiver explaining that they the child was on the waiting list at two different public hospitals to see where the surgery was most likely to be performed first.

> *I was thinking about it but I just wanted to see, I do have back-up plans in December with the Lyell McEwin but now that this appointment has been made and a secured date I will need to cancel that but I was just going to see what happened in December first to then make the decision whether to go private. – Participant 96*

These behaviours indicate that the way that parents/caregivers view and value the public and private healthcare systems differ. These differences are influenced by a multitude of factors, including cultural background, disease severity, and financial circumstances.

8.4 DISCUSSION

In this chapter, the results were presented for a cross-sectional qualitative research study. This study involved a series of interviews conducted with parents/caregivers of children due to undergo tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion at the Women's and Children's Hospital. The children had a range of underlying medical conditions that contributed towards the need for surgery, predominantly otitis media, obstructive sleep apnoea, and/or tonsillitis. Three key themes emerged during the interviews: 1) the impact on the family; 2) the cues to seek intervention; and 3) the expectations of the healthcare system. The findings were influenced by the parents'/caregivers' cultural and social background.

8.4.1 Impact on the Family

The impact the child's medical condition had on the family was discussed within the context of three distinct domains: 1) the disruption to the family's day-to-day functioning; 2) the disruption to the physical, emotional and social wellbeing of the child; and 3) the coping and adaptations that the family made to compensate for these disruptions. The first domain was centred on the impact to the parents'/caregivers' work, particularly the inability to work effectively due to sleep deprivation and the potential loss of income due to work absences. Modifications to the family's activities occurred in response to the child's ENT condition. These modifications were an attempt to prevent further disease episodes by reducing potential exposures to respiratory infections through avoiding social interactions. Modifications were also made to accommodate the child's condition, such as modifying dinner menus and holiday plans. Disruptions to the family functioning were not only the practical disruptions, but also the emotional and social disruption, associated with caring for a sick child. The primary impact was the development of discord in the familial interrelationships. Furthermore, parents/caregivers felt unsupported, isolated from, and not understood by their social supports, such as extended family and friends.

Despite family disruption being a major theme discussed by this study population, research from New York showed that in a retrospective review of medical records, medical practitioners attributed only 2.2% of tympanostomy tube insertions being conducted due to severe disruption of the family life.[265] In contrast, research that surveyed parents of children with tonsillitis found that 58% indicated that their child's condition caused a high level of disruption to the family.[299] A large international study showed that the heavy burden of AOM for families is concerning, with parents worried about sleepless nights, performance at work or home, and feeling helpless.[426] As described by Wuest and Stern,[291] there are documented differences in the parental and medical practitioner perceptions of the intensity of the health problem. This is supported by the research presented in this thesis, and together the evidence demonstrates that these upper respiratory tract conditions have a greater social impact than the medical profession may acknowledge.

The second domain identified within the context of the family impact was the direct disruption the ENT condition had on the child's physical, emotional, and social wellbeing. Physically, the ENT conditions caused a combination of lethargy, daytime somnolence, hearing impairment, snoring, breathing difficulties, imbalance, speech delays, loss of appetite, swallowing difficulties, and/or pain. These are all well documented physical side effects of the ENT conditions that are the indications for surgical intervention.[16, 40, 41, 67, 74, 91, 93, 211] Interestingly, despite sleep disordered associated enuresis being well documented,[42-45, 211, 427] this was not raised as a discussion point in this study by the interviewees. This may be due to the children in this cohort not experiencing this symptom. Alternatively, the embarrassment and taboo that has been associated with bed-wetting,[428-431] may explain a reluctance of parents/caregivers to discuss the topic. Furthermore, previous research has shown parents are concerned about the suffering experienced by the child and the long-term consequences of the illness.[426] In previous research, parents have reported that ENT conditions manifested behavioural changes in their children, such as aggression, depression, and inattention.[35-38] However, in this thesis, the association between behavioural changes and the ENT condition was not apparent to parents/caregivers until highlighted by education providers or clinicians. Despite this, the link between these ENT conditions and changes in child behaviour have been widely studied and well documented in the literature.[35, 36] While absences from school were discussed by parents and caregivers, the focus was on how hearing difficulties and speech delays would impact on the child's education. Lock *et al.*[293] reported that all 12 children interviewed in conjunction with their parents, reported having time off school either because they were too unwell to attend, or were sent home by their teachers. As with the research presented in this thesis, the focus of the parents interviewed by Lock *et al.*[293] was on the impact that this would have on the child's education, particularly for those children in the later years of schooling. Howel *et al.*[299] reported that 48% of parents surveyed reported that their child's episodes of tonsillitis always resulted in school absences. Likewise, they report that a recurrent issue raised by parents was the affect that absences would have on their child's education. Clearly this is a common concern for parents, however, there have been conflicting reports on the impact that ENT conditions have on long term educational outcomes, such as intelligence quotient (IQ).[33, 34, 39, 47, 202, 432] Most of the research on impact on education has occurred in the field of research focussed on obstructive sleep apnoea. Kennedy *et al.*[34] suggest that for children with obstructive sleep apnoea the neurocognitive deficits reported in their research may be caused by oxygen desaturation as a result of the apnoeic episodes occurring during the pivotal and rapid neurological development that occurs early in life. This theory was supported by research by Gozal *et al*.[39] who found that children with poor school performance also had decreased SaO2 as measured by pulse oximetry. Whatever the reason that obstructive sleep apnoea causes these neurological deficits, there is evidence that these deficits persist for at least 6-months following intervention with adenotonsillectomy.[202]

The third domain discussed by parents was the way that the family adapted and coped with the condition and its impact on the family's functioning. This took the form of behaviour modification, such as increasing the volume on the television or speaking louder to the child; adaptations, such as preparing different meal items for the child, or taking naps during the day; and restrictions, such as preventing the consumption of particular food items. Parents also coped by delegating or sharing the caring, often with the aim of allowing one of the child's carers a full night of sleep. This was a similar strategy adopted by British parents of children with recurrent sore throat.[293] They would engage their extended family, such as the child's aunties, uncles, and grandparents, as an alternative source of care when taking time off work. Previous research has also described that some parents cope by requesting repeat prescriptions or requesting prescriptions over the telephone rather than having an in-clinic appointment.[293]

8.4.2 The Cues to Seek Intervention

Prompts for intervention seeking behaviour were discussed within the theme of cues prompting intervention seeking. Two distinct experiences influenced parents/caregivers to seek intervention for their child's ENT condition: 1) their interaction with their medical practitioner, and 2) their previous experience with ENT conditions. Firstly, the perceived lack of concern by their healthcare provider was a cue to question the medical care provided. This often led to further advice being sought by parents/caregivers for treatment options for their child. Parents/caregivers did not have an understanding that medical practitioners were potentially adhering to recommendations on the management of ENT illnesses by implementing 'watchful waiting' to allow resolution without intervention. This lack of understanding has been previously commented on by medical practitioners.[433, 434] Medical practitioners have reported that parents often lack an understanding of the aetiology and treatment of respiratory tract infections, leading to the perception by medical practitioners that there is parental pressure for inappropriate antibiotic use[298, 434, 435] and specialist referral.[436] Certainly, it has been reported that some parents (17%) expect to receive an antibiotic prescription as a result of a consultation regarding their child's respiratory tract infection.[298] Furthermore, that there is a potential association between the parental expectation to receive an antibiotic prescription and the actual receipt of the prescription.[298] However, despite these parental expectations, the medical practitioner view that parents may not have a good understanding of these medical conditions may be somewhat incorrect. For example, between 65% and 89% of Scandinavian parents have expressed concerned that overuse of antibiotics could lead to the development of antibiotic resistance.[295-297] Another study that surveyed parents from across Europe, North America, South Africa, Asia, and the Pacific, found that 73% parents were concerned about the rise in antibiotic resistance.[426] Furthermore, regardless of whether they did or did not receive an antibiotic prescription, up to 99% of parents are reported as satisfied with the outcome of the medical appointment.[298] Research suggests that the implementation of ‘watchful waiting’ varies between countries despite fairly consistent guidelines internationally. The majority of Dutch parents (59%) reported that their medical practitioner had used ‘watchful waiting’ at some time to treat their child’s ear infection, compared to just 13% of Finnish parents.[297] While both general practitioners and specialists use ‘watchful waiting’, the research presented in this thesis suggests that parents/caregivers were more accepting of ‘watchful waiting’ if the advice was provided by an ‘expert’ - this being an ENT surgeon.

The findings presented in this chapter indicate that there is a certain lack of confidence amongst parents/caregivers in the ability of general practitioners to adequately identify and manage the treatment of ENT conditions. This is further compounded by experiences where different doctors provided different interventions and treatment advice. Certainly, other research has suggested that parents perceive medical practitioners to be more credible if they behave in a manner consistent with the families’ expectations.[291] For the cohort of parents/caregivers interviewed for this thesis, the receipt of conflicting information further added to the frustration, confusion, and disappointment experienced. Inconsistent medical advice may be a result of a lack of understanding or knowledge by medical practitioners; a lack of widely accepted and approved Australian guideline for the management of these conditions; or simply a difference in opinion by medical practitioners in the management of these conditions. While inconsistencies in medical knowledge and opinion are expected - particularly since there will always be differing levels of training and experience amongst the medical profession - the introduction of a set of Australian guidelines would remove some variations in treatment advice. This would improve the uniformity of the information provided by doctors, resulting in improved parental/caregiver confidence. A key implication would be that parents/caregivers would have more confidence in their general practitioners’ medical advice regarding the implementation of ‘watchful waiting’. This would include a clear explanation of the disease process and medical rationale for delaying surgical intervention, and may result in parents/caregivers being more reluctant to seek surgical intervention – with a potential resultant reduction in the demand for surgical intervention, a reduction in the waiting lists for the surgery, and a reduction in the burden on the public health system.

Surgery seeking behaviour was influenced by the past medical history and experiences of parent/caregiver, their children, and their family members. Parents/caregivers who themselves had had surgical intervention in the past, or who had other children who had undergone surgical intervention for ENT conditions, were accepting of, and keen for, surgical intervention. Similar findings have been previously reported where the decision-making of parents was influenced by the experiences of themselves or others.[291, 293] However, as reported herein, the individual experiences, opinions, and perceptions of each family directly influences the likelihood to seek surgical intervention. To further clarify, different families each had their own differing thresholds of tolerance for the same disease profile – with each family’s decision-making influenced by a complex matrix of understandings and experiences.

8.4.3 The Expectations of the Healthcare System

Parents/caregivers had a variety of expectations and experiences of their interaction with the South Australian healthcare system. They discussed these expectations and experiences within four domains, namely: 1) the expectations of the outpatient appointment, 2) the expectations of the surgery, 3) the experience of having to wait, and 4) the options available to them.

The main expectation that parents had of the hospital outpatient appointment was that the child be placed onto the surgical waiting list. This reinforces previous research in which English parents expressed eagerness for surgical intervention to treat their child's recurrent throat infections.[299] Similarly, in another study, English parents were reluctant to wait for their child to 'grow out of' the medical condition and felt that they had to demand surgical intervention for their child with tonsillitis.[293] Previous research has shown that as parents become more familiar with the ENT healthcare system their confidence to negotiate increases and they become more assertive.[291] By the time that children are reviewed in the hospital outpatient department, their parents and caregivers have learnt the rules of the healthcare system. These rules have been described as learnt through the prolonged and continued experience with a range of healthcare providers - nurses, doctors, hospitals, emergency departments – and through seeking information from fellow parents and the available resource material.[291] However, this assertive behaviour may be at odds with the current United Kingdom recommendations. In 2009, the British public health authorities recommended that tonsillectomy is of little benefit and should be decommissioned as a routine operation.[437] Despite this, parents interviewed herein still expected surgical intervention and, certainly, parents had an expectation that the surgery would cure the child of their ENT condition and resolve all the perceived issues that arose as a result of the illness. This reflects previous research that found that parents felt that surgical intervention was the only long-term solution for tonsillitis.[293] Indeed, there is evidence to suggest that following surgical intervention parents are happy with their decision to pursue tonsillectomy for their child.[437] Thankfully, however, this demand for surgery may be balanced by potential preference by parents for day-case surgery compared to overnight stays.[438] This preference for day surgery reduces the potential impact that an increase in surgical procedures would have on the healthcare system.

Another complaint that parents expressed was the perception that the outpatient appointment was not long enough. Having waited for weeks or months for the appointment, parents spoke of feeling rushed during the appointment. Evidence suggests that parents and caregivers using ENT outpatient facilities are more likely to be satisfied if they have the doctor's attention during the appointment,[302, 303] and the accessibility and convenience of the clinic.[302] Furthermore, it has been demonstrated that families have greater satisfaction with their appointment experience if they have a shorter duration spent in the waiting room prior to the consultation.[302-304] Furthermore, the information provided by the medical professionals at the time of listing the child for surgery must ensure that parents/caregivers have a clear understanding of the potential benefits and risks of surgery, and that they have provided informed consent for their child's surgical procedure.

Parents/caregivers expressed frustration at the length of time between the referral from the general practitioner to the hospital outpatient appointment. However, once placed onto the surgical waiting list they were accepting of the waiting time. This was despite the mean time to surgery being 113 days for tonsil-related conditions and 65 days for ear-related conditions. These waiting list times suggest that children with ear-related conditions are more likely to be operated on in a quicker timeframe than those with tonsillitis or sleep apnoea. Indeed, there is evidence that clinicians prioritise surgery for those children with hearing deficits over those with snoring issues.[196] In addition, previous research suggests that parents of children with ENT conditions often become disillusioned by the healthcare system.[291] However, in this study the success of getting their child onto the surgical waiting list was sufficient to relieve any wariness or frustration that they may have developed.

A small number of parents choose to utilise their private health insurance, or considered paying out of pocket, to hasten and have more control over the timing of the surgical procedure. Indeed, research has shown that the time between referral and specialist appointment is influenced by insurance status. In New Zealand, the interval between the referral and the appointment with an ENT specialist was 20 weeks for public patients compared to 5 weeks for private patients.[439] Seeking alternative medical advice for childhood otitis media with effusion was described in previous research. Families who had unsuccessfully negotiated with their medical practitioner reported seeking alternative care, a second opinion, or went 'doctor shopping'.[291] However, for most of the study population interviewed for this thesis, seeking alternative healthcare options were not an option and they remained on the public surgery waiting list.

8.4.4 An Understanding of the Clinical Practice Guidelines

Without a set of current Australian clinical practice guidelines, many clinicians adopt the guidelines published by overseas agencies which suggest the most appropriate treatment approaches for otitis media, tonsillitis and sleep apnoea. These guidelines outline the duration of disease, and the number and severity of disease episodes that a child should have had prior to consideration of surgical intervention. For tonsillitis it has been recommended that children have at least seven episodes in the year preceding surgery.[21, 22] While for otitis media with effusion children should have persistent effusion for at least 3 months with confirmation of hearing loss before consideration of surgical intervention.[66, 67] In contrast, current recommendations by the *American Academy of Pediatrics* – an authority in the US – make no reference to surgical intervention for acute otitis media.[74] The adoption of these guidelines within the Australian medical profession remains at the discretion of clinicians themselves. Indeed, within the guidelines there is oft times a statement similar, or exactly, stating that the guidelines are '*not intended to replace clinical judgment or establish a protocol for all children with this condition and* *may not provide the only appropriate approach to diagnosing and managing this problem*'.[67] This ability for clinicians to reinterpret and apply the guidelines as they determine clearly leads to inconsistencies in medical care between practitioners. This, in turn, can lead to increased anxiety, confusion and frustration amongst patients, as was evident in this study. Furthermore, from the evidence provided by the parents/caregivers interviewed in this study, it has become clear that general practitioners may ignore, or may not be aware of, the guidelines. Recall that one parent stated their child had had up to 26 episodes of tonsillitis in the previous year, and 16 episodes to date in the current year. Clearly, this far exceeds the international guidelines for consideration of surgical intervention. In this case the general practitioner may have been more conservative in their medical care than was warranted. Of course, the number of episodes quoted by this parent may be an exaggeration of the number of disease episodes, however, it can be agreed that the child clearly had a protracted wait for referral. Consequently, a situation results where the child experiences unnecessary episodes of illness, and the family has prolonged stress and anxiety. In addition, the repeated exposure to antibiotics not only creates undue financial strain for the family, but also risks the development of multi-resistant strains of pathogens.

Conversely, many parents complained of general practitioners taking too long to refer their child, despite general practitioners seemingly following the 'watchful waiting' protocol outlined for otitis media. Often they were not happy with the general practitioner's explanation that a minimum number of episodes were required in any given year to necessitate referral to a specialist. In this circumstance, many parents/caregiver felt they had to demand a referral even though the child may not have met the recommended referral criteria. It might be assumed that in these situations, the general practitioners were placating the parent by providing the referral and thereby allowing the 'specialist' to determine the best course of action. While this may seem dismissive, it is probable given that general practitioners often have busy workloads and truncated clinic times in which to consult with anxious parents. Perhaps general practitioners realise that if parents do not receive a referral when it has been requested, that they will seek a referral elsewhere – as was the case for many parents/caregivers interviewed. However, whatever the circumstances may be, herein it can only be speculated since it was not within the constraint of this thesis to conduct interviews with the referring general practitioners. Despite this, clearly a disconnect exists between the recommended referral guidelines, general practitioners, and parent/caregiver expectations.

8.4.5 Study Limitations

There are several limitations that could influence the generalisability of the study findings. These will be outlined and disputed henceforth. Firstly, the study population interviewed was sourced from the public health system. Furthermore, a large proportion of interviewees resided in the northern Adelaide region - an area of lower socioeconomic status.[307] Therefore, it could be argued that the issues and topics discussed by interviewees are only representative of those children and families with lower socioeconomic status. While it is possible that issues specific to children and families with private health insurance have been missed, it is unlikely that the main themes differ greatly. Financial stress and family relationships are universal issues regardless of socioeconomic or health insurance status. However, the evidence does suggest that these issues are more pronounced in the lower socioeconomic status groups.[440-443] So, since the study population was predominantly uninsured and residing in lower socioeconomic areas, it is possible that these social factors impacted on the results of the study as these are the populations most at risk of social, financial, and familial stress.

The majority of interviewees were from English speaking backgrounds and were from families where the children had two biological parents in the household. This was highly representative of the South Australian population at the time of the study. In 2011, the majority of households were defined as a couple family with children under 15 (41.5%).[307] When the households without children were excluded from the data, 76% of families consisted of a couple with children, with 16% being one parent families.[307] In contrast, there was an over-representation of single parent families (30.0%) in this study. Furthermore, in 2011, 86.2% of the South Australian population spoke English as their first language.[307] This is comparable to the percentage of interviewees that spoke English as their first language in this research (90.0%).

Finally, the majority of interviewees were parents/caregivers of boys. However, this is to be expected given that these ENT conditions are known to be more common amongst male children.[105, 126, 131, 132, 138, 141, 142, 173] Therefore, it can be posited that the larger proportion of interviewees who were parents/caregivers of boys is reflective of the popualtion of children affected by the underlying medical conditions being examined in this thesis.

8.4.6 Conclusion

Clearly, the decision to pursue surgical intervention is more complex than just the physical implications for the child. There is an abundance of literature on the impact that caring for sick children can have on the family unit.[146, 197-200] Furthermore, these issues are similar regardless of the child's medical condition and can lead to both work and home related stress.[186] A predominant concern found in this research was the disruptive nature of the illness to the daily routine of the family unit. This supports previous research which found that there are disruptions to the family's sleep and work schedules, and childcare arrangements.[444] As found in this research, sleep disruptions lead to daytime somnolence for both parent and child. Previous research found that parents caring for children with otitis media with effusion found the night-time sleep disturbances the most concerning.[213]

The results of this study reinforce data previously presented in the literature but also provide new insights into the quality of life of these child and their families. The impact that the ENT condition had on the child’s health and wellbeing was important, but so was the impact to other household and family members. Social stressors and financial burdens underpin the cues to seek surgical intervention. Furthermore, there is a lack of congruence between the expectations of parents/caregivers and the recommended medical care. Parents often demand intervention much sooner than is recommended. Medical practitioners need to understand and consider the social and financial implications of childhood ENT conditions, particularly those requiring repeated antibiotic exposure, on the overall health of the family unit.

SECTION IV:

DISCUSSION

Health and disease are the good and bad effects of where you are in the hierarchy,

mediated by the effects of chronic stress.

Michael Marmot

CHAPTER 9
Discussion

9.1 OVERVIEW

The purpose of this thesis was to understand the epidemiology of the three most common ear, nose, and throat (ENT) surgeries – tonsillectomy, adenoidectomy, and myringotomy with/without tympanostomy tube insertion – performed on the South Australian paediatric population. In order to understand the epidemiology of the surgical procedures, a mixed-methods approach was adopted to further identify, explore, and understand factors that influence the incidence of these surgical procedures. Quantitative and qualitative methods provided a data rich foundation on which to draw conclusions about the reasons for the higher than expected incidences previously seen in South Australia. An extensive epidemiological profile has been presented of the most common ENT procedures performed on children, as well as a data rich thematic analysis of interviews with primary caregivers who made the decision to seek surgical intervention for their child. The findings presented in this thesis have been discussed in depth in chapters 4 through 8. Each of these chapters directly addresses one of the research questions as proposed in Section 1.2.3. This final chapter summarises the key findings, and provides an overview of these findings as they relate to the thesis aims and objectives. The discussion provides a critique of the potential limitations of these findings, suggests opportunities for further research, and highlights the public health significance and implications of these findings on the provision of healthcare in South Australia.

9.2 MAIN FINDINGS

9.2.1 The Epidemiology of ENT Surgery in South Australia.

In this thesis, a detailed description was presented of the demographic and epidemiological profile of children who underwent tonsillectomy, adenoidectomy, and/or myringotomy with/without tympanostomy tube insertion in South Australia during 1997-2007. The accurate description of the age- and sex-specific incidences of these surgeries directly addressed a number of the key objectives of the thesis and answered the primary research question. To summarise some of the key findings, the research showed that more boys underwent these procedures than girls, but that adolescent girls also frequently underwent tonsillectomy; tonsillitis was the primary reason for tonsillectomy alone, ear-related conditions were the main reason for adenoidectomy, and both tonsillitis and sleep disordered breathing were indications for adenotonsillectomy; that the peak incidence of adenotonsillectomy and tonsillectomy occurred in four-year-olds and the peak incidence of myringotomy with/without tympanostomy tube insertion occurred in one-year-olds; and large numbers of these ENT surgeries were funded by private health insurance.

To reiterate, the overall incidence of tonsillectomy in South Australian children was 6.47 per 1,000 child-years, which is similar to the incidences previously reported for other western countries.[240, 250] The highest incidence of tonsillectomy occurred in 4-year-old children, with an incidence of 16.6 per 1,000 child-years. This was nearly twice the incidence reported for Danish children of the same age (8.6 per 1,000),[235] in the only research report that likewise provided paediatric incidences for each age year. Another key finding was that adolescent girls had a much higher incidence of tonsillectomy alone than their male counterparts. This has not been described previously for the Australian population. This may be driven by the social stigma experienced by teenage girls caused by the significant halitosis and chronic sore throats caused by chronic tonsillitis. The only comparable study, that is, research that reported one-year age-band incidences,[235] also described a high incidence of tonsillectomy amongst Danish adolescents; however, these results were seen in both sexes. Although not as detailed, other reports have suggested similar findings. A recent British report stated that although the overall incidence of adenotonsillectomy had decreased, the proportion of females aged 12 to 15-years-old undergoing adenotonsillectomy had increased from 70% of children in 2001/2 to 72% in 2011/12.[445] One potential explanation was demonstrated in research that found that amongst older children (aged 8 to 15-years), girls in England with a history of sore throat have been shown to be more likely referred for adenotonsillectomy, while boys are more likely to opt for conservation management of their sore throat.[294, 446] Another study, of Icelandic children aged under 6-years-old, found that girls with sleep-disordered breathing were older than their male counterparts.[51] Despite the findings presented in this thesis, the reason for the differences amongst adolescents remains unexplained and constitutes an area for further research.

The annual incidence for South Australian children of adenotonsillectomy was 4.4 per 1,000 child-years, with the incidence of adenoidectomy at 2 per 1,000 child-years. As discussed in Chapter 4, there are difficulties in drawing comparisons of these results with other reports due to the differences in the age groups under investigation and inconsistencies in how adenoidectomy and/or tonsillectomy is described in the literature. However, despite the differences in reporting practices, it was clear that children in South Australia underwent these surgeries at a younger age than described elsewhere.[248] In fact, children in South Australia underwent the ENT surgeries at a younger age than in other similar populations.[7, 265, 267] It was proposed that these findings may reflect an underlying shift in medical practice. The incidence of adenotonsillectomy peaked in four-year-old children, with a trend in the indication for surgery changing over time from tonsillitis to obstructive symptoms. As shown in Chapter 4, in 1997, 9% of cases indicated that the surgery was performed for obstructive symptoms, whereas by 2007 this had nearly tripled to 26% of adenotonsillectomy cases. Furthermore, by 2007, the percentage of cases performed for obstructive symptoms had increased to 70%.

During the study period, between 50.3% and 61.7% South Australian children that underwent ENT surgery had their surgery privately funded. Interestingly, these proportions are much higher than the reported proportion of Australians that had private health insurance during the same timeframe. Only 32% of Australians had private health insurance in 1998,[322] with this increasing to 47% of Australians by 2004-5,[323] as a result of the introduction of the Private Health Insurance Incentives Act 1998.[325] While one explanation might be that perhaps South Australians have more health insurance than other states, this is most likely not a viable explanation since in 2005 South Australia (43.4%) had very similar health insurance levels compared with other states, such as New South Wales (44.4%) and Western Australia (45.7%).[328] Instead, what is more likely is that South Australians with private health insurance have better, or more timely, access to healthcare. This theory is supported by research that reported children without private health insurance receive less medical care,[224, 329] that children from low socioeconomic backgrounds receive less surgical interventions,[221] and that parents perceive a lack of private insurance as a barrier to paediatric healthcare services.[330]

One of the most surprising, and notable, findings in this thesis is the age at which children in South Australia underwent myringotomy with/without tympanostomy tube insertion. The peak incidence of myringotomy with/without tympanostomy tube insertion occurred in one-year-old children. While a peak incidence has also been documented in Canadian one-year-old children,[259] this is much younger than other international reports.[265, 267] As discussed in Chapter 4, these incidences in very young children are most likely related to the reported peak incidence of otitis media in this age-group.[108, 171, 296] Interestingly, for children aged one-year-old and under, the proportion of myringotomy with/without tympanostomy tube insertion funded by private insurance was nearly three times that publicly funded. This result reflects the findings of a New York City study in which 74% of children who received tympanostomy tube insertion in 2002 had private health insurance.[265] Herein, the proposed hypothesis was that children with access to private health insurance have more timely access to surgical intervention and that this accounts for the increased proportion of younger children that underwent this surgical procedure. Indeed, recent reports confirm that children with otitis media who are referred for private specialist treatment and who have private health insurance are younger than their publicly treated counterparts.[447-449] Also, children with otitis media and who have private health insurance receive more medical treatment, including a greater number of visits to primary healthcare providers and antibiotic courses.[447] A reduction in the waiting time for surgical intervention for children with otitis media with effusion who have private insurance has been seen for children living in Taiwan,[449] New York City,[265] and New Zealand.[448] This relationship between private health insurance and a reduced surgery waiting time has been documented for paediatric ENT surgery since the 1980s.[448]

Consistent with the current literature, South Australian children that underwent myringotomy with/without tympanostomy tube insertion were most commonly boys. This finding is in concordance with the currently published literature,[213, 234, 249, 263, 265] which consistently described boys having a higher incidence of this procedure. Furthermore, this finding correlates with current literature that has shown that boys are more commonly afflicted with acute otitis media,[105, 126, 131, 132, 141, 142] and otitis media with effusion.[138, 150, 173] The main indication for myringotomy with/without tympanostomy tube insertion in South Australian children was otitis media with effusion. International research concurs that children most commonly undergo this surgical procedure for otitis media with effusion,[265] and this is the recommended indication for the surgery.[450]

Furthermore, this is consistent with the recommendations made in the available guidelines of disease treatment.[65-67, 71, 74] In fact, the most recent American guidelines do not endorse the use of the procedure for recurrent acute otitis media.[450] In addition, it was shown in this thesis that young boys (aged under 4-years-old) have the highest incidences of adenotonsillectomy. Commentators have noted this pattern for boys since as early as 1938[217] and as recently as 2014.[445] Despite the long standing known association, the reason for the gender difference seen in this thesis remains unresolved. A number of possible explanations were posited in this thesis, including anatomical and pathological variations between the sexes,[248, 320, 321] however they fail to adequately explain these difference in adenotonsillectomy intervention in boys and girls.

9.2.2 South Australia has a Higher Incidence of Paediatric ENT Surgery

An important finding in this thesis was that these ENT surgical procedures were performed on children living in South Australia at a greater incidence, during the period spanning 2001 to 2009, than in the five other Australian states. As previously discussed in Chapter 4, procedural incidences can be difficult to compare due to differences in definitions, analysis, and reporting methods. However, in this thesis these issues were able to be eliminated by utilising national data which utilises nationally standardised reporting mechanisms.[275, 308]

While the incidences of the procedures varied considerably between the states, the most notable variations were for adenotonsillectomy (incidences ranging from 1.67 per 1,000 children in Tasmania to 4.92 per 1,000 children in South Australia), and for myringotomy with/without tympanostomy tube insertion (incidences ranging from 3.88 per 1,000 children in Tasmania to 11.00 per 1,000 children in South Australia). The results undoubtedly show that the incidence of these procedures was significantly higher in South Australia than the other states and territories studied. Yet despite this definitive discrepancy, there continues to be no clearly defined reason to explain South Australia's greater frequency of paediatric ENT surgery. What was identified, however, was that there was a definitive link between incidence of surgery and age, sex and state of residence. The age-specific incidence profiles highlighted differences across Australia, with children in South Australia undergoing the procedures at younger ages than in the other states. Of note were the differences in myringotomy with/without tympanostomy tube insertion where the profiles of the children were markedly difference between each of the states. In addition, South Australian children underwent adenoidectomy at a younger age than in the other states. Despite South Australia having a higher incidence of, or an age-shift in the surgical profiles, there were underlying similarities in the sex-specific profiles of the children across Australia. For example, boys underwent the procedures much more frequently than girls across all Australian states studied. As previously discussed, this reflects current internationally published data for these ENT surgeries in children.[213, 234, 249, 263, 265, 267, 445]

As discussed in Chapter 5, by investigating the incidence of these procedures in depth and across Australian jurisdictions, it is clear that there are underlying relationships between these surgical procedures and the determinants of health. In this case, the determinants of surgical intervention were age, gender, access, and economic inequity. Evidence for this argument is grounded in the marked differences observed in the epidemiology of tonsillectomy and/or adenoidectomy, and myringotomy with/without tympanostomy tube insertion, across five Australian states. There were disparities between these five jurisdictions in the frequency of, and the ages at which, children underwent these procedures. To reiterate, more children in South Australia underwent the procedures and at a younger age than in the other states, with an age-shift seen for all the surgical interventions.

Evidence suggests that there were underlying socioeconomic variations between the populations within each state, with different sources of funding used and different populations of children being under- or over-represented. The child's residential location, age, and sex were clearly associated with the likelihood of undergoing these common ENT procedures. A proposed reason for these jurisdictional differences was differences in clinical practice. Despite there being a national training program provided through the Royal Australian College of Surgeons (RACS) in conjunction with the Australian Society for Otolaryngology Head and Neck Surgery (ASOHNS), differences of opinion and treatment practices are bound to exist. Research suggests that in the past there has been a high degree of clinical uncertainty about the indications for surgery,[243] with geographical differences best explained by surgeon opinion and proclivity to intervene rather than any differences in the incidence of the underlying diseases. In addition to personal opinions, it has been proposed that physicians may see guidelines as a threat to their decisional autonomy and as a cost-cutting tool for health care.[240]

During the study period, Australia did not have any nationally endorsed clinical practice guidelines for tonsillectomy, adenoidectomy, or myringotomy with/without tympanostomy tube insertion. However, in 2008 the ASOHNS, in conjunction with The Royal Australian College of Physicians, published a position paper that outlined recommendations for the treatment of children with tonsillitis and obstructive sleep apnoea.[25] Later, in 2010, the '*Recommendations for Clinical Care Guidelines on the Management of Otitis Media in Aboriginal and Torres Strait Islander Populations'* were published by the Darwin Otitis Guidelines Group.[451] These guidelines were based on the previously published recommendations from March 2001",[452] with both documents being targeted towards the management of the condition in a specialised sub-population. More generalised and widely agreed upon guidelines still do not exist. Although, the recently established Choosing Wisely Australia®,[361] along with the Australasian College of

Physicians Evolve program[363] and the research work of the CareTrack Kids program,[364-366] aim to improve healthcare delivery through the development of nationally agreed recommendations and guidelines. However, to date, only two recommendations have been developed and published by Choosing Wisely Australia® that address ENT conditions. The first recommendation developed by The Royal Australian College of General Practitioners states that antibiotics should not be used to treat otitis media in non-Indigenous children aged 2 to 12-years-old that can be reassessed,[453] while a second recommendation by the Australia Society for Infectious Diseases directs clinicians to 'avoid prescribing antibiotics for upper respiratory tract infections'.[454] However, while programs like Choosing Wisely Australia® aim to assist clinicians and consumers with information to improve the quality of the healthcare received in Australia, the guidelines are still in development. Furthermore, the guidelines that have been endorsed appear to be developed by a single Choosing Wisely Australia® member agency, such as the Royal Australian College of General Practitioners. Guidelines do not exist that are transparently produced and nationally endorsed by all relevant stakeholder agencies. Projects underway in Australia, such as CareTrack Kids[364] and ABC-SETS,[455] aim to develop nationally agreed upon guidelines and clinical indicators that are developed in a clear and transparent manner and endorsed by all relevant stakeholder agencies. In addition, guidelines still do not exist that explicitly state recommendations for the use of the surgical procedures studied herein. Therefore, surgeons must rely on their clinical training, professional development, and the existing international guidelines to guide them towards the appropriate application of these surgical procedures. Therefore, it is not surprising that variations exist in the management of ENT surgery and their subsequent surgical interventions amongst the surgical community. However, the development of appropriate Australian guidelines, and implementing strategies for enhancing adherence amongst surgeons to these guidelines, may result in a reduction in the vast variation in incidence seen between jurisdictions.

9.2.3 Geographical Variations Exist Across South Australia.

A key finding of this thesis was that there were variations in the geographical distribution of tonsillectomy and/or adenoidectomy, and myringotomy with/without tympanostomy tube insertion across South Australia. A spatial representation of the standardised admission ratios (SARs) for the ENT surgical procedures found clear patterns in the locality where the children resided. To reiterate, tonsillectomy was more frequently performed on children from rural areas, specifically, the Murray Mallee and South Eastern regions of South Australia. In contrast, adenotonsillectomy was most commonly performed on children in the Northern suburbs of metropolitan Adelaide. However, both tonsillectomy and adenotonsillectomy were frequently performed at greater than expected levels in the regional centres of Ceduna and Port Augusta. Myringotomy with/without tympanostomy tube insertion and adenoidectomy were both performed most frequently in the lower South Eastern region of South Australia and throughout metropolitan Adelaide. To clarify, the similarities in the geographical distribution of these two procedures was not surprising since they are often performed in conjunction, and for similar surgical indications, as previously discussed.

In this thesis, it was proposed that the higher surgical frequencies seen in rural regions were most likely linked to difficulties in access to healthcare and lower socioeconomic status, as well as geographical issues, such as climatic, industrial, and environmental exposures. While it may seem counter-intuitive to propose that higher incidences of surgical intervention are a result of difficulties in access to healthcare, this can be explained. Financial constraints of a lower socioeconomic status, compounded by the distance to convenient primary healthcare, can result in difficulties in both the affordability and accessibility of healthcare for patients living in rural and remote regions of the state. A swifter decision to intervene with surgery can reduce the financial strain on families that would otherwise need to afford repeat doctor's appointments and antibiotic prescriptions that are inevitably the result of the recommended 'watchful waiting' guidelines. A 'cure' obtained by the decision to insert tympanostomy tubes allows families living in lower socioeconomic circumstances to regain their stability – parents can return to work rather than caring for their unwell child, the burden of medical costs is alleviated, and the child can return to their regular activities.

In Italy, geographical variations were seen in the incidence of ENT surgery across the Veneto region. Italian-nationals living in the area were nearly twice as likely to undergo surgery compared to foreign-born children.[240] The authors argued that this was could be related to differences in socioeconomic status, and in diagnosis and care from medical practitioners towards the two population groups. Similarly, in Canada, a lower tonsillectomy incidence was seen in neighbourhoods with larger immigrant populations.[237, 259] These differences contributed to potential variations in the attitudes of primary care providers, specialists and parents. Indeed, differences in opinion and disease management practice do exist between primary care providers and specialists.[347, 352, 353, 356, 400] The higher incidences of tonsillectomy noted among residents of rural Manitoba, Canada, raised quality of care concerns.[243] These concerns were related to small caseload volumes, performance of surgery in young children, and access to postoperative healthcare. [243] Evidence suggests that low-volume hospitals and surgeons have poorer outcomes following a variety of surgical procedures, including thyroid surgery,[301] head and neck cancer surgery,[456] oesophagectomy,[457] prostatectomy,[458] total knee arthroplasty,[459] and colorectal cancer surgery.[460] These outcomes typically include longer length of stay and higher risk of complications. Furthermore, these poor outcomes have been seen amongst low volume surgeons performing paediatric surgery.[461, 462] When examining the high proportion of rural children that underwent surgery, not only should the possible reasons for the higher proportion be considered, but also the potential impact of these findings. Importantly, there are public health implications for rural cases – whether this is an earlier than expected intervention as seen in South Australian cases, or the potential for difficulties in access to postoperative care. Unfortunately, the examination of where surgery was performed and the incidence of postoperative complications were outside the scope of this thesis. Despite this, as demonstrated, evidence exists that the experience and caseload of surgeons and hospitals influences patient outcomes for adult and paediatric surgical procedures, such that low-volume hospitals and surgeons have poorer outcomes.[301, 456-462] Therefore, it is not unreasonable to suggest that similar issues may exist for rural paediatric case of ENT surgery undergoing surgery in rural South Australian healthcare centres. Previous research has suggested that further education on the clinical practice guidelines and indications for surgery should be targeted at rural physicians rather than urban specialists.[243]

9.2.4 Financial Burden is the Main Cue to Seek Surgical Intervention

The results presented in this thesis provide a significant insight into the quality of life of these children and their families. In chapter 8, the results of the qualitative research study were presented. During semi-structured interviews with parents and caregivers of children scheduled for ENT surgery, three key themes emerged. These themes were 1) how the child's ENT condition impacted on the overall wellbeing of the family, 2) the cues that prompted the parent/caregiver to seek surgical intervention, and 3) the parent/caregiver expectations of the healthcare system.

While the impact of an ENT condition on the child's health and wellbeing was important, so was the impact to other household and family members. The family's quality of life was greatly impacted by the child's illness. The child's ENT condition was discussed within the context of three distinct domains. Specifically, these were the disruption to the family's day-today functioning; the disruption to the physical, emotional, and social wellbeing of the child; and the coping strategies that the family implemented to compensate for these disruptions. Household disruptions, such as sleep deprivation and loss of income due to caring responsibilities, were discussed in great depth by interviewees, clearly indicating their importance and impact. However, the emotional strain placed on the family by the child's illness was also of great concern, with parents/caregivers discussing their sense of being unsupported, isolated from, and misunderstood by their key social supports, such as family and friends. Parents/caregivers spoke of the strain placed on their adult relationships, particularly with their spouse, due to sleep deprivation, financial stress, and delegation of household responsibilities. These strained relationships also impacted and included the children in the household, particularly the child with the ENT condition. These relationship issues often manifested as frustration, anger, or decreased tolerance between household members. In addition to these concerns, as previous research has identified,[293, 294, 299] parents and caregivers worry about the impact of the ENT condition on their child's learning and development. Indeed, in this thesis, parents and caregivers spoke of the impact that school absences, speech delays, and hearing difficulties had on their child, with particular concern for the impact that this would have on the child's education. However, the long-term impact of ENT conditions on intellect and education continues to be debated in the literature.[33, 34, 39, 47, 202, 432] Despite these disruptions to the family and household, parents/caregivers spoke of the successes they had in adapting and coping with the child's ENT condition. Behaviour modifications (such as, increased TV volume or varying meal choices), behaviour restrictions (such as, not attending functions or not going out in cold weather), and delegation (such as sharing parenting responsibilities) were methods employed to cope and adapt to the changing nature of the child's ENT condition.

Cues to seek surgical intervention were influenced by two distinct domains. The first was the parents'/caregivers' interaction with their child's medical practitioners, and the second was the parents'/caregivers' previous experience with the ENT condition. Parents and caregivers would seek further medical advice if their perception was that their medical practitioner did not express an appropriate level of concern about the child's ENT condition. However, different families had different expectations of what appropriate concern was and entailed. Previous research has shown that there are often parental expectations regarding the medical practitioner interaction, particularly related to the receipt of antibiotic prescriptions,[298, 434, 435] and referrals to specialists.[436] Alternatively, in this thesis, parents/caregivers expressed a lack of confidence in their medical practitioner, particularly when they received conflicting advice, different interventions and prescriptions, and believed their medical practitioner inadequate at identifying and managing the child's ENT condition. Further to these experiences, the parents'/caregivers' own past medical history or experience of ENT conditions and treatment through other family members influenced their expectations and threshold for seeking surgical intervention for the child. Indeed, other research has found that decision-making is influenced by the parents'/caregivers' own past experiences.[291, 293] Furthermore, it was demonstrated that parents often demand intervention much sooner than is commonly recommended. For example, current internationally recognised guidelines recommend that tympanostomy tube insertion be offered to children with bilateral otitis media with effusion for 3 months or longer.[450] However, it is important to understand that the cues to seeking surgical intervention is underpinned by a complex matrix of understanding and experiences influenced by each family's differing experiences and thresholds for decision-making.

Finally, there is a lack of congruence between the expectations of parents/caregivers and the recommended medical care. Parents described their expectations and experiences of the healthcare system within four domains that constituted the final theme identified during the qualitative research study. These four domains were the expectations of the outpatient appointment, the expectations of the surgical procedure, the experience of waiting for surgery, and the alternatives available. Generally, parents and caregiver expected their child to be added to the surgical waiting list as a result of the appointment at the ENT clinic. Certainly similar research has shown that British parents were eager for their child to undergo surgical intervention for recurrent sore throats, [299] and are reluctant for their children to 'grow out of' their medical condition.[293] In fact, as parents become more familiar with the ENT healthcare system their confidence and assertiveness increases,[291] often resulting in their demand for surgical intervention.[291] Furthermore, research suggests that parents are happy with their decision to pursue surgical intervention for their child.[437] However, despite some parents insisting that surgical intervention is the only long-term solution for tonsillitis,[293] this is at odds with many of the surgical guidelines that recommend 'watchful waiting' for ENT conditions,[66, 67, 76, 98-100] as well as, at least one public health authority that recommends tonsillectomy be decommissioned as a routine procedure due to a lack of public economic benefit.[437] In addition to these expectations, parents complained that the time with the ENT specialist was rushed and not long enough. These findings are supported by other research that found that parents/caregivers are more likely to be satisfied if they have the doctor's attention during the appointment,[302, 303] if there is good accessibility to the clinic,[302] and a shorter duration spent in the waiting room prior to the consultation.[302-304] Furthermore, parents found the delay between medical practitioner referral and ENT outpatient appointment was too long. In contrast, once the child was placed onto the surgical waiting list, parents/caregivers were more open to a long wait for surgery, as they saw this as a 'light at the end of the tunnel'. However, despite this, a small number of families did pursue using private health insurance or paying for surgical intervention in order to hasten and have more control over the timing of the surgery.

Clearly the decision to pursue surgical intervention is full of complexity. The results of this research provide new insights into the social, financial, and quality of life issues that South Australian children with an ENT condition, and their families experience. Therefore, with the experiences of this cohort of parents and caregivers in mind, medical practitioners need to understand and consider the social and financial implications of childhood ENT conditions, particularly those requiring repeated antibiotic exposure, on the overall health of the family unit.

9.3 STUDY LIMITATIONS

9.3.1 Secondary Data

Data used in the epidemiological components of this thesis were sourced from databases maintained by state and federal governmental agencies. The data was collected by these agencies to serve other purposes, not by the author of the thesis. This type of data is termed secondary data. While there are certain limitations with any data used, secondary data tend to inherently have its own set of limitations. These limitations are primarily related to the fact that the data were not collected, or intended, for the purpose of the study and so there may be key data points missing or discrepancies in the way that the data were collected between data sources. This can lead to difficulties in data linkage and, hence, data analysis and the accuracy of the resultant findings.

Data in the SA Health ISAAC database[305] were collated from hospitals across the state. The data provided to the ISAAC database are subject to periodic audits of admission and coding practices. Trained staff check the contents of hospital medical records against data reported to ISAAC.[305] While these audits confirm procedural codes are accurate, it is possible that they do not adequately address errors in diagnostic coding. The accuracy of the database relies on the accuracy of the data provided by the individual institutions. Furthermore, only public hospitals incur penalties for failure to provide data and data corrections in a timely fashion. These hospitals are funded by the state government according to their activity reports, so errors in the ISAAC database are likely to be less common and the data are comprehensive with underreporting unlikely.[305] Potential limitations, therefore, include a lack of comprehensive coverage or the inaccurate coding of diseases and surgical procedures. As the data can be provided in either paper-based or electronic formats, transcription errors are always possible. Hospital coding personnel are trained to identify diseases and surgical interventions, and to code them appropriately using the ICD-10-AM system. However, there can be a lack of clinical information, or unclear information, in the medical records. These issues, together with other problems such as difficulties deciphering handwriting in medical records or transcription errors, can lead to errors in the coding of diseases and surgical interventions.

The ABS Census does record all people in Australia on Census Night, including all visitors to Australia except for foreign diplomats and their families. In addition, it cannot accurately account for vagrant populations. This may have affected the denominators used in this study. In the ABS Census there were no data recorded for several postcode areas, indicating that these were not residential postcodes at the time of the 1996, 2001, and 2006 Censuses. Generally, these postcodes did not have data in the dataset; however, four records were removed from the dataset for children who had the postcode of their usual place of residence recorded as Lonsdale (postcode 5160). Without a denominator, it was impossible to calculate the incidence for this postcode area. This discrepancy pointed to possible inaccuracies in the residential postcode data. Other potential issues identified included transient patients with no fixed residential address, patients not providing correct information about their residential address, or patients providing a postal address only. To combat these potential inconsistencies, only records with residential postcodes were extracted from the ISAAC database. Records were excluded for post office box postcodes and for the ‘unknown’ postcodes 5998 and 5999 that are used in situations where the correct information is unavailable. Four (0.006%) records were omitted corresponding to Lonsdale (residential postcode 5160) because the Census did not record a population for this postcode area, hence there was no denominator data. While the omission of these four records has resulted in the exclusion of relevant data, the number of records excluded is so small in comparison to the size of the dataset it is assumed that this would not have altered the results of this research. Also, the dataset spanned 11 years (January 1997 to December 2007). As such, it is likely that data reporting changed over time. Evidence of this is the lack of Indigenous reporting prior to 2001.

Data supplied by the Australian Institute of Health and Welfare (AIHW) were similarly collated from data provided by the healthcare jurisdictions for each Australian state and territory. While the component of research that used these data aimed to be a comprehensive analysis of the epidemiology across Australia, it was hindered by legislation. This legislation primarily aims to protect the confidentiality of patients by requiring the consent of each healthcare jurisdiction to release data to third parties, in this case the researcher. While the data are de-identified, some data can be retained by the jurisdiction if there are concerns that re-identification is possible – for example, indigenous status, private hospital use, or residential postcode. Jurisdictions can also deny consent to release data. These restraints were placed on some of the data released to the researcher. The state of Queensland – the third most populous in Australia – did not consent to the data release, while Northern Territory and Tasmania suppressed some data from the data set. This resulted in the absence of these jurisdictions from some, or all, of analyses and an incomplete epidemiological profile of the surgeries across Australia. However, despite these restrictions, the data that was released for analysis provided rich and meaningful information which was able to be interpreted and that expanded the understanding of South Australia's higher incidence of the procedures.

9.3.2 Qualitative Research

The interviews were conducted via the telephone which reduced the ability of the researcher to interact with the interviewee. Subtleties in body language are not detectable, so the researcher only has intonation and pronunciation to provide an understanding of the interviewee's meanings. In addition, telephone interviews can be impacted by poor telephone connection, poor audio-recordings, and the intrusion of noises outside of the telephone conversation. Distractions were occasionally a problem, particularly for those interviewees who had children with them at the time. The researcher was detached from the activities ongoing at the interviewee's location. It is possible that if the interview was conducted face-to-face, these activities may have posed less of a distraction. In some cases, the interviewee asked that the researcher allow them time to settle children who were crying, fighting, or needing attention; for a few interviews this required the researcher calling back at a later time. In some instances, the researcher felt that the interviews were time constrained, especially those few that were conducted while the interviewee was at work or parked in their car. Despite the researcher offering to call at another time, these interviewees insisted on participating at that time. This may have resulted in shorter, less data rich interviews. However, it was decided that the researcher should not attend the interviewee's place of abode to conduct the interviewee for safety reasons. Likewise, it was not financially possible to relay interviewees to the researcher's facility to conduct the interviews. It was determined that the approach taken herein - to conduct the interviews via telephone at a time that suited the interviewee - was the most convenient, cost-effective, and safest method of conducting the interviews. It also provided the interviewees with a level of anonymity, which in some instances allowed them the freedom to discuss aspects that they might otherwise not have discussed.

Thematic Analysis

Thematic analysis has been criticised for lacking depth.[463] This criticism is a result of sections of data being fragmented from the original dataset during thematic analysis, and this has the potential for data misinterpretation. As a consequence, findings are subjective and can lack transparency in how themes were developed.[464] However herein, the methods used to develop themes and interpret data have been clearly outlined to ensure that the analysis is transparent. Furthermore, the selection criteria ensured a large sample size with a wide cross-section of the study population sampled, resulting in a generalizable and representative data set. Since data was collected until saturation was reached, the author is confident that the key issues were identified. The development of relevant themes underpinning the data is reaffirmed by similar research identifying and discussing similar findings amongst a group of 12 parent-child dyads in North-eastern England.[293] While the report used a different methodological approach, the similarities in the themes identified support the validity of the research presented.

9.4 OPPORTUNITIES FOR FURTHER RESEARCH

Several opportunities for further research have presented themselves during the course of this thesis. Areas for further research include a more extensive examination of the spatial epidemiology of these procedures across Australia, as well as conducting targeted interviews with specific groups of the population, such as the medical practitioners referring patients for, and adolescents undergoing, the surgical procedures. The following sections will discuss these potential research opportunities in greater detail.

9.4.1 Geographical Differences

The geographical variations of the three ENT surgeries under examination herein should, and can, be further explored to elucidate a greater understanding of the reasons for these variations. Firstly, the author suggests that the spatial epidemiology be investigated for other Australian states and territories and comparison made to the spatial variations seen within South Australia. These spatial analyses could be overlaid with the locations of medical practitioners, medical specialists, and hospitals to determine whether the vicinity of these across the jurisdictions can potentially explain the variations. The distances between medical providers and the areas with higher standardised admission ratios could be examined to determine whether similarities, or patterns, exist between the states and territories.

In addition to geographical differences in epidemiology, targeted interviews with parents, medical practitioners, and patients could provide insight into whether there are disparities in attitudes, practices, and opinions across geographical locations. Any variations in societal views of the surgical interventions may underpin any geographical differences, as could variations in medical practices and referral practices.

9.4.2 Interviews with Medical Practitioners

It was outside the scope this thesis to conduct interviews with the medical practitioners involved in the medical care of children. While this avenue of research was initially explored, discussions with representatives from the Division of General Practice (now the Primary Health Network) indicated that recruitment of general practitioners would be within the required timeframe would be problematic and financially prohibitive. However, research of this nature would provide an additional layer of understanding on which factors underpin surgical incidences in the South Australian population, and this should be explored. International research has shown that medical practitioners have the opinion that parents lack knowledge regarding respiratory tract infections.[433, 434] A recent survey found that 41% of Italian parents mistakenly identified bacteria as a potential cause of the common cold.[298] This lack of understanding by parents has been shown to influence their healthcare seeking behaviour and expectations. Medical practitioners have implicated parental pressure as a cause of over-treatment with antibiotics for otitis media. Requests by parents for antimicrobial treatment occur despite medical advice,[295-298, 434, 435] with 54% of American paediatricians indicating that parental pressure is an influence on the inappropriate use of oral antibiotics.[435] In Pakistan, 35% of physicians reported prescribing antibiotics to meet parental expectations, while 33% admitted that is was more convenient than explaining the course of the illness to parents.[434] Similarly, in Italy, parental expectation has been strongly associated to antibiotic prescribing (OR = 12.8, 95% CI 10.4 - 15.8).[298] In contrast, 56% of Italian paediatricians suggested that their own diagnostic uncertainty was a common cause of inappropriate antibiotic use.[298] Furthermore, general practitioners in Nova Scotia reported feeling pressured to refer cases because of parental insistence.[436] Given this evidence, the role that medical practitioners play in the treatment of, and interaction with the parents of, children with these conditions is an important area for exploration.

There are several mechanisms by which children are referred for surgical intervention – via a general practitioner, a paediatrician, or an audiologist; and the pathway can include one or all of these practitioners. Exploring the opinions of all referral sources is of benefit, especially since otitis media has been shown to be the condition that paediatricians most commonly refer to specialists, with the condition accounting for 9.2% of all referrals in USA.[465] Furthermore, the training and opinion of type of referrer will influence the likelihood and urgency of referral to a specialist ENT surgeon. Of course, once referred the training and opinion of the surgeon will also determine if, and when, surgical intervention occurs. General practitioners are, generally, the first 'port of call' for children with common ENT complaints, therefore it is suggested that further research is warranted to examine their referral patterns and strategies. Indeed, there is evidence to suggest that the use of a risk assessment checklist and training for general practitioners improves their ability to appropriately refer children with otitis media with effusion.[466] New research could focus on doctors with a large paediatric component to their practice, but could then compare these across geographical locations or to general practitioners who do not regularly treat children. A number of meritorious research questions could be devised to explore how general practitioners impact on the surgical incidence of these procedures. In addition, the approach used to address the research questions will influence the results achieved since the study design options are numerous. Given that general practitioners are notoriously time-poor, the best method for data collection may be to conduct a short telephone survey, with the option of more in-depth interviews with those general practitioners willing to participate. An online or paper-based survey may be an alternative option. However, study design would need to account for the often poor response rates for paper-based and online surveys, including time constraints, lack of internet access, or technological difficulties.

Potential topics for exploration would be which factors general practitioners take into consideration when determining to refer a child to an ENT specialist for consideration of surgical intervention via tonsillectomy, adenoidectomy, and/or myringotomy. An important factor to consider is confidentiality, since doctors may be reluctant to participate if there are concerns regarding identification of knowledge gaps or inadequate clinical practice. This can be a problem with surveys of medical practitioners in an environment that is increasingly litigious.

9.4.3 Adolescent Tonsillectomy

A key finding of this thesis was that there was a propensity for tonsillectomy to be performed amongst adolescent females but not amongst their male counterparts. Unlike the paediatric population assessed in the interviews presented and discussed in Chapter 8, adolescents are involved in the decision-making process regarding their health. Therefore, it is vital to not only interview parents/caregivers but also the patient themselves. The purpose of such a research study would be to gain an understanding of the symptomatology and clinical history of adolescent children who require tonsillectomy without adenoidectomy. Suggested aims for research would be to assess the symptomatology of adolescent children who present for tonsillectomy; to understand what factors drive key decision makers to refer an adolescent with a tonsillar condition for surgical intervention; and to understand how adolescents assess their tonsillar health and how much influence they have in the decision to have surgical intervention.

The research could incorporate a multifaceted approach, including both qualitative and quantitative research methods. A prospective qualitative cohort study of interviews with adolescents, their parents/caregivers, and their general practitioners would provide detailed information about the tonsillar symptoms of, and decision making processes for, adolescents requiring tonsillectomy. It would be preferable to interview adolescents alone to allow them the opportunity to speak openly and without parental influence, while interviewing parents/caregivers could be conducted in the presence of the adolescent. In those instances, where an adolescent is 16 years or older and has attended the ENT Outpatient Clinic without a parent/caregiver, they could elect to forgo the second interview with their parent/caregiver as they are able to provide consent without parental/caregiver input.

Meanwhile, a retrospective, quantitative cross-sectional study of medical records would provide in depth epidemiological data not obtainable in the constraints of this thesis from the SA Health due to confidentiality concerns (discussed elsewhere). Suggested data to be extracted could include demographic data, such as date of birth, gender, postcode, height (if available), and weight; referral data, such as reason for referral, referring medical practitioner and referral date; clinic experience, such as the number of previous appointments, and previous recommended treatment; and surgical data, including waiting list category, and date of surgery. Such research would provide detailed information about the experiences of adolescent tonsillectomy patients and their families. This would provide an insight into the mechanisms influencing the incidence of adolescent tonsillectomy, and possibly the gender variations that have been identified in South Australia and discussed in this thesis.

9.5 POLICY IMPLICATIONS

Controversies

From the commencement of the research project, it was always the intention of the author to only understand the reasons that may be driving the higher than anticipated surgical incidences seen in South Australia. There was never any intention to posit that the incidence was unnecessarily, or inappropriately, high in South Australia; or that the other states were under-utilising the procedures. The author acknowledged that she was not in a position to question the validity or appropriateness of the use of the surgical approaches to treat the underlying ENT conditions.

In presenting the proposed research to members of the medical and academic arena, the author consistently proposed that the intent of the research was to understand what factors were at play and to provide a more detailed understanding of the incidences since none had been provided thus far. However, in the months following the commencement of this research there was much discussion amongst proponents of adenotonsillectomy, and the case for increased incidences was argued in the South Australian print media.[432] It was not long thereafter, in 2008, that a position statement was released by the ASOHNS[337] outlining clinical practice guidelines for adenotonsillectomy. The opening page in this document states that '*an increase in access to adenotonsillectomy for children with moderate/severe obstructive sleep apnoea [OSA] is urgently required*.' This may well be the case for adenotonsillectomy; however, this thesis also explored the incidence of tonsillectomy alone and myringotomy with/without tympanostomy tube insertion. Recall that as presented in earlier chapters all three surgical procedures were already markedly higher in South Australia than in the other states at the time that the position statement was published. Furthermore, key members of the working party that devised the position statement are South Australian based sleep apnoea physicians – physicians advocating for increased intervention in a state that already has the highest intervention incidence in the country. Therefore, on reflection, the research presented in this thesis does *now* raise questions on whether the jurisdictions other than South Australia are under diagnosing the indicative conditions or under-treating the affected patient populations. Is the incidence described herein for South Australia representative of what other states and territories should be striving to achieve? Are the other jurisdictions unable to meet the demand for surgery?

The results reported in this thesis show that there are key differences in the epidemiology of three common childhood surgeries across Australia. An interesting exercise will be to reassess the longitudinal incidences of the procedures over time and across Australia to determine whether the introduction of the ASOHNS position statement impacted on the performance of adenotonsillectomy, and whether this had a flow-on effect to the incidence of tonsillectomy alone and myringotomy with/without tympanostomy tube insertion. Specifically, whether there was a widening or closing in the size of the incidence difference between the Australian states studied, and whether the age and sex profile of the target population changed as a result of the introduction of the position statement. However, in the meantime, further information is required on the prevalence of obstructive sleep apnoea syndrome, tonsillitis and otitis media in the Australia paediatric population to provide accurate estimates of the recommended surgical incidences. Obviously, the purpose of this thesis was to provide a snapshot of the events that have already occurred but these incidences, along with prevalence information for the indicative conditions, must be used to predict future requirements for service provision and medical personnel training.

Importantly, there are opportunities to streamline service delivery to provide better access to healthcare that is appropriate and affordable to patients and their families. The burden that the ENT conditions impose on the families of the affected children is great and the long-term impact can be severe. Loss of income and relationship strain both have the potential to incur long-lasting sociological impact on the family unit. Reduced days of schooling, loss of weight and changed demeanour can impact on the long-term physical and social development of the child.

9.6 CONCLUSIONS

The key finding of this thesis is that there are disparities within South Australia, and more broadly across Australia, in the frequency and age at which children undergo otolaryngological surgery. The geographical distribution of children undergoing these surgical procedures across South Australia is most likely influenced by difficulties in access to healthcare and the financial pressures linked to lower socioeconomic status. Thus, there is an opportunity to improve access to appropriate healthcare services for children affected with ENT medical conditions.

Improved access to healthcare will not only improve the physical and social wellbeing of the child, but reduce the disruption to the family. These disruptions have a great impact on the financial security of the child’s familial unit, through school, childcare, and work absences, as well as the financial burden of repeat medical appointments and medications.

By improving access to paediatric otolaryngological healthcare, we may ultimately improve the long-term outcomes for these children and their families, as well as reduce the burden on a strained Australian healthcare system.

SECTION V: REFERENCES AND APPENDICES

Everything has to come to an end, sometime.

L. Frank Baum, The Marvelous Land of Oz

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APPENDICES

Appendix A: Literature Review

This appendix details the search strategies developed with the University of Adelaide librarian that were used to search the following online databases of indexed citations and abstracts: PubMed, Scopus, Web of Knowledge, EMBASE, and CINAHL. The literature identified through these searches were used in the systematic literature review described in Chapter 3.

PUBMED

(parents[mh] OR parent*[tw] OR father*[tw] OR mother*[tw] OR legal guardian[mh] OR guardian*[tw]) AND (sleep apnea syndromes/surgery[mh] OR tonsillectomy[mh] OR tonsillectom*[tw] OR adenoidectomy[mh] OR adenoidectom*[tw] OR middle ear ventilation[mh] OR middle ear ventilation*[tw] OR tympanostom*[tw] OR sleep apnea*[tw] OR sleep apoena*[tw] OR otitis media with effusion[mh] OR otitis media with effusion[tw] OR middle ear effusion*[tw] OR tonsillitis[mh] OR tonsilliti*[tw]) AND ((referral and consultation[mh] OR referral*[tw] OR second opinion*[tw]) OR (Decision Making[Mh] OR expectation*[tw]))

SCOPUS

(parent* OR father* OR mother* OR guardian*) AND (tonsillectom* OR adenoidectom* OR "middle ear ventilation" OR tympanostom* OR "sleep apnea" OR "sleep apoena" OR "otitis media with effusion" OR "middle ear effusion" OR tonsilliti* OR "ear inflammation") AND (referral* OR "second opinion" OR expectation*)

Web of Knowledge

(parent* OR father* OR mother* OR guardian*) AND (tonsillectom* OR adenoidectom* OR "middle ear ventilation*" OR tympanostom* OR "sleep apnea*" OR "sleep apoena*" OR "otitis media with effusion*" OR "middle ear effusion*" OR tonsilliti* OR "ear inflammation*") AND (referral* OR "second opinion*" OR expectation*)

EMBASE

(parent* OR father/exp OR father OR mother/exp OR mother) AND (tonsillectom* OR adenoidectom* OR ((ventilation/exp OR ventilation) AND (tube/exp OR tube)) OR (otitis/exp OR otitis) OR ('tonsillitis'/exp OR 'tonsillitis') OR ((sleep/exp OR sleep) AND (apnoea/exp OR apnoea)) OR ((sleep/exp OR sleep) AND (apnea/exp OR apnea))) AND (referral/exp OR referral OR expectation*)

CINAHL

(parent* OR father OR mother OR guardian) AND (tonsillectom* OR adenoidectom* OR (ventilation tube) OR (otitis media) OR tonsillitis OR (sleep apnoea) OR (sleep apnea)) AND (referral OR expectation*)

Appendix B: Supporting Documentation

This appendix contains copies of letters received supporting the research documented in this thesis. Specifically, the approval letters from the Women's and Children's Hospital Human Research Ethics Committee for applications *Audit172A* and *REC2061511*, as well as the approval letter received from the Australian Institute of Health and Welfare Research Ethics Committee.

Government of South Australia
SA Health

Women's & Children's Hospital

Research Secretariat
72 King William Road
North Adelaide SA 5006
Tel 08 8161 6521
Tel 08 8161 5727
Fax 08 8161 8177
www.cywhs.sa.gov.au

29th January 2010

Ms J Stephens
Public Health Research Unit
CYWHS

Dear Ms Stephens

Re: Understanding the rates of myringotomy and tonsillectomy/adenoidectomy in SA children with special reference to the northern Communities of Adelaide. Audit 172A

I refer to your letter dated 27th January 2010 and approve the proposed modification to compare South Australian **surgical** incidences with those of other Australian states and territories. I also note the change to research personnel in the audit. As previously advised by the CYWHS Human Research Ethics Committee in its letter dated 1st June 2007, the Committee considers that a case has been made that the public interest in the study outweighs any privacy concerns.

Please note that, since original approval of the audit, the following is also required:

a. **National Police Certificates for students (excluding students from University of South Australia) and non-CYWHS staff involved in the project on CYWHS sites.** The Certificates are to be provided to the CYWHS Human Resources Department for verification (telephone 81617249 for further information) and copies forwarded to the Ethics Committee.

b. **Confidentiality Agreements.** If the project involves patients/clients/staff of CYWHS or their personal information, signed Confidentiality Agreements are to be provided for all students and non CYWHS staff to the Committee. Please refer to http://www.wch.sa.gov.au/research/committees/humanethics/ConfidentialityAgreement.html

The above requirements relate to current and future students and non-CYWHS staff on the project. If the students and non-CYWHS staff are subsequently involved on other projects approved by the Committee, a copy of the National Police Certificate will need to be re-sent to the Committee and a Confidentiality Agreement signed for each specific project.

Yours sincerely

JENNY FEREDAY (DR)
A/CHAIR
CYWHS HUMAN RESEARCH ETHICS COMMITTEE

Cc: A/Prof P Baghurst, Public Health Research Unit

Government of South Australia
Children, Youth and Women's Health Service

Women's & Children's Hospital

Research Secretariat
72 King William Road
North Adelaide SA 5006
Tel [illegible]
Tel [illegible]
Fax [illegible]
[illegible]

12[th] August 2008

Mrs J Stephens
Public Health Research Unit
CYWHS

Dear Mrs Stephens

Re: Understanding the rates of myringotomy, tonsillectomy, and adenoidectomy in SA children with special reference to the Northern Communities of Adelaide: Referral Patterns & Waiting Lists. REC2061/5/11

Thank you for your letter dated 17[th] July and 8[th] August 2008 in which you responded to matters raised by the CYWHS Research Ethics Committee at its May 2008 meeting. I approve the proposal to include families who are culturally and linguistically diverse. All matters have been addressed with the exception of Police Checks for any students or non-CYWHS employees involved in the project now, or in the future, being sighted by you. You should record that you have sighted all relevant Police checks. The study may proceed on this proviso.

I remind you approval is given subject to:

- immediate notification of any serious or unexpected adverse events to subjects;
- immediate notification of any unforeseen events that might affect continued ethical acceptability of the project;
- submission of any proposed changes to the original protocol. Changes must be approved by the Committee before they are implemented;
- immediate advice, giving reasons, if the protocol is discontinued before its completion;
- submission of an annual report on the progress of the study, and a final report when it is completed. Please note it is your responsibility to provide these reports – without reminder from the Ethics Committee

Approval is given for three years only, and if the study is more prolonged than this, a new submission will be required. Please note the approval number above indicates the month and year in which approval expires and it should be used in any future communication.

If University of Adelaide personnel are involved in this project you, as chief investigator must submit a Human Research Approval notification form online at http://www.adelaide.edu.au/ethics/human/guidelines/ within 14 days of receiving this ethical clearance to ensure compliance with University requirements and appropriate indemnification.

Yours sincerely

TAMARA ZUTLEVICS (DR)
CHAIR
CYWHS HUMAN RESEARCH ETHICS COMMITTEE

Cc: A/Prof P Baghurst, Public Health Research Unit

Associate Professor Peter Baghurst

Head Public Health Research Unit

Women's and Children's Hospital

Children Youth and Women's Health Service

72 King William Road

North Adelaide

South Australia 5006

2010-035 Baghurst

August 26th, 2011

Dear Peter,

We are pleased to inform you that the AIHW Data Custodian has approval from all six jurisdictions to clear their respective data for your request for myringotomy and adeno-tonsillectomy in under 18's De-identified Unit Record Datafor the period July 2001 to June 2009 inclusive.Those jurisdictions that have special conditions to be applied are listed below along with their conditions:

Western Australia:

Any tables generated shall contain footnotes that provide specifications of the data selected and all exclusions;

Copies of the data will not be circulated to other parties without prior written permission of the Department of health, Western Australia;

Published results from any data analysis will protect the identity of individual patients and individual establishment (counts less than 5 shall be suppressed);

The data will not be used for any purpose other than that specified in the approved request and will not be linked to any other data.

Tasmania:

Usual conditions apply. This includes suppression of numbers below 5 and any other number needed so the total doesn't indicate the suppressed number if raw numbers are to be used.

Northern Territory:

Private Hospital data is not to be released and separation counts less than '5' are suppressed.

New South Wales:

All conditions specified in the signed agreement.

Victoria:

All conditions specified in the signed agreement.

To confirm; the remaining jurisdiction **SA,** also approves the release of data. It should be noted that any cells with 1-4 separation counts are not to be published across all the jurisdictions regardless of whether they state it as a condition or not.

It should also be noted that Cross-border separations have been excluded; in other words, only separations where the patient's usual residence was within the state of hospitalisation were included.

Kind regards

John Gross (HDU)

Fields requested – Peter Baghurst, July 2001 to June 2009 data.

proj_id: AIHW generated record id.

seifaQuintile: Quintile of SEIFA score IRSD index. For years 2006-07 to 2008-09 inclusive, SEIFA 2006 was applied; for years 2001-02 to 2005-06, SEIFA 2001 was applied.

sepmonth: Separation month.

sepyear: separation year.

residence_state: state of patient usual residence.

age: in years, up to age of 17 years inclusive

sex

sector: Sector of hospital (public or private)

funding_source

totprocs: Number of procedures reported

procs1, procs2 ...: individual procedures

blocs1, blocs2 ...: block number for procedure

totdiags: Number of diagnoses reported

diag1, diag2...: individual diagnosis

Note:

1. Data are stored as tab delimited text file.
2. Cross border separations have been excluded, in other words, only separations where the patient's usual residence was within the state of hospitalisation were included.

1

Appendix C: Statistical Software Programming Code

This appendix contains the programming code used in the R software environment for the computation of statistics and graphics presented throughout this thesis. The programming code is organised into scripts – a text file containing a multiple lines of coded commands that allows for reproducibility and automation. The scripts developed for the data analysis presented in this thesis are detailed herein.

STATISTICAL CODING FOR CHAPTER 4

Script 1: Basic statistical analyses

```
PATH<-"C:\\Users\\Jacque\\Desktop\\PHD\\R\\"
#
my.table<-table(tamsa$adenoidectomy,tamsa$sex)
my.table<-table(tamsa$adenoidectomy,tamsa$admission_election)
my.table<-table(tamsa$adenoidectomy,tamsa$hospital_sect)
#
my.table<-
table(tamsa$tonsillectomy[tamsa$adenoidectomy=="N"],tamsa$sex[tamsa$adenoidectomy=="N"])
my.table<-
table(tamsa$tonsillectomy[tamsa$adenoidectomy=="N"],tamsa$admission_election[tamsa$adenoidect
omy=="N"])
my.table<-
table(tamsa$tonsillectomy[tamsa$adenoidectomy=="N"],tamsa$hospital_sect[tamsa$adenoidectomy=
="N"])
my.table<-
table(tamsa$tonsillectomy[tamsa$adenoidectomy=="N"],tamsa$hospital_type[tamsa$adenoidectomy=
="N"])
#
my.table<-
table(tamsa$adenoidectomy[tamsa$tonsillectomy=="N"],tamsa$sex[tamsa$tonsillectomy=="N"])
my.table<-
table(tamsa$adenoidectomy[tamsa$tonsillectomy=="N"],tamsa$admission_election[tamsa$tonsillecto
my=="N"])
my.table<-
table(tamsa$adenoidectomy[tamsa$tonsillectomy=="N"],tamsa$hospital_sect[tamsa$tonsillectomy=="
N"])
my.table<-
table(tamsa$adenoidectomy[tamsa$tonsillectomy=="N"],tamsa$hospital_type[tamsa$tonsillectomy==
"N"])
#
my.table<-table(tamsa$myringotomy,tamsa$admission_election)
my.table<-table(tamsa$myringotomy,tamsa$hospital_sect)
my.table<-table(tamsa$myringotomy,tamsa$hospital_type)
#
my.table
prop.table(my.table,1)
#
my.data<-
(tamsa$age[tamsa$myringotomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="Y"])
summary(my.data)
sd(my.data)
#
summary(tamsa$los_h[tamsa$myringotomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy
=="Y"])
quantile(tamsa$los_h[tamsa$myringotomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=
="Y"],c(0.05,0.95,0.99))
#
tamsa$dx_bi<-"other"
tamsa$dx_bi[tamsa$diagnosis=="G4730"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="G4731"]<-"OSAht"
```

```
tamsa$dx_bi[tamsa$diagnosis=="G4732"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="G4739"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="J351"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="J352"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="J353"]<-"OSAht"
tamsa$dx_bi[tamsa$diagnosis=="J350"]<-"J350"
my.table<-
table(tamsa$separation_year[tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="N"&tamsa$admiss
ion_election=="2"],

        tamsa$dx_bi[tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="N"&tamsa$admission_elec
tion=="2"])
my.table
prop.table(my.table,1)
#
tamsa$dx_bi2<-"other"
tamsa$dx_bi2[tamsa$diagnosis=="H650"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H651"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H660"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H652"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H653"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H654"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H659"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H661"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H662"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="H663"]<-"OM"
tamsa$dx_bi2[tamsa$diagnosis=="G4730"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="G4731"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="G4732"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="G4739"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="J351"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="J352"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="J353"]<-"OSAht"
tamsa$dx_bi2[tamsa$diagnosis=="J350"]<-"J350"
my.table2<-table(tamsa$separation_year[tamsa$adenoidectomy=="Y"&tamsa$tonsillectomy=="N"],
                    tamsa$dx_bi2[tamsa$adenoidectomy=="Y"&tamsa$tonsillectomy=="N"])
my.table2
prop.table(my.table2,1)
#
my.table4<-
table(tamsa$separation_year[tamsa$adenoidectomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$myring
otomy=="Y"&tamsa$admission_election=="1"],

        tamsa$dx_bi2[tamsa$adenoidectomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$myringotomy
=="Y"&tamsa$admission_election=="1"])
my.table4
prop.table(my.table4,1)
#
tamsa$dx_bi3<-"other"
tamsa$dx_bi3[tamsa$diagnosis=="H650"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H651"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H660"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H652"]<-"OME"
tamsa$dx_bi3[tamsa$diagnosis=="H653"]<-"OME"
tamsa$dx_bi3[tamsa$diagnosis=="H654"]<-"OME"
tamsa$dx_bi3[tamsa$diagnosis=="H659"]<-"OME"
```

```
tamsa$dx_bi3[tamsa$diagnosis=="H661"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H662"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H663"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H664"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="H669"]<-"OM"
tamsa$dx_bi3[tamsa$diagnosis=="G4730"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="G4731"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="G4732"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="G4739"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="J351"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="J352"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="J353"]<-"TA"
tamsa$dx_bi3[tamsa$diagnosis=="J350"]<-"TA"
my.table3<-
table(tamsa$separation_year[tamsa$myringotomy=="Y"&tamsa$admission_election=="2"],
                                tamsa$dx_bi3[tamsa$myringotomy=="Y"&tamsa$admission_election=="2"])
my.table3
prop.table(my.table3,1)
#
```

Script 2: Venn-Euler Diagram

```
vd<-
venneuler(c(M=0.499985,T=0.107383,A=0.051883,"M&T"=0.011259,"M&A"=0.07871,"M&A&T"=0.05
7948,"A&T"=0.192833))
#vd$labels<-c("M","T","A")
vd$labels <- rep("", length(v$labels))
plot(vd, col=c("red","green","blue"))
vd$labels<-text(0.1,0.2,"Adenoidectomy")
vd$labels<-text(0.95,0.2,"Tonsillectomy")
vd$labels<-text(0.45,1.1,"Myringotomy +/- Tympanostomy Tube Insertion")
```

Script 3: Identify and code any field containing 'sleep apnoea' diagnoses

```
AnyMentionOf<-function(diagnostic.code) {
	kd<-rep(0,length(tamsa$diagnosis))
	for (j in c(29:53)) kd<-kd + 1*(tamsa[ ,j]==diagnostic.code) # Note this assumes all diagnoses are in columns 29 to 53
	kdelta<-kd>0
	return(kdelta)
}
#
################
#
sleep.apnoea0<-AnyMentionOf("G4730")
sleep.apnoea1<-AnyMentionOf("G4731")
sleep.apnoea2<-AnyMentionOf("G4732")
sleep.apnoea3<-AnyMentionOf("G4739")
Any.Sleep.Apnoea<-sleep.apnoea0|sleep.apnoea1|sleep.apnoea2|sleep.apnoea3
tamsa$AnySleepApnoea<-Any.Sleep.Apnoea
#
```

Script 4: Calculate the ABS Census denominators for the ISAAC dataset

```
options(width=160,length=9999)
#
#           Run this job first to set up the required data objects.....
#           Read in census data: calculate intercensal estimates using linear interpolation
#           store the data as an array with dimensions:-
#                                   postcode, sex, age and year
#
PATH<-"F:\\R\\R-2.7.0\\ISAAC\\"
            males.96<-read.table(file=paste(PATH,"c96male.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            females.96<-read.table(file=paste(PATH,"c96female.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            males.01<-read.table(file=paste(PATH,"c01male.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            females.01<-read.table(file=paste(PATH,"c01female.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            males.06<-read.table(file=paste(PATH,"c06male.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            females.06<-read.table(file=paste(PATH,"c06female.csv",sep=""),sep=",",
header=TRUE,row.names="postcode")
            summary(females.06)
#
males.97<- males.96+1*(males.01-males.96)/5
males.98<- males.96+2*(males.01-males.96)/5
males.99<- males.96+3*(males.01-males.96)/5
males.00<- males.96+4*(males.01-males.96)/5
males.02<- males.01+1*(males.06-males.01)/5
males.03<- males.01+2*(males.06-males.01)/5
males.04<- males.01+3*(males.06-males.01)/5
males.05<- males.01+4*(males.06-males.01)/5
males.07<- males.06+1*(males.06-males.01)/5
ageband.names<-as.character(c(0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17))
for (i in list(males.96,males.97,males.98,males.99,males.00,males.01,males.02,
           males.03,males.04,males.05,males.06,males.07)) {
            postcode.names<-dimnames(i)[[1]]
#           print(postcode.names)
}
#
year.names<-as.character(c(1997,1998,1999,2000,2001,2002,2003,2004,2005,2006,2007))
census.m.array<-
array(c(as.matrix(males.97),as.matrix(males.98),as.matrix(males.99),as.matrix(males.00),

            as.matrix(males.01),as.matrix(males.02),as.matrix(males.03),as.matrix(males.04),as.matrix(m
ales.05),
                                    as.matrix(males.06),as.matrix(males.07)),dim=c(331,18,11),
                                    dimnames=list(postcode.names,ageband.names,year.names))
census.m.array[is.na(census.m.array)]<-0
#print(census.m.array)
#
females.97<- females.96+1*(females.01-females.96)/5
females.98<- females.96+2*(females.01-females.96)/5
females.99<- females.96+3*(females.01-females.96)/5
females.00<- females.96+4*(females.01-females.96)/5
females.02<- females.01+1*(females.06-females.01)/5
```

```
females.03<- females.01+2*(females.06-females.01)/5
females.04<- females.01+3*(females.06-females.01)/5
females.05<- females.01+4*(females.06-females.01)/5
females.07<- females.06+1*(females.06-females.01)/5
census.f.array<-array(c(as.matrix(females.97),as.matrix(females.98),as.matrix(females.99),

        as.matrix(females.00),as.matrix(females.01),as.matrix(females.02),as.matrix(females.03),

        as.matrix(females.04),as.matrix(females.05),as.matrix(females.06),as.matrix(females.07)),

        dim=c(331,18,11),dimnames=list(postcode.names,ageband.names,year.names))
census.f.array[is.na(census.f.array)]<-0
#
# Person years for 2001 - 2007
#
personyears0107.m<-males.01+males.02+males.03+males.04+males.05+males.06+males.07
personyears0107.f<-
females.01+females.02+females.03+females.04+females.05+females.06+females.07
#print(personyears0107.m)
personyears0107.m[is.na(personyears0107.m)]<-0
personyears0107.f[is.na(personyears0107.f)]<-0
print(sum(personyears0107.m))
print(sum(personyears0107.f))
#
census.m.age.tab<-colSums(census.m.array,dims=1)
census.f.age.tab<-colSums(census.f.array,dims=1)
#
census.m.age.9707.tab<-rowSums(census.m.age.tab,dims=1)
census.f.age.9707.tab<-rowSums(census.f.age.tab,dims=1)
#
census.m.year.tab<-colSums(census.m.array,dims=2)
census.f.year.tab<-colSums(census.f.array,dims=2)
#
# The following 'fix' is to get over the lack of rural postcode denominators for the 1996 census
#
males.age.tab96<-
c(9387,9552,9943,9926,10212,10086,10151,10164,10014,9907,10276,10293,10530,10347,10088,98
40,9718,9769)
females.age.tab96<-
c(8787,9087,9519,9576,9552,9527,9551,9422,9416,9587,9907,9776,10105,9835,9610,9604,9239,91
79)
males.age.tab01<-as.vector(colSums(as.matrix(males.01)))
females.age.tab01<-as.vector(colSums(as.matrix(females.01)))
#
# Now interpolate for all SA children for Census year by Age, Male/Female
#
males.age.tab97<- males.age.tab96+1*(males.age.tab01-males.age.tab96)/5
males.age.tab98<- males.age.tab96+2*(males.age.tab01-males.age.tab96)/5
males.age.tab99<- males.age.tab96+3*(males.age.tab01-males.age.tab96)/5
males.age.tab00<- males.age.tab96+4*(males.age.tab01-males.age.tab96)/5
females.age.tab97<- females.age.tab96+1*(females.age.tab01-females.age.tab96)/5
females.age.tab98<- females.age.tab96+2*(females.age.tab01-females.age.tab96)/5
females.age.tab99<- females.age.tab96+3*(females.age.tab01-females.age.tab96)/5
females.age.tab00<- females.age.tab96+4*(females.age.tab01-females.age.tab96)/5
#
```

```
# Now sum all ages and replace fields in the "census.m/f.year.tab" Tables for Census Year total children, Male/Female Tables
#
census.m.year.tab[1]<-sum(males.age.tab97)
census.m.year.tab[2]<-sum(males.age.tab98)
census.m.year.tab[3]<-sum(males.age.tab99)
census.m.year.tab[4]<-sum(males.age.tab00)
census.f.year.tab[1]<-sum(females.age.tab97)
census.f.year.tab[2]<-sum(females.age.tab98)
census.f.year.tab[3]<-sum(females.age.tab99)
census.f.year.tab[4]<-sum(females.age.tab00)
#
# Now replace fields in the "census.m/f.age.table" Tables for each Census Year by age-group, Male/Female Tables
#
census.m.age.tab[c(1:18),1]<-males.age.tab97
census.m.age.tab[c(1:18),2]<-males.age.tab98
census.m.age.tab[c(1:18),3]<-males.age.tab99
census.m.age.tab[c(1:18),4]<-males.age.tab97
census.f.age.tab[c(1:18),1]<-females.age.tab97
census.f.age.tab[c(1:18),2]<-females.age.tab98
census.f.age.tab[c(1:18),3]<-females.age.tab99
census.f.age.tab[c(1:18),4]<-females.age.tab00
#
# POSTCODES
#
census.m.pc.tab<-rowSums(census.m.array,dims=1)
census.f.pc.tab<-rowSums(census.f.array,dims=1)
print(census.f.pc.tab)
#
```

Script 5: Calculate the incidence of procedures in the ISAAC dataset

```
# TAMSA SCRIPT
#
PATH<-"F:\\R\\R-2.7.0\\ISAAC\\"
tamsawithPC5160<-read.table(paste(PATH,"tamsa.csv",sep=""),header=TRUE,sep=",")
#
# remove 4 kids who claim to live in Lonsdale 5160 for which there are zero residents according to census data
#
tamsa<-tamsawithPC5160[tamsawithPC5160$postcode!=5160,]
#
# Postcodes in which legitimate cases may be classified - derived from census files
postcode_list<-
c("5000","5006","5007","5008","5009","5010","5011","5012","5013","5014","5015","5016",
"5017","5018","5019","5020","5021","5022","5023","5024","5025","5031","5032","5033",
"5034","5035","5037","5038","5039","5040","5041","5042","5043","5044","5045","5046",
"5047","5048","5049","5050","5051","5052","5061","5062","5063","5064","5065","5066",
"5067","5068","5069","5070","5072","5073","5074","5075","5076","5081","5082","5083",
"5084","5085","5086","5087","5088","5089","5090","5091","5092","5093","5094","5095",
"5096","5097","5098","5106","5107","5108","5109","5110","5111","5112","5113","5114",
"5115","5116","5117","5118","5120","5121","5125","5126","5127","5131","5132","5133",
"5134","5136","5137","5138","5139","5140","5141","5142","5144","5151","5152","5153",
"5154","5155","5156","5157","5158","5159","5161","5162","5163","5164","5165",
"5166","5167","5168","5169","5170","5171","5172","5173","5174","5201","5202","5203",
"5204","5210","5211","5212","5213","5214","5220","5221","5222","5223","5231","5232",
"5233","5234","5235","5236","5237","5238","5240","5241","5242","5243","5244","5245",
"5250","5251","5252","5253","5254","5255","5256","5259","5260","5261","5262","5263",
"5264","5265","5266","5267","5268","5269","5270","5271","5272","5273","5275","5276",
"5277","5278","5279","5280","5290","5291","5301","5302","5303","5304","5306","5307",
"5308","5309","5310","5311","5320","5321","5322","5330","5331","5332","5333","5340",
"5341","5342","5343","5344","5345","5346","5350","5351","5352","5353","5354","5355",
"5356","5357","5360","5371","5372","5373","5374","5381","5400","5401","5410","5411",
"5412","5413","5414","5415","5416","5417","5418","5419","5420","5421","5422","5431",
"5432","5433","5434","5440","5451","5452","5453","5454","5455","5460","5461","5462",
"5464","5470","5471","5472","5473","5480","5481","5482","5483","5485","5490","5491",
"5493","5495","5501","5502","5510","5520","5521","5522","5523","5540","5550","5552",
"5554","5555","5556","5558","5560","5570","5571","5572","5573","5575","5576","5577",
"5580","5581","5582","5583","5600","5601","5602","5603","5604","5605","5606","5607",
"5608","5609","5630","5631","5632","5633","5640","5641","5642","5650","5651","5652",
"5653","5654","5655","5661","5670","5671","5680","5690","5700","5710","5720","5722",
"5723","5724","5725","5730","5731","5732","5733","5734")
#
BasicDescription<-function(subset,ylim1,ylim2,ylim4,ylegend1,ylegend2,ylegend4,

	filename1,filename1A,filename2,filename3,filename3A,filename4,filename4A,filename5) {
	if (missing(subset)) subset<-rep(TRUE,length(tamsa$sex))
	tamsa.subset<-tamsa[subset,]
#
# set up age, postcode and calendar year factors
#
	age_yr<-factor(tamsa.subset$age_wholeyears, levels=c(0:17))
#	postcode_list<-unique(tamsa.subset$postcode)
	postcode<-factor(tamsa.subset$postcode,levels=postcode_list)
	year<-factor(tamsa.subset$separation_year,levels=c(1997:2007))
#
```

```
        males<-tamsa.subset$sex=="M"
        females<-tamsa.subset$sex=="F"
        males_pub<-tamsa.subset$sex=="M"&tamsa.subset$admission_election=="1"
        males_pri<-tamsa.subset$sex=="M"&tamsa.subset$admission_election=="2"
        females_pub<-tamsa.subset$sex=="F"&tamsa.subset$admission_election=="1"
        females_pri<-tamsa.subset$sex=="F"&tamsa.subset$admission_election=="2"
#
# Generate tables/arrays of counts by postcode, age-year and calendar year
# (a) just for boys and girls separately
#
        both.tab<-table(postcode,age_yr,year)
        males.tab<-table(postcode[males],age_yr[males],year[males])
        females.tab<-table(postcode[females],age_yr[females],year[females])
        both.array<-as.array(both.tab)
        males.array<-as.array(males.tab)
        females.array<-as.array(females.tab)
#       print(females.array)
#
# (b) for boys and girls by private & public insurance status
#
        males.pub.tab<-table(postcode[males_pub],age_yr[males_pub],year[males_pub])
        males.pri.tab<-table(postcode[males_pri],age_yr[males_pri],year[males_pri])
        females.pub.tab<-table(postcode[females_pub],age_yr[females_pub],year[females_pub])
        females.pri.tab<-table(postcode[females_pri],age_yr[females_pri],year[females_pri])
        males.pub.array<-as.array(males.pub.tab)
        males.pri.array<-as.array(males.pri.tab)
        females.pub.array<-as.array(females.pub.tab)
        females.pri.array<-as.array(females.pri.tab)
#
# Get margins for counts by postcode, by age-year, by calendar year and by calendar_year.age
#
        postcode.tab<-rowSums(both.array,dims=1)
        year.tab<-colSums(both.array,dims=2)
        year.age.tab<-colSums(both.array,dims=1)
        age.tab<-rowSums(colSums(both.array,dims=1),dims=1)
#
# Same again but by males and females as well - and get total observed cases by postcode for the
period 2001-2007
#
        males.postcode.total<-rowSums(males.array,dims=1)
        males.postcode.tot0107<-rowSums(males.array[,,5:11],dims=1)
        males.year.tab<-colSums(males.array,dims=2)
        males.year.age.tab<-colSums(males.array,dims=1)
        males.age.tab<-rowSums(colSums(males.array,dims=1),dims=1)
        males.age.0107tab<-rowSums(colSums(males.array[,,5:11],dims=1),dims=1)
        maleincidence.age.0107tab<-males.age.0107tab/colSums(personyears0107.m)
        maleexpected.postcode<-
as.matrix(personyears0107.m)%*%as.matrix(maleincidence.age.0107tab)
        maleratio<-as.matrix(males.postcode.tot0107)*100/maleexpected.postcode
        females.postcode.total<-rowSums(females.array,dims=1)
        females.postcode.tot0107<-rowSums(females.array[,,5:11],dims=1)
        females.year.tab<-colSums(females.array,dims=2)
        females.year.age.tab<-colSums(females.array,dims=1)
        females.age.tab<-rowSums(colSums(females.array,dims=1),dims=1)
        females.age.0107tab<-rowSums(colSums(females.array[,,5:11],dims=1),dims=1)
        femaleincidence.age.0107tab<-females.age.0107tab/colSums(personyears0107.f)
```

```
            femaleexpected.postcode<-
as.matrix(personyears0107.f)%*%as.matrix(femaleincidence.age.0107tab)
            femaleratio<-as.matrix(females.postcode.tot0107)*100/femaleexpected.postcode
#
mapdata0107<-
as.matrix(cbind(males.postcode.tot0107,maleexpected.postcode,maleratio,females.postcode.tot0107,f
emaleexpected.postcode,femaleratio),ncol=6)
dimnames(mapdata0107)[[2]] <- c("males.observed", "males.expected", "male.ratio",
"females.observed","females.expected","female.ratio")  # change col names
MapData0107<-as.data.frame(mapdata0107)
print(MapData0107)
#
# Now get tables of sex by insurance status by calendar year
#
            f.pri.year.tab<-colSums(females.pri.array,dims=2)
            f.pub.year.tab<-colSums(females.pub.array,dims=2)
            m.pri.year.tab<-colSums(males.pri.array,dims=2)
            m.pub.year.tab<-colSums(males.pub.array,dims=2)
            f.pri.age.tab<-rowSums(colSums(females.pri.array,dims=1),dims=1)
            f.pub.age.tab<-rowSums(colSums(females.pub.array,dims=1),dims=1)
            m.pri.age.tab<-rowSums(colSums(males.pri.array,dims=1),dims=1)
            m.pub.age.tab<-rowSums(colSums(males.pub.array,dims=1),dims=1)
#
# calculate incidence (percent) by calendar year for males and females across SA
#
            females.percent<-females.year.tab*1000/census.f.year.tab
            males.percent<-males.year.tab*1000/census.m.year.tab
            both.percent<-(females.year.tab+males.year.tab)*1000/(census.m.year.tab+census.f.year.tab)
            print(cbind(males.percent,females.percent,both.percent))
#
# Finally some plots...
# Firstly, annual incidence by calendar year - separate plots for boys and girls
#
par(cex=0.85)
matplot(c(1997:2007),cbind(males.percent,females.percent),type="l",lty=(1:2),lwd=c(2),lab=c(11,15,2
),
col=c(4,2,1),xlab="Year",ylim=ylim1,ylab="per 1000 children")
legend(x=ylegend1,legend=c("male","female"),lty=(1:2),col=c(4,2,1))
# savePlot(filename=filename1,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# Now annual incidence by calendar year for all combinations of sex and insurance status
#
f.pri.percent<-f.pri.year.tab*1000/census.f.year.tab
m.pri.percent<-m.pri.year.tab*1000/census.m.year.tab
f.pub.percent<-f.pub.year.tab*1000/census.f.year.tab
m.pub.percent<-m.pub.year.tab*1000/census.m.year.tab
matplot(c(1997:2007),cbind(m.pri.percent,f.pri.percent,m.pub.percent,f.pub.percent),type="l",lty=c(1,
1,2,2),lwd=c(2,2),lab=c(11,15,2),
                        col=c(4,2),xlab="Year",ylim=ylim1,ylab="per 1000 children")
legend(x=ylegend1,legend=c("male private","female private","male public","female
public"),lty=c(1,1,2,2),col=c(4,2))
# savePlot(filename=filename1A,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# Plot age_by_sex specific incidence by calendar year
#
females.age.percent<-females.year.age.tab*1000/census.f.age.tab
```

```
males.age.percent<-males.year.age.tab*1000/census.m.age.tab
matplot(c(0:17),cbind(males.age.percent,females.age.percent),type="l",lty=(1:11),lab=c(17,20,7),
col=c(rep(4,times=11),rep(2,times=11)),xlab="Age(years)",ylim=ylim2,ylab="per 1000 children")
legend(x=ylegend2,legend=c(1997:2007),lty=(1:11),col=c(rep(4,times=11),rep(2,times=11)))
#       savePlot(filename=filename2,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# Plot for males and females separately, plot incidence by age-year (pooled across calendar years)
#
        females.age.9707.percent<-females.age.tab*1000/census.f.age.9707.tab
        males.age.9707.percent<-males.age.tab*1000/census.m.age.9707.tab
        both.age.9707.percent<-
(females.age.tab+males.age.tab)*1000/(census.m.age.9707.tab+census.f.age.9707.tab)
        print(cbind(males.age.9707.percent,females.age.9707.percent,both.age.9707.percent))
        matplot(c(0:17),cbind(males.age.9707.percent,females.age.9707.percent),type="l",lty=(1:2),l
wd=c(2,2),lab=c(17,20,7),
                col=c(4,2),xlab="Age (years)",ylim=ylim2,ylab="per 1000 children")
        legend(x=ylegend2,legend=c("male","female"),lty=(1:2),col=c(4,2))
#       savePlot(filename=filename3,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# Plot incidence by age-year for all 4 combinations of gender and insurance status
#
        f.pri.age.9707.percent<-f.pri.age.tab*1000/census.f.age.9707.tab
        m.pri.age.9707.percent<-m.pri.age.tab*1000/census.m.age.9707.tab
        f.pub.age.9707.percent<-f.pub.age.tab*1000/census.f.age.9707.tab
        m.pub.age.9707.percent<-m.pub.age.tab*1000/census.m.age.9707.tab
        matplot(c(0:17),cbind(m.pri.age.9707.percent,f.pri.age.9707.percent,m.pub.age.9707.percent,f
.pub.age.9707.percent),
                type="l",lty=c(1,1,2,2),lab=c(17,20,7),col=c(4,2),xlab="Age
(years)",ylim=ylim2,ylab="per 1000 children")
        legend(x=ylegend2,legend=c("male private","female private","male public","female
public"),lty=c(1,1,2,2),col=c(4,2))
#       savePlot(filename=filename3A,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# Finally some cumulative (across age) prevalence plots
#
# (a) just by sex
#
        females.age.9707.cumsum<-cumsum(females.age.9707.percent)
        males.age.9707.cumsum<-cumsum(males.age.9707.percent)
        both.age.9707.cumsum<-cumsum(both.age.9707.percent)
#print(cbind(males.age.9707.cumsum,females.age.9707.cumsum,both.age.9707.cumsum))
        matplot(c(0:17),cbind(males.age.9707.cumsum,females.age.9707.cumsum),type="l",lty=(1:2),l
wd=c(2,2),lab=c(17,20,7),
                col=c(4,2),xlab="Age (years)",ylim=ylim4,ylab="cumulative rate per 1000 children")
        legend(x=ylegend4,legend=c("male","female"),lty=(1:2),col=c(4,2))
#       savePlot(filename=filename4,type=c("jpg"),device=2,restoreConsole=TRUE)
#
# (b) by all combinations of sex by insurance status
#
        f.pri.age.9707.cumsum<-cumsum(f.pri.age.9707.percent)
        m.pri.age.9707.cumsum<-cumsum(m.pri.age.9707.percent)
        f.pub.age.9707.cumsum<-cumsum(f.pub.age.9707.percent)
        m.pub.age.9707.cumsum<-cumsum(m.pub.age.9707.percent)
        matplot(c(0:17),cbind(m.pri.age.9707.cumsum,f.pri.age.9707.cumsum,m.pub.age.9707.cumsu
m,f.pub.age.9707.cumsum),
```

```
                type="l",lty=c(1,1,2,2),lab=c(17,20,7),col=c(4,2),xlab="Age
(years)",ylim=ylim4,ylab="cumulative rate per 1000 children")
        legend(x=ylegend4,legend=c("male private","female private","male public","female
public"),lty=c(1,1,2,2),lwd=c(2,2),col=c(4,2))
#       savePlot(filename=filename4A,device=2,restoreConsole=TRUE)
#
# (c) - same as (a) - but as cumulative prevalence per 1000
#
        females.age.cumsum<-matrix(NA,nrow=18,ncol=11)
        for (i in 1:11) females.age.cumsum[,i]<-cumsum(females.age.percent[,i])
        dimnames(females.age.cumsum)<-dimnames(females.age.percent)
        males.age.cumsum<-matrix(NA,nrow=18,ncol=11)
        for (i in 1:11) males.age.cumsum[,i]<-cumsum(males.age.percent[,i])
        dimnames(males.age.cumsum)<-dimnames(males.age.percent)
        matplot(c(0:17),cbind(males.age.cumsum,females.age.cumsum),type="l",lty=(1:11),lab=c(17,2
0,7),
                col=c(rep(4,times=11),rep(2,times=11)),xlab="Age
(years)",ylim=ylim4,ylab="cumulative rate per 1000 children")
        legend(x=ylegend4,legend=c(1997:2007),lty=(1:11),col=c(rep(4,times=11),rep(2,times=11)))
#       savePlot(filename=filename5,device=2,restoreConsole=TRUE)
        return("MapData0107"=MapData0107)
}
#
#
tonsil<-tamsa$tonsillectomy=="Y"
adenoid<-tamsa$adenoidectomy=="Y"
adenot<-tamsa$adenoidectomy=="Y"&tamsa$tonsillectomy=="Y"
tonsilonly<-tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="N"
adenoidonly<-tamsa$tonsillectomy=="N"&tamsa$adenoidectomy=="Y"
myrin<-tamsa$myringotomy=="Y"
tam<-
tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="Y"&tamsa$myringotomy=="Y"&tamsa$admissio
n_election=="2"
#
#CODE FOR HOSPITAL STATUS: tamsa$admission_election=="1"|tamsa$admission_election=="2"
#
#CODE FOR INDIGENOUS STATUS:
tamsa$indigenous=="1"|tamsa$indigenous=="2"|tamsa$indigenous=="3"
#
Data.map<-BasicDescription(adenot,
        ylim1=c(0,10),ylegend1="topright",filename1=paste(PATH,"Plot1_T",".jpg"),
        filename1A=paste(PATH,"Plot1_T_pri",".jpg"),
        ylim2=c(0,25),ylegend2="topright",filename2=paste(PATH,"Plot2_T",".jpg"),
        filename3=paste(PATH,"Plot3_T",".jpg"),
        filename3A=paste(PATH,"Plot3_T_pri",".jpg"),
        ylim4=c(0,150),ylegend4="topleft",filename4=paste(PATH,"Plot4_T",".jpg"),
        filename4A=paste(PATH,"Plot4_T_pri",".jpg"),
        filename5=paste(PATH,"Plot5_T",".jpg"))
#
#
```

Script 6: Calculate the proportion of surgical indications in the ISAAC dataset

```
# PLOT DIAGNOSES
#
PlotDiagnoses<-function(diagnosis,denominator,ylim,ylegend,title,filename) {
	AgeYears<-factor(tamsa$age_wholeyears,levels=c(0:17))
	counts.tab<-table(tamsa$diagnosis[diagnosis],AgeYears[diagnosis])
#	print(counts.tab)
	OM<-
c("H650","H651","H652","H653","H654","H659","H660","H661","H662","H663","H664","H669")
	AOM<-c("H650","H651","H660")
	OME<-c("H652","H653","H654","H659")
	CSOM<-c("H661","H662","H663")
	otherOM<-c("H664","H669")
	SINUS<-
c("J320","J321","J322","J323","J324","J328","J329","J330","J338","J339","J341","J342","J343","J348")
	OSA<-c("G4730","G4731","G4732","G4739")
	hyperTA<-c("J351","J352","J353")
	OSAht<-c("G4730","G4731","G4732","G4739","J351","J352","J353")
#
	dx.all<-colSums(counts.tab)
	dx.OM<-colSums(counts.tab[OM,])
	dx.AOM<-colSums(counts.tab[AOM,])
	dx.OME<-colSums(counts.tab[OME,])
	dx.CSOM<-colSums(counts.tab[CSOM,])
	dx.otherOM<-colSums(counts.tab[otherOM,])
	dx.SINUS<-colSums(counts.tab[SINUS,])
	dx.OSA<-colSums(counts.tab[OSA,])
	dx.hyperTA<-colSums(counts.tab[hyperTA,])
	dx.OSAht<-colSums(counts.tab[OSAht,])
	dx.J350<-counts.tab["J350",]
#
	dx.TA<-dx.J350+dx.OSAht
	dx.AOMOM<-dx.AOM+dx.CSOM+dx.otherOM
	dx.otherEAR<-dx.all-dx.AOM-dx.OME-dx.CSOM-dx.TA-dx.otherOM
	dx.tidyEAR<-cbind(dx.all,dx.OME,dx.AOMOM,dx.TA,dx.otherEAR)
	print(dx.tidyEAR)
	dx.rateEAR<-dx.tidyEAR/denominator*1000
	print(dx.rateEAR)
#
	dx.otitis<-dx.AOM+dx.OME+dx.CSOM+dx.otherOM
	dx.otherTA<-dx.all-dx.J350-dx.OSAht
	dx.tidyTA<-cbind(dx.all,dx.J350,dx.OSAht,dx.otitis,dx.otherTA)
	print(dx.tidyTA)
	dx.rateTA<-dx.tidyTA/denominator*1000
	print(dx.rateTA)
#
# NOW GRAPHS
#
#	par(cex=0.75)
#
	matplot(c(0:17),dx.rateTA,type="l",pch=1,lwd=c(2),lab=c(17,16,7),lty=c(1,1,2,1,2,1,1),col=c(1,
3,3,6,6,8),
#		ylim=ylim,xlab="Age (years)",ylab="Incidence (separations per 1,000 children)")
#	title(main=list(title, cex=0.75, col=8, font=2))
#
```

```
#	legend(13.25,y=ylegend,lwd=c(2),legend=c("All
cases","AOM","OME","CSOM","Tonsillitis","OSA-HT","Other"),
#
	lty=c(1,1,2,1,2,1,2),col=c(1,3,3,6,6,8,2))
#	savePlot(filename=filename,type=c("tiff"),device=2,restoreConsole=TRUE)
}
#
#diagnosis<-
tamsa$admission_election=="2"&tamsa$tonsillectomy=="N"&tamsa$adenoidectomy=="Y"
diagnosis<-
tamsa$myringotomy=="Y"&tamsa$tonsillectomy=="Y"&tamsa$adenoidectomy=="Y"&tamsa$admissio
n_election=="2"
denominator<-census.m.age.9707.tab+census.f.age.9707.tab
#
PlotDiagnoses(diagnosis,denominator,ylim=c(0,20),ylegend=20,filename=paste("Plot","tiff",sep="."),
	title="Tonsils ALL")
#
```

STATISTICAL CODING FOR CHAPTER 5

Script 1: Import AIHW datasets

```
# AIHW Script - Run this second to get the numerators for the analysis of the AIHW data
#
PATH<-"F:\\R\\R-2.7.0\\AIHW\\"AIHW_NSW<-read.table(paste(PATH,"2010-035
data_'NSW'.txt",sep=""),header=TRUE,sep="\t")
        AIHW_NT<-read.table(paste(PATH,"2010-035data_'NT'.txt",sep=""),header=TRUE,sep="\t")
        AIHW_SA<-read.table(paste(PATH,"2010-035data_'SA'.txt",sep=""),header=TRUE,sep="\t")
        AIHW_TAS<-read.table(paste(PATH,"2010-035data_'TAS'.txt",sep=""),header=TRUE,sep="\t")
        AIHW_VIC<-read.table(paste(PATH,"2010-035data_'VIC'.txt",sep=""),header=TRUE,sep="\t")
        AIHW_WA<-read.table(paste(PATH,"2010-035data_'WA'.txt",sep=""),header=TRUE,sep="\t")
```

Script 2: Find and code procedures in AIHW datasets

```
# Proc codes of interest
# Code   Description
# 4162600       Myringotomy, unilateral
# 4162601       Myringotomy, bilateral
# 4163200       Myringotomy with tympanostomy tube insertion, unilateral
# 4163201       Myringotomy with tympanostomy tube insertion, bilateral
# 4178900       Tonsillectomy without adenoidectomy
# 4178901       Tonsillectomy with adenoidectomy
# 4180100       Adenoidectomy without tonsillectomy or removal of lingual tonsil
#
######################################################################
# Function TO TABLE THE NUMBER OF CHILDREN (BY FIELD NUMBER) WHO HAD A SPECIFIED
PROCEDURES CODE IN EACH OF THE FIRST <nfields> "PROCS" FIELDS.  (Useful for knowing how
many procedure fields out of a maximum of 100 need to be searched for a give procedure code)
# Example:-ProcTabler(AIHW_WA,4178901,20)
# tables all occurrences of procedure 4178900 in the first 20 "procs" fields
#
ProcTabler<-function(stateDF,procedure.code,nfields) {
        if (missing(nfields)) nfields<-1
        nkids<-nrow(stateDF)
        colnos<-c(11:(11+nfields-1))
        procvec<-as.vector(stateDF[,colnos])       # form a single vector from all the procedure
columns to be scanned
        placeno<-rep(1:nfields,each=nkids)
        placeno.fac<-factor(placeno,levels=c(1:nfields))
        procedure<-procvec==procedure.code
        position.tab<-table(placeno.fac,procedure)
        return(position.tab)
}
######################################################################
# Function To return a column of subjects who did (1) or did not (0) have a specified procedure code
in the first <nfields> "PROCS" fields. (This function can be called repeatedly to get COMBINATIONS of
procedure codes performed within the same child).
# Examples:-ProcFinder(AIHW_NT,4178901,20)
# generates a column (0,1)list of all occurrences of procedure 4178900 in the first 20 "procs" fields
#
ProcFinder<-function(stateDF,procedure.code,nfields) {
        if (missing(nfields)) nfields<-1
        nkids<-nrow(stateDF)
        colnos<-c(10:(10+nfields-1))
        procvec<-as.vector(stateDF[,colnos])              # form a single vector from all the
procedure columns to be scanned
        procvec[is.na(procvec)]<--1                       # for a subject with say j
procedures, procedure fields j+1, j+2, ... contain NAs
        procedure<-1*(procvec==procedure.code)
        ProcByField.mat<-matrix(procedure,nrow=nkids,ncol=nfields,byrow=F)
        proc.found<-rowSums(ProcByField.mat)
        total.count<-sum(proc.found)
        placeno<-rep(1:nfields,each=nkids)
        placeno.fac<-factor(placeno,levels=c(1:nfields))
        position.tab<-table(placeno.fac,procedure)
        return(proc.found)
}
#
```

```
####################################################################
Proc1T<- ProcFinder(AIHW_TAS,4178901,50)                # 1=found proc 4178901
Proc2T<- ProcFinder(AIHW_TAS,4178900,50)                # 1=found proc 4178900
AIHW_TAS$T<-Proc1T+Proc2T                               # 1=found both procs in same subject
AIHW_TAS$T<-replace(AIHW_TAS$T,AIHW_TAS$T==2,1)  # replace any cell value of 2 with a 1
AIHW_TAS$T<-as.factor(AIHW_TAS$T)
#
Proc1A<- ProcFinder(AIHW_TAS,4178901,50)                # 1=found proc 4178901
Proc2A<- ProcFinder(AIHW_TAS,4180100,50)                # 1=found proc 4178900
AIHW_TAS$A<-Proc1A+Proc2A                               # 1=found both procs in same subject
AIHW_TAS$A<-replace(AIHW_TAS$A,AIHW_TAS$A==2,1)  # replace any cell value of 2 with a 1
AIHW_TAS$A<-as.factor(AIHW_TAS$A)
#
Proc1TTI<- ProcFinder(AIHW_TAS,4163201,50)              # 1=found proc 4178901
Proc2TTI<- ProcFinder(AIHW_TAS,4163200,50)              # 1=found proc 4178900
Proc3TTI<- ProcFinder(AIHW_TAS,4162601,50)
Proc4TTI<- ProcFinder(AIHW_TAS,4162600,50)
AIHW_TAS$TTI<-Proc1TTI+Proc2TTI+Proc3TTI+Proc4TTI           # 1=found procs in same subject
AIHW_TAS$TTI<-replace(AIHW_TAS$TTI,AIHW_TAS$TTI==2,1)      #replace any cell value 2 with a 1
AIHW_TAS$TTI<-replace(AIHW_TAS$TTI,AIHW_TAS$TTI==3,1)      #replace any cell value 3 with a 1
AIHW_TAS$TTI<-as.factor(AIHW_TAS$TTI)
#
####################################################################
#Proc1other<- ProcFinder(AIHW_WA,4188900,100)
#AIHW_WA$other<-Proc1other
#AIHW_WA$other<-replace(AIHW_WA$other,AIHW_WA$other==2,1)
# CHECK DATA
#table(AIHW_WA$T,AIHW_WA$A,AIHW_WA$TTI)
#table(AIHW_WA$other[AIHW_WA$T=="0"&AIHW_WA$A=="0"&AIHW_WA$TTI=="0"])
#
```

Script 3: Calculate the ABS Census denominators for the AIHW analysis

```
#
# AIHW ABS Script - Run this first to get the Census denominators for the analysis of the AIHW data
# 2001 & 2009 in the AIHW dataset are only given for half years, so denominator needs to be half
(hence "a")
#
#
PATH<-"F:\\R\\AIHW\\"
m01<-read.table(file=paste(PATH,"c01m_aust.csv",sep=""),sep=",", header=TRUE,row.names="state")
f01<-read.table(file=paste(PATH,"c01f_aust.csv",sep=""),sep=",", header=TRUE,row.names="state")
m06<-read.table(file=paste(PATH,"c06m_aust.csv",sep=""),sep=",", header=TRUE,row.names="state")
f06<-read.table(file=paste(PATH,"c06f_aust.csv",sep=""),sep=",", header=TRUE,row.names="state")
#
m01a<-m01/2
m02<- m01+1*(m06-m01)/5
m03<- m01+2*(m06-m01)/5
m04<- m01+3*(m06-m01)/5
m05<- m01+4*(m06-m01)/5
m07<- m06+1*(m06-m01)/5
m08<- m06+2*(m06-m01)/5
m09a<- (m06+3*(m06-m01)/5)/2
#
age_names<-as.character(c(0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17))
for (i in list(m01a,m02,m03,m04,m05,m06,m07,m08,m09a)) {
        state_names<-dimnames(i)[[1]]
}
#
yr_names<-as.character(c(2001,2002,2003,2004,2005,2006,2007,2008,2009))
c.m.array<-array(c(as.matrix(m01a),as.matrix(m02),as.matrix(m03),as.matrix(m04),
                as.matrix(m05),as.matrix(m06),as.matrix(m07),as.matrix(m08),
                as.matrix(m09a)),dim=c(6,18,9),dimnames=list(state_names,age_names,yr_names))
c.m.array[is.na(c.m.array)]<-0
#
f01a<-f01/2
f02<- f01+1*(f06-f01)/5
f03<- f01+2*(f06-f01)/5
f04<- f01+3*(f06-f01)/5
f05<- f01+4*(f06-f01)/5
f07<- f06+1*(f06-f01)/5
f08<- f06+2*(f06-f01)/5
f09a<- (f06+3*(f06-f01)/5)/2
age_names<-as.character(c(0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17))
for (i in list(f01a,f02,f03,f04,f05,f06,f07,f08,f09a)) {
        state_names<-dimnames(i)[[1]]
}
#
yr_names<-as.character(c(2001,2002,2003,2004,2005,2006,2007,2008,2009))
c.f.array<-array(c(as.matrix(f01a),as.matrix(f02),as.matrix(f03),as.matrix(f04),
                as.matrix(f05),as.matrix(f06),as.matrix(f07),as.matrix(f08),
                as.matrix(f09a)),dim=c(6,18,9),dimnames=list(state_names,age_names,yr_names))
c.f.array[is.na(c.f.array)]<-0
#
# PERSON-YEARS FOR 2001-2009
#
pyrs0109.m<-m01a+m02+m03+m04+m05+m06+m07+m08+m09a
```

```
pyrs0109.m[is.na(pyrs0109.m)]<-0
pyrs0109.f<-f01a+f02+f03+f04+f05+f06+f07+f08+f09a
pyrs0109.f[is.na(pyrs0109.f)]<-0
#
# COLUMN & ROW TOTALS 2001-2009
#
c.m.age.tab<-colSums(c.m.array,dims=1)
c.m.age.0109.tab<-rowSums(c.m.age.tab,dims=1)
c.m.year.tab<-colSums(c.m.array,dims=1)
c.m.tab<-rowSums(c.m.array,dims=2)
c.m.y.tab<-apply(c.m.array,3,rowSums)
print(c.m.y.tab)
#
c.f.age.tab<-colSums(c.f.array,dims=1)
c.f.age.0109.tab<-rowSums(c.f.age.tab,dims=1)
c.f.year.tab<-colSums(c.f.array,dims=2)
c.f.tab<-rowSums(c.f.array,dims=2)
c.f.y.tab<-apply(c.f.array,3,rowSums)
print(c.f.y.tab)
#
```

Script 4: Calculate simple analyses of the AIHW dataset

```
#ls()                          # lists all items in workspace
#rm(list = ls(all = TRUE))     # clears the workspace
#
# SIMPLE ANALYSIS
#
# Proc codes of interest
# Code   Description
# 4162600       Myringotomy, unilateral
# 4162601       Myringotomy, bilateral
# 4163200       Myringotomy with tympanostomy tube insertion, unilateral
# 4163201       Myringotomy with tympanostomy tube insertion, bilateral
# 4178900       Tonsillectomy without adenoidectomy
# 4178901       Tonsillectomy with adenoidectomy
# 4180100       Adenoidectomy without tonsillectomy or removal of lingual tonsil
#
#####################################################################
BasicStats<-function(VAR1,VAR2,VAR3,VAR4) {
	print(paste("Age Mean =",mean(VAR1)))
	print(paste("Age StDev =",sd(VAR1)))
	print(paste("Age Median =",median(VAR1)))
	print(paste("Age Min =",min(VAR1)))
	print(paste("Age Max =",max(VAR1)))
	print(table(VAR2))
	print(table(VAR3))
	#print(table(VAR2,VAR3))
	#print(chisq.test(table(VAR2,VAR3),correct=FALSE))
	print(paste("SEIFA Median =",median(VAR4)))
	print(paste("SEIFA Min =",min(VAR4)))
	print(paste("SEIFA Max =",max(VAR4)))
}
#
#####################################################################
#
max(AIHW_NSW$proj_id)
BasicStats(AIHW_NSW$AGE,AIHW_NSW$SEX,AIHW_NSW$SECTOR,AIHW_NSW$seifaQuintile)
#
sum(AIHW_NSW$T=="1"&AIHW_NSW$A=="1")
BasicStats(AIHW_NSW$AGE[AIHW_NSW$T=="1"&AIHW_NSW$A=="1"],AIHW_NSW$SEX[AIHW_NSW$
T=="1"&AIHW_NSW$A=="1"],

	AIHW_NSW$SECTOR[AIHW_NSW$T=="1"&AIHW_NSW$A=="1"],AIHW_NSW$seifaQuintile[AI
HW_NSW$T=="1"&AIHW_NSW$A=="1"])
#
sum(AIHW_NSW$TTI=="1")
BasicStats(AIHW_NSW$AGE[AIHW_NSW$TTI=="1"],AIHW_NSW$SEX[AIHW_NSW$TTI=="1"],

	AIHW_NSW$SECTOR[AIHW_NSW$TTI=="1"],AIHW_NSW$seifaQuintile[AIHW_NSW$TTI=="1"
])
#####################################################################
#
# COMPARE SEX VS STATES
#
tab1=table(AIHW_NSW$SEX)
```

```
tab2=table(AIHW_SA$SEX)
tab3=table(AIHW_TAS$SEX[AIHW_TAS$SEX!="Not known"])
        remove<-c("Not known")
        tab3<-tab3[-match(remove, names(tab3))]
tab4=table(AIHW_VIC$SEX)
tab5=table(AIHW_WA$SEX)
rel=rbind(NSW=c(tab1),SA=c(tab2),TAS=c(tab3),VIC=c(tab4),WA=c(tab5))
#
print(rel)
prop.table(rel,1)
chisq.test(rel,correct = TRUE)
#
######################################################################
#
# COMPARE SECTOR VS STATES
#
tab1=table(AIHW_NSW$SECTOR)
tab2=table(AIHW_SA$SECTOR)
tab3=table(AIHW_TAS$SECTOR)
tab4=table(AIHW_VIC$SECTOR)
tab5=table(AIHW_WA$SECTOR)
rel=rbind(NSW=c(tab1),SA=c(tab2),TAS=c(tab3),VIC=c(tab4),WA=c(tab5))
#
t(rel)
t(prop.table(rel,1))
chisq.test(rel)
#
######################################################################
# COMPARE MEAN AGES FOR EACH STATE
#
median(AIHW_NSW$AGE)
median(AIHW_SA$AGE)
median(AIHW_TAS$AGE)
median(AIHW_VIC$AGE)
median(AIHW_WA$AGE)
#
wilcox.test(AIHW_NSW$AGE,AIHW_SA$AGE)
#
######################################################################
median(AIHW_NSW$seifaQuintile)
median(AIHW_SA$seifaQuintile)
median(AIHW_TAS$seifaQuintile)
median(AIHW_VIC$seifaQuintile)
median(AIHW_WA$seifaQuintile)
#
tab1=table(AIHW_NSW$seifaQuintile)
tab2=table(AIHW_SA$seifaQuintile)
tab3=table(AIHW_TAS$seifaQuintile)
tab4=table(AIHW_VIC$seifaQuintile)
tab5=table(AIHW_WA$seifaQuintile)
seifa=rbind(NSW=c(tab1),SA=c(tab2),TAS=c(tab3),VIC=c(tab4),WA=c(tab5))
        seifa["VIC",c('6')]<-0
#
seifa
prop.table(seifa,1)
chisq.test(seifa)
```

Script 5: Calculate the annual incidences of the procedures in the AIHW datasets

```
# ANNUAL INCIDENCES - OVERALL, PUBLIC & PRIVATE
#
# Calculate the row and column sums by year
#
Surg.byY.nsw<-
table(AIHW_NSW$sepyear[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"],AIHW_NSW$SEX[AIHW_NSW$A
=="0"&AIHW_NSW$T=="1"])
Surg.byY.nsw.Sum<-rowSums(Surg.byY.nsw,dims=1)
Surg.byY.sa<-
table(AIHW_SA$sepyear[AIHW_SA$A=="0"&AIHW_SA$T=="1"],AIHW_SA$SEX[AIHW_SA$A=="0"&AIH
W_SA$T=="1"])
Surg.byY.sa.Sum<-rowSums(Surg.byY.sa,dims=1)
Surg.byY.tas<-
table(AIHW_TAS$sepyear[AIHW_TAS$A=="0"&AIHW_TAS$T=="1"],AIHW_TAS$SEX[AIHW_TAS$A=="
0"&AIHW_TAS$T=="1"])
Surg.byY.tas.Sum<-rowSums(Surg.byY.tas,dims=1)
Surg.byY.vic<-
table(AIHW_VIC$sepyear[AIHW_VIC$A=="0"&AIHW_VIC$T=="1"],AIHW_VIC$SEX[AIHW_VIC$A=="0"
&AIHW_VIC$T=="1"])
Surg.byY.vic.Sum<-rowSums(Surg.byY.vic,dims=1)
Surg.byY.wa<-
table(AIHW_WA$sepyear[AIHW_WA$A=="0"&AIHW_WA$T=="1"],AIHW_WA$SEX[AIHW_WA$A=="0"
&AIHW_WA$T=="1"])
Surg.byY.wa.Sum<-rowSums(Surg.byY.wa,dims=1)
print(cbind(Surg.byY.nsw.Sum,Surg.byY.sa.Sum,Surg.byY.tas.Sum,Surg.byY.vic.Sum,Surg.byY.wa.Sum))
#
# Calculate incidence for males and females
#
y.i.nsw<-(Surg.byY.nsw.Sum)*1000/(c.f.y.tab["NSW",]+c.m.y.tab["NSW",])
y.i.sa<-(Surg.byY.sa.Sum)*1000/(c.f.y.tab["SA",]+c.m.y.tab["SA",])
y.i.tas<-(Surg.byY.tas.Sum)*1000/(c.f.y.tab["TAS",]+c.m.y.tab["TAS",])
y.i.vic<-(Surg.byY.vic.Sum)*1000/(c.f.y.tab["VIC",]+c.m.y.tab["VIC",])
y.i.wa<-(Surg.byY.wa.Sum)*1000/(c.f.y.tab["WA",]+c.m.y.tab["WA",])
print(cbind(y.i.nsw,y.i.sa,y.i.tas,y.i.vic,y.i.wa))
#
########################################################################
#
# Calculate the row and column sums by year [PUBLIC]
#
Surg.byY.nsw.p<-
table(AIHW_NSW$sepyear[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Public
hospital"],AIHW_NSW$SEX[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Public
hospital"])
Surg.byY.nsw.p.Sum<-rowSums(Surg.byY.nsw.p,dims=1)
Surg.byY.sa.p<-
table(AIHW_SA$sepyear[AIHW_SA$A=="0"&AIHW_SA$T=="1"&AIHW_SA$SECTOR=="Public
hospital"],AIHW_SA$SEX[AIHW_SA$A=="0"&AIHW_SA$T=="1"&AIHW_SA$SECTOR=="Public
hospital"])
Surg.byY.sa.p.Sum<-rowSums(Surg.byY.sa.p,dims=1)
Surg.byY.vic.p<-
table(AIHW_VIC$sepyear[AIHW_VIC$A=="0"&AIHW_VIC$T=="1"&AIHW_VIC$SECTOR=="Public
hospital"],AIHW_VIC$SEX[AIHW_VIC$A=="0"&AIHW_VIC$T=="1"&AIHW_VIC$SECTOR=="Public
hospital"])
Surg.byY.vic.p.Sum<-rowSums(Surg.byY.vic.p,dims=1)
```

```
Surg.byY.wa.p<-
table(AIHW_WA$sepyear[AIHW_WA$A=="0"&AIHW_WA$T=="1"&AIHW_WA$SECTOR=="Public
hospital"],AIHW_WA$SEX[AIHW_WA$A=="0"&AIHW_WA$T=="1"&AIHW_WA$SECTOR=="Public
hospital"])
Surg.byY.wa.p.Sum<-rowSums(Surg.byY.wa.p,dims=1)
print(cbind(Surg.byY.nsw.p.Sum,Surg.byY.sa.p.Sum,Surg.byY.vic.p.Sum,Surg.byY.wa.p.Sum))
#
# Calculate incidence for males and females
#
y.i.p.nsw<-(Surg.byY.nsw.p.Sum)*1000/(c.f.y.tab["NSW",]+c.m.y.tab["NSW",])
y.i.p.sa<-(Surg.byY.sa.p.Sum)*1000/(c.f.y.tab["SA",]+c.m.y.tab["SA",])
y.i.p.vic<-(Surg.byY.vic.p.Sum)*1000/(c.f.y.tab["VIC",]+c.m.y.tab["VIC",])
y.i.p.wa<-(Surg.byY.wa.p.Sum)*1000/(c.f.y.tab["WA",]+c.m.y.tab["WA",])
print(cbind(y.i.p.nsw,y.i.p.sa,y.i.p.vic,y.i.p.wa))
#
######################################################################
#
# Calculate the row and column sums by year [PRIVATE]
#
Surg.byY.nsw.pr<-
table(AIHW_NSW$sepyear[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Private
hospital"],AIHW_NSW$SEX[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Privat
e hospital"])
Surg.byY.nsw.pr.Sum<-rowSums(Surg.byY.nsw.pr,dims=1)
Surg.byY.sa.pr<-
table(AIHW_SA$sepyear[AIHW_SA$A=="0"&AIHW_SA$T=="1"&AIHW_SA$SECTOR=="Private
hospital"],AIHW_SA$SEX[AIHW_SA$A=="0"&AIHW_SA$T=="1"&AIHW_SA$SECTOR=="Private
hospital"])
Surg.byY.sa.pr.Sum<-rowSums(Surg.byY.sa.pr,dims=1)
Surg.byY.vic.pr<-
table(AIHW_VIC$sepyear[AIHW_VIC$A=="0"&AIHW_VIC$T=="1"&AIHW_VIC$SECTOR=="Private
hospital"],AIHW_VIC$SEX[AIHW_VIC$A=="0"&AIHW_VIC$T=="1"&AIHW_VIC$SECTOR=="Private
hospital"])
Surg.byY.vic.pr.Sum<-rowSums(Surg.byY.vic.pr,dims=1)
Surg.byY.wa.pr<-
table(AIHW_WA$sepyear[AIHW_WA$A=="0"&AIHW_WA$T=="1"&AIHW_WA$SECTOR=="Private
hospital"],AIHW_WA$SEX[AIHW_WA$A=="0"&AIHW_WA$T=="1"&AIHW_WA$SECTOR=="Private
hospital"])
Surg.byY.wa.pr.Sum<-rowSums(Surg.byY.wa.pr,dims=1)
print(cbind(Surg.byY.nsw.pr.Sum,Surg.byY.sa.pr.Sum,Surg.byY.vic.pr.Sum,Surg.byY.wa.pr.Sum))
#
# Calculate incidence for males and females
#
y.i.pr.nsw<-(Surg.byY.nsw.pr.Sum)*1000/(c.f.y.tab["NSW",]+c.m.y.tab["NSW",])
y.i.pr.sa<-(Surg.byY.sa.pr.Sum)*1000/(c.f.y.tab["SA",]+c.m.y.tab["SA",])
y.i.pr.vic<-(Surg.byY.vic.pr.Sum)*1000/(c.f.y.tab["VIC",]+c.m.y.tab["VIC",])
y.i.pr.wa<-(Surg.byY.wa.pr.Sum)*1000/(c.f.y.tab["WA",]+c.m.y.tab["WA",])
print(cbind(y.i.pr.nsw,y.i.pr.sa,y.i.pr.vic,y.i.pr.wa))
#
```

Script 6: Calculate the age-specific incidences of the procedures in the AIHW datasets

```
# AGE-SPECIFIC INCIDENCES - OVERALL, PUBLIC & PRIVATE
#
Surg.byAgeSex<-
table(AIHW_NSW$AGE[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"],AIHW_NSW$SEX[AIHW_NSW$A=="
0"&AIHW_NSW$T=="1"])
Surg.byAge<-rowSums(Surg.byAgeSex,dims=1)
#
# Calculate incidence for males and females
#
f.i<-(Surg.byAgeSex[,"Female"]*1000)/c.f.tab["NSW",]
m.i<-(Surg.byAgeSex[,"Male"]*1000)/c.m.tab["NSW",]
fm.i<-(Surg.byAgeSex[,"Female"]+Surg.byAgeSex[,"Male"])*1000/(c.f.tab["NSW",]+c.m.tab["NSW",])
print(cbind(f.i,m.i,fm.i))
#
#########################################################################
#
# Calculate the row and column sums by age, sex and hospital [PUBLIC]
#
Surg.byAgeSex<-
table(AIHW_NSW$AGE[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Public
hospital"],AIHW_NSW$SEX[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Public
hospital"])
Surg.byAge<-rowSums(Surg.byAgeSex,dims=1)
#
# Calculate incidence for males and females
#
f.i<-(Surg.byAgeSex[,"Female"]*1000)/c.f.tab["NSW",]
m.i<-(Surg.byAgeSex[,"Male"]*1000)/c.m.tab["NSW",]
fm.i<-(Surg.byAgeSex[,"Female"]+Surg.byAgeSex[,"Male"])*1000/(c.f.tab["NSW",]+c.m.tab["NSW",])
print(cbind(f.i,m.i,fm.i))
#
#########################################################################
#
# Calculate the row and column sums by age, sex and hospital [PRIVATE]
#
Surg.byAgeSex<-
table(AIHW_NSW$AGE[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Private
hospital"],AIHW_NSW$SEX[AIHW_NSW$A=="0"&AIHW_NSW$T=="1"&AIHW_NSW$SECTOR=="Privat
e hospital"])
Surg.byAge<-rowSums(Surg.byAgeSex,dims=1)
#
# Calculate incidence for males and females
#
f.i<-(Surg.byAgeSex[,"Female"]*1000)/c.f.tab["NSW",]
m.i<-(Surg.byAgeSex[,"Male"]*1000)/c.m.tab["NSW",]
fm.i<-(Surg.byAgeSex[,"Female"]+Surg.byAgeSex[,"Male"])*1000/(c.f.tab["NSW",]+c.m.tab["NSW",])
print(cbind(f.i,m.i,fm.i))
#
```

Script 7: Calculate the age-specific incidences of ICD-10-AM codes in the AIHW datasets

```
#
# AGE-SPECIFIC INCIDENCES FOR SPECIFIC SURGERY CODES
#
# Proc codes of interest
# Code   Description
# 4162600        Myringotomy, unilateral
# 4162601        Myringotomy, bilateral
# 4163200        Myringotomy with tympanostomy tube insertion, unilateral
# 4163201        Myringotomy with tympanostomy tube insertion, bilateral
# 4178900        Tonsillectomy without adenoidectomy
# 4178901        Tonsillectomy with adenoidectomy
# 4180100        Adenoidectomy without tonsillectomy or removal of lingual tonsil
#
##########################################################################
#
AIHWincidence<-function(stateDF,procedure.codes) {
#
# For a specified state dataframe, <stateDF>, returns a table of counts by AGE-YEAR, SEX and
HOSPITAL SECTOR for the set of specified <procedure.codes>
#
age_yr<-factor(stateDF$AGE, levels=c(0:17))
nprocs<-length(procedure.codes)
proc.mat<-matrix(NA,nrow=nrow(stateDF),ncol=nprocs)
dimnames(proc.mat)[[2]]<-list(procedure.codes)
for (iproc in 1:nprocs) {proc.mat[,iproc]<-ProcFinder(stateDF,procedure.codes[iproc],50)}
        occurrence<-1*(rowSums(proc.mat)==nprocs)
        incidence.array<-tapply(occurrence,list(stateDF$SEX,age_yr,stateDF$SECTOR),FUN=sum)
        return(incidence.array)
}
##########################################################################
#
# Calculate the row and column sums by age, sex and hospital
#
Surg.byAgeSexHosp<-AIHWincidence(AIHW_SA,4178901)
Surg.byAgeSex<-rowSums(Surg.byAgeSexHosp,dims=2)
Surg.byAge<-colSums(Surg.byAgeSex,dims=1)
Surg.byAgeHosp<-t(colSums(Surg.byAgeSexHosp,dims=1))
print(Surg.byAgeSex)
#
# Calculate incidence for males and females
#
f.i<-(Surg.byAgeSex["Female",]*1000)/c.f.tab["SA",]
m.i<-(Surg.byAgeSex["Male",]*1000)/c.m.tab["SA",]
fm.i<-(Surg.byAgeSex["Female",]+Surg.byAgeSex["Male",])*1000/(c.f.tab["SA",]+c.m.tab["SA",])
print(cbind(f.i,m.i,fm.i))
#
```

Script 8: Calculate the proportion of diagnostic indications in the AIHW datasets

```
AIHW_SA$dx_bi<-"other"
AIHW_SA$dx_bi[AIHW_SA$diag1=="G4730"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="G4731"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="G4732"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="G4739"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="J351"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="J352"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="J353"]<-"OSAht"
AIHW_SA$dx_bi[AIHW_SA$diag1=="J350"]<-"J350"
my.table<-table(AIHW_SA$sepyear[AIHW_SA$T=="1"&AIHW_SA$A=="0"],
                AIHW_SA$dx_bi[AIHW_SA$T=="1"&AIHW_SA$A=="0"])
my.table
prop.table(my.table,1)
#
AIHW_SA$dx_bi2<-"other"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H650"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H651"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H660"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H652"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H653"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H654"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H659"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H661"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H662"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="H663"]<-"OM"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="G4730"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="G4731"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="G4732"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="G4739"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="J351"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="J352"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="J353"]<-"OSAht"
AIHW_SA$dx_bi2[AIHW_SA$diag1=="J350"]<-"J350"
my.table2<-table(AIHW_SA$sepyear[AIHW_SA$A=="1"&AIHW_SA$T=="0"],
                        AIHW_SA$dx_bi2[AIHW_SA$A=="1"&AIHW_SA$T=="0"])
my.table2
prop.table(my.table2,1)
#
my.table4<-table(AIHW_SA$sepyear[AIHW_SA$A=="1"&AIHW_SA$T=="1"&AIHW_SA$TTI=="1"],
                AIHW_SA$dx_bi2[AIHW_SA$A=="1"&AIHW_SA$T=="1"&AIHW_SA$TTI=="1"])
my.table4
prop.table(my.table4,1)
#
AIHW_SA$dx_bi3<-"other"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H650"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H651"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H660"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H652"]<-"OME"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H653"]<-"OME"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H654"]<-"OME"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H659"]<-"OME"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H661"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H662"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H663"]<-"OM"
```

```
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H664"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="H669"]<-"OM"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="G4730"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="G4731"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="G4732"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="G4739"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="J351"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="J352"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="J353"]<-"TA"
AIHW_SA$dx_bi3[AIHW_SA$diag1=="J350"]<-"TA"
my.table3<-table(AIHW_SA$sepyear[AIHW_SA$TTI=="1"],AIHW_SA$dx_bi3[AIHW_SA$TTI=="1"])
my.table3
prop.table(my.table3,1)
```

STATISTICAL CODING FOR CHAPTER 6

Script 1: Descriptive Analyses

```
# ISAAC MAP SUBSET DESCRIPTIVE STATS
#
isaac0107<-subset(isaac,separation_year>2000)
table(isaac0107$separation_year)
ls(isaac0107)
attach(isaac0107)
#
table(tonsillectomy=="Y"&adenoidectomy=="N")
table(myringotomy)
#
my.data<-(age[tonsillectomy=="Y"&adenoidectomy=="N"])
summary(my.data)
sd(my.data)
#
CODE<-tonsillectomy=="Y"&adenoidectomy=="N"
CODE<-myringotomy=="Y"
my.table<-table(sex[CODE])
my.table<-table(admission_election[CODE])
my.table<-table(hospital_sect[CODE])
my.table<-table(hospital_type[CODE])
my.table
#
summary(los_h[CODE])
quantile(los_h[CODE],c(0.05,0.95,0.99))
#
ls()
sum(sla.all.array)

#
regions <- matrix(c(100,101,102,103,104),ncol=1,byrow=TRUE)
colnames(regions)<-c("code")
rownames(regions)                                                    <-
c("metro.public","nthn.adelaide","wstn.adelaide","estn.adelaide","sthn.adelaide")
regions <- as.table(regions)
```

Script 2: Denominator Calculation

```
# Read in census data
# Calculate intercensal estimates using linear interpolation
# Store the data as an array with dimensions:- sla, sex, age and year
# Roll 2006 SLA "250" back into 2001 SLA "9589" - Anauga
# Roll 2006 SLA "5896" & "5897" back into 2001 SLA "5898" - Port Adelaide Port and Park
# Deleted row for SLA "250", "5896" and "5897"
# Deleted row for SLA "9039" as there is no ISAAC data for this SLA - Unicorp, Riverland
# Deleted row for SLA "999" as there is no geographical location for "no usual address"
#
PATH<-"F:\\R\\ISAAC\\"
m.01<-
read.table(file=paste(PATH,"sla2001_boys.csv",sep=""),sep=",",header=TRUE,row.names="SLAcode")
m.01<-m.01[order(as.numeric(rownames(m.01))), ]
m.01<-m.01[!rownames(m.01) %in% c("9039"),]
m.06<-
read.table(file=paste(PATH,"sla2006_boys.csv",sep=""),sep=",",header=TRUE,row.names="SLAcode")
m.06["9589",]<-m.06["9589",]+m.06["250",]
m.06["5898",]<-m.06["5897",]+m.06["5896",]
m.06<-m.06[!rownames(m.06) %in% c("250","999","5896","5897","9039"),]
m.06<-m.06[order(as.numeric(rownames(m.06))), ]
f.01<-
read.table(file=paste(PATH,"sla2001_girls.csv",sep=""),sep=",",header=TRUE,row.names="SLAcode")
f.01<-f.01[order(as.numeric(rownames(f.01))), ]
f.01<-f.01[!rownames(f.01) %in% c("9039"),]
f.06<-
read.table(file=paste(PATH,"sla2006_girls.csv",sep=""),sep=",",header=TRUE,row.names="SLAcode")
f.06["9589",]<-f.06["9589",]+f.06["250",]
f.06["5898",]<-f.06["5897",]+f.06["5896",]
f.06<-f.06[!rownames(f.06) %in% c("250","999","5896","5897","9039"),]
f.06<-f.06[order(as.numeric(rownames(f.06))), ]
#
ageband.names<-as.character(c(0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17))
for (i in list(m.01,m.02,m.03,m.04,m.05,m.06,m.07)){
        sla.names<-dimnames(i)[[1]]
}
year.names<-as.character(c(2001,2002,2003,2004,2005,2006,2007))
#
m.02<- m.01+1*(m.06-m.01)/5
m.03<- m.01+2*(m.06-m.01)/5
m.04<- m.01+3*(m.06-m.01)/5
m.05<- m.01+4*(m.06-m.01)/5
m.07<- m.06+1*(m.06-m.01)/5
sla.m.array<-array(c(as.matrix(m.01),as.matrix(m.02),as.matrix(m.03),
        as.matrix(m.04),as.matrix(m.05),as.matrix(m.06),as.matrix(m.07)),
        dim=c(119,18,7),dimnames=list(sla.names,ageband.names,year.names))
sla.m.array[is.na(sla.m.array)]<-0
#
f.02<- f.01+1*(f.06-f.01)/5
f.03<- f.01+2*(f.06-f.01)/5
f.04<- f.01+3*(f.06-f.01)/5
f.05<- f.01+4*(f.06-f.01)/5
f.07<- f.06+1*(f.06-f.01)/5
sla.f.array<-array(c(as.matrix(f.01),as.matrix(f.02),as.matrix(f.03),
        as.matrix(f.04),as.matrix(f.05),as.matrix(f.06),as.matrix(f.07)),
```

```
        dim=c(119,18,7),dimnames=list(sla.names,ageband.names,year.names))
sla.f.array[is.na(sla.f.array)]<-0
#
#
all.01<-m.01+f.01
all.06<-m.06+f.06
all.02<- all.01+1*(all.06-all.01)/5
all.03<- all.01+2*(all.06-all.01)/5
all.04<- all.01+3*(all.06-all.01)/5
all.05<- all.01+4*(all.06-all.01)/5
all.07<- all.06+1*(all.06-all.01)/5
sla.all.array<-array(c(as.matrix(all.01),as.matrix(all.02),as.matrix(all.03),
        as.matrix(all.04),as.matrix(all.05),as.matrix(all.06),as.matrix(all.07)),
        dim=c(119,18,7),dimnames=list(sla.names,ageband.names,year.names))
sla.all.array[is.na(sla.all.array)]<-0
#
```

Script 3: Incidence Calculation

```
#rm(list = ls(all = TRUE))
#
isaac<-read.table(paste(PATH,"tamsa.csv",sep=""),header=TRUE,sep=",")
#
isaac<-isaac[isaac$sla!=999,]                #Remove "No Usual Address"
isaac<-isaac[isaac$sla!=8899,]               #Remove "Unicorp, West", no Census data
isaac<-isaac[isaac$sla!=8969,]               #Remove "Unicorp, Yorke", no Census data
isaac$sla[isaac$sla=="250"]<-"9589"          #Roll back to 2001 SLA
isaac$sla[isaac$sla=="5896"]<-"5898"         #Roll back to 2001 SLA
isaac$sla[isaac$sla=="5897"]<-"5898"         #Roll back to 2001 SLA
#
tonsilonly<-isaac$tonsillectomy=="Y"&isaac$adenoidectomy=="N"
adenoidonly<-isaac$tonsillectomy=="N"&isaac$adenoidectomy=="Y"
adenot<-isaac$tonsillectomy=="Y"&isaac$adenoidectomy=="Y"
myrin<-isaac$myringotomy=="Y"
#
sla_list<-
c("70","121","124","125","128","221","224","311","314","315","430","521","524","701","704","911","9
14","1010","1061","1064","1065","1068","1140","1190","1330","1560","1750","1830","1960","2030","
2110","2250","2601","2604","2750","3080","3220","3360","3570","3650","3710","3791","3794","3920
","4061","4064","4065","4210","4341","4344","4345","4551","4554","4620","4830","5040","5090","51
20","5291","5294","5341","5342","5343","5344","5345","5346","5347","5400","5540","5681","5683","
5684","5686","5688","5891","5894","5895","5898","6090","6300","6451","6454","6510","6671","6674
","6860","6970","7141","7143","7144","7146","7148","7290","7490","7630","7701","7704","7705","77
08","7800","7910","7981","7984","8050","8130","8260","8341","8344","8411","8414","8540","8750","
8831","8834","9249","9389","9459","9529","9589")
# sort(as.numeric(unique(isaac$sla)))
#
MapFunction<-function(subset) #
Data.map<-MapFunction(adenoidonly)
#
```

STATISTICAL CODING FOR CHAPTER 8

Script 1: Interview Analyses

```
# INTERVIEW ANALYSIS
#
PATH<-"C:\\Users\\Jacque\\Desktop\\PHD\\3_PARENT_INTERVIEWS\\"
interviews<-read.table(paste(PATH,"R_data_interviews.csv",sep=""),header=TRUE,sep=",")
#
summary(interviews)
median(interviews$ch_f[interviews$organ=="tonsil"])
min(interviews$ch_f[interviews$organ=="tonsil"])
max(interviews$ch_f[interviews$organ=="tonsil"])
#
wilcox.test(ch_f ~ organ, data=interviews)
wilcox.test(Q1_first_time ~ organ, data=interviews)
#
table(interviews$organ,interviews$p1_employed)
chisq.test(table(interviews$organ,interviews$p1_employed))
#
# RELATIONSHIP TO CHILD: OTHER vs MOTHER
#
rel=rbind(c(3,37),c(6,39))
chisq.test(rel)
```

Appendix D: Research Forms

This appendix contains copies of the research documents used during the qualitative interview study presented in Chapters 7 and 8 of this thesis. Specifically, contained herein are the:

- Patient Information Sheet
- Informed Consent Form
- Data Collection Form

The Patient Information Sheet and Informed Consent Form were approved by the Women's and Children's Hospital Human Research Ethics Committee.

CHILDREN, YOUTH & WOMEN'S HEALTH SERVICE (CYWHS)
HUMAN RESEARCH ETHICS COMMITTEE (HREC)

PARTICIPANT INFORMATION SHEET

UNDERSTANDING THE RATES OF MYRINGOTOMY, TONSILLECTOMY, AND ADENOIDECTOMY IN SOUTH AUSTRALIAN CHILDREN

Protocol No: REC 2061/5/11

Investigators:
Mrs Jacqueline Stephens, PhD Candidate, Public Health Research Unit, CYWHS
A/Prof Peter Baghurst, Head of Public Health Research Unit, CYWHS
A/Prof Maree O'Keefe, Associate Dean (Learning & Teaching), The University of Adelaide
Mr Mark Schembri, Consultant Surgeon, Ear Nose and Throat Unit, CYWHS

Please read this information sheet carefully

Introduction

We would like to invite you to participate in a research project involving your child. However, before you accept our invitation, we need to be sure that you understand exactly what we are asking.

Please read the following information carefully and be sure to ask any questions you have. The investigators conducting the research will be happy to respond to any queries. You should feel free to discuss this study with your family, friends and/or your medical practitioner. You do not have to make an immediate decision.

What is the purpose of this study?

Your child has been referred to the Ear, Nose and Throat (ENT) Clinic at the Women's and Children's Hospital because your medical practitioner has suggested that your child has a medical condition which may require surgery.

The purpose of this study is to look into the reasons that children are referred to the ENT clinic, and to document the experience of our patients and their families during the time between referral to the ENT Clinic and their surgical treatment. We are also interested in how the experiences of patients and their families may vary depending on which part of South Australia they live in.

The study will involve approximately 100 patients and their parents/guardians.

Why am I being invited to take part?

We are asking you and your child to consider taking part in this study because your child has been referred to the ENT Clinic and may need to have surgery.

Do I have to take part?

You are under no obligation to take part in this study, and should you decide not to, no reason will be asked, and the future treatment of your child will not be affected in any way.

What will I have to do if I take part in this study?

If you agree to participate, you will be agreeing to accept a phone call on at least one (but possibly more) occasion(s) to ask about how you and your child are managing while waiting for surgery.

During these phone calls, you will be asked about your child's health and wellbeing, about your expectations now that your child has been seen in the ENT clinic, and about the experience of having your child referred for ENT surgery.

The first phone call will occur as soon as possible after your child's appointment in the Ear Nose and Throat clinic. We expect that this first "interview" will be the longest, but it should take no longer than 15 minutes.

Additional phone calls may be conducted if your child has to wait for his or her surgery. If your child is on the waiting list for longer than three (3) months, we may contact you for a follow-up interview. These phone calls will give us the opportunity to understand how you and your family are managing while your child waits for surgery.

To assist in the analysis, all phone calls will be tape-recorded and then anonymously transcribed (typed out on a computer). Any information you provide during these phone calls will be kept strictly confidential and will not affect your child's medical care.

Information about your child's medical condition and his or her surgery will be provided to the research team by your child's ENT specialist. This information will be kept strictly confidential in the same way as your other medical records.

Can I withdraw from the study?

Your and you child's participation in this study is entirely voluntary. You can withdraw from the study at any time.

Signing the consent form does not commit you to joining the study, and withdrawal will not affect the standard of care that you and/or your child receive in the future. If you decide to withdraw from the study, any information collected from you for the purpose of the study will be destroyed.

This study has been approved by the Human Research Ethics Committee of the Children, Youth and Women's Health Service.

Are there any benefits of participating in this study?

Although you may not benefit directly, the information gathered about you, your child and the other participants may benefit patients in the future who need similar operations. Better knowledge of the experience of our patients will help to improve healthcare services in South Australia.

Do I get any financial payment or reimbursement?

No, you will not be paid for your participation.

What will happen to the results of the study?

As mentioned previously, your responses during the interviews, as well as any information you provide will be kept confidential at all times. Your information will be seen only by people involved in the study.

When the study has finished we will put together all the information and responses collected from the participating families. These results will be analysed and may be published in medical journals but your identity will never be revealed. Results of this study may be presented at national or international conferences and included in a PhD thesis.

What if I have a question about the study?

You are encouraged to ask questions at any time before or during the study. Further information regarding the study and/or your rights as a carer of a patient in this study, may be obtained by contacting

Mrs Jacqueline Stephens, PhD candidate, Public Health Research Unit, Telephone: (08) 81617790

A/Prof Peter Baghurst, Head of Public Health Research Unit, Telephone: (08) 81616935

What if I wish to complain about the way in which this study has been conducted?

Should you wish to speak to a person not directly involved in the research work, in particular in relation to matters concerning policies, information about the conduct of the study or your rights as a participant, or should you wish to make a confidential complaint, you may contact the Research Information Officer of Children, Youth & Women's Health Service Human Ethics Research Committee on (08) 8161 6521.

THANK YOU FOR READING THIS INFORMATION SHEET AND TAKING THE TIME TO CONSIDER PARTICIPATING IN THIS STUDY.

VERSION 3, MONDAY 22 SEPTEMBER 2008 PAGE 2 OF 3

CHILDREN, YOUTH & WOMEN'S HEALTH SERVICE (CYWHS)
HUMAN RESEARCH ETHICS COMMITTEE (HREC)

CONSENT FORM

UNDERSTANDING THE RATES OF MYRINGOTOMY, TONSILLECTOMY, AND ADENOIDECTOMY IN SOUTH AUSTRALIAN CHILDREN, WITH SPECIAL REFERENCE TO THE NORTHERN COMMUNITIES OF ADELAIDE: REFERRAL PATTERNS & WAITING LISTS

Protocol No: REC 2061/5/11

I ____ hereby consent to my and my child's involvement in the research project entitled:

Understanding the rates of myringotomy, tonsillectomy, and adenoidectomy in South australian children, with special reference to the Northern Communities of Adelaide: Referral Patterns & Waiting Lists.

1. The nature and purpose of the research project described on the attached Information Sheet has been explained to me. I understand it and agree to my child and I taking part.
2. I understand that my child and I may not directly benefit by taking part in this study.
3. I acknowledge that the possible risks and/or side effects, discomforts and inconveniences, as outlined in the Information Sheet, have been explained to me.
4. I understand that I can withdraw my child and I from the study at any stage and that this will not affect medical care or any other aspects of my and my child's relationship with this healthcare service.
5. I understand that there will be no payment to my child and I for taking part in this study.
6. I have had the opportunity to discuss taking part in this research project with a family member or friend, and/or have had the opportunity to have a family member or friend present whilst the research project was being explained by the researcher.
7. I am aware that I should retain a copy of the Information Sheet and Consent Form, when completed.
8. I agree to the accessing of my (my child's) medical records.
9. I understand that my and my child's information will be kept confidential as explained in the information sheet except where there is a requirement by law for it to be divulged.
10. The phone number on which you may contact me is ______________________________.

    The best time of the day for me would be ______________________________________.

Signed:

Relationship to Patient:

Full name of patient:

Dated:

I certify that I have explained the study to the parent and/or child and consider that he/she understands what is involved.

Signed: Title:

Dated:

VERSION 3, MONDAY 22 SEPTEMBER 2008 PAGE 3 OF 3

ENT REFERRAL & WAITNG LIST STUDY

Subject Number ☐☐☐

CONSENT

Date ☐☐-☐☐☐-☐☐☐☐

Has the parent/guardian *signed and dated* the Subject Information and Consent Form? ☐ Yes ☐ No

Has the parent/guardian *received a copy* of the Subject Information and Consent Form? ☐ Yes ☐ No

CHILD INFORMATION

Name ____________________

URN ☐☐☐☐☐☐☐

Date of Birth ☐☐-☐☐☐-☐☐☐☐

Gender ☐ Male ☐ Female

Hospital Status ☐ Public ☐ Private

Language spoken ☐ English ☐ NESB, specify: ____________

Who does the child live with: ☐ Two natural parents ☐ Two adoptive parents ☐ Mother & stepfather/other ☐ Mother alone ☐ Father & stepmother/other ☐ Father alone ☐ Relatives ☐ Other: ____________

No. of children in the family: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

No. of children living at home: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

Within the siblings, the child is: ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th ☐ ______

No of days at childcare, kindergarten or school: ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Residential postcode ☐☐☐☐

PARENT/GUARDIAN INFORMATION - INTERVIEWEE

Name ____________________

Translator required ☐ No ☐ Yes, specify: ____________

Address: ____________________

Telephone Home: ☐☐☐☐-☐☐☐☐

Work: ☐☐☐☐-☐☐☐☐

Mobile: ☐☐☐☐-☐☐☐-☐☐☐

Age ________ years

Relationship to child ☐ Mother ☐ Father ☐ Relative ☐ Guardian

Marital Status ☐ Never married ☐ Married/Defacto ☐ Separated/Divorced ☐ Widowed

Country of Birth ☐ Australia ☐ Other: ____________

Ethnicity ☐ Caucasian ☐ ATSI ☐ Other: ____________

Smoker ☐ Never ☐ Ceased ☐ Yes

Education ☐ Never attended school ☐ Some primary school ☐ Primary school ☐ Some high school ☐ High School ☐ Technical, trade or TAFE certificate ☐ Some tertiary, didn't complete ☐ Tertiary degree

Currently employed ☐ Yes ☐ No ☐ Maternity Leave

Usual Occupation ____________________

PARENT/GUARDIAN INFORMATION - OTHER ☐ NOT APPLICABLE

Age ________ years

Relationship to child ☐ Mother ☐ Father ☐ Step-parent ☐ Relative ☐ Guardian

Relationship to interviewee ☐ Spouse ☐ Partner ☐ Relative ☐ Other

Marital Status ☐ Never married ☐ Married/Defacto ☐ Separated/Divorced ☐ Widowed

Country of Birth ☐ Australia ☐ Other: ________

Ethnicity ☐ Caucasian ☐ ATSI ☐ Other: ________

Smoker ☐ Never ☐ Ceased ☐ Yes

Education ☐ Never attended school ☐ Some primary school
☐ Primary school ☐ Some high school
☐ High School ☐ Technical, trade or TAFE certificate
☐ Some tertiary, didn't complete ☐ Tertiary degree

Currently employed ☐ Yes ☐ No ☐ Maternity Leave

Usual Occupation ________

OUTPATIENT APPOINTMENT

Date Referral Letter ☐☐-☐☐☐-☐☐☐☐

Referred by ☐ GP ☐ Specialist ☐ Internal CYWHS ☐ Other

Date Appointment ☐☐-☐☐☐-☐☐☐☐

Seen by ☐ Consultant ☐ Registrar ☐ RMO ☐ Other

Diagnosis ☐ AOM ☐ OME ☐ CSOM ☐ OSAS
☐ Tonsillitis ☐ Adenoiditis
☐ Other: ________

Surgery booked ☐ No ☐ Yes Date ☐☐-☐☐☐-☐☐☐☐

Planned Procedure ☐ Adenotonsillectomy ☐ Tonsillectomy alone ☐ Adenoidectomy alone
☐ Tympanostomy tube insertion, unilateral ☐ Myringotomy, unilateral
☐ Tympanostomy tube insertion, bilateral ☐ Myringotomy, bilateral
☐ Other: ________

INTERVIEWS

Date Interview ☐☐-☐☐☐-☐☐☐☐ ☐ Lost

Filename ________

Additional Interview ☐☐-☐☐☐-☐☐☐☐ ☐ Not applicable/Not done

Filename ________

☐ 6 weeks ☐ 3 months ☐ 6 months ☐ 12 months

SURGERY

Date ☐☐-☐☐☐-☐☐☐☐

Procedure ☐ Adenotonsillectomy ☐ Tonsillectomy alone ☐ Adenoidectomy alone
☐ Tympanostomy tube insertion, unilateral ☐ Myringotomy, unilateral
☐ Tympanostomy tube insertion, bilateral ☐ Myringotomy, bilateral
☐ Other: ________

Page 2 of 2

Appendix E: Tables

This appendix contains additional tables not included elsewhere. In addition, presented in this appendix are the tables that support graphical representations, such as figures and maps, of data presented within this thesis.

Table E-1: Proportion of concomitant surgical procedures for children admitted to a South Australian hospital for the period 1997-2007.

Adenoidectomy		**Tonsillectomy**		**TOTAL**
		No	**Yes**	
Yes	MTTI – No	-	7,153 (10.74%)	7153
	MTTI - Yes	33,305 (50.00%)	750 (1.13%)	34055
No	MTTI – No	3,456 (5.19%)	12,845 (19.28%)	16301
	MTTI - Yes	5,243 (7.87%)	3,860 (5.79%)	9103
Total		42,004 (63.06%)	24,608 (36.94%)	66612

Notes:
M±TTI = Myringotomy with/without tympanostomy tube insertion (uni- or bilateral)

Table E-2: Incidence estimates for children who had a tonsillectomy (ICD-10-AM 41789-00) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	Male		Female		Total		Male		Female		Total		Male		Female		Total	
1997	0.91	(0.77, 1.05)	1.57	(1.39, 1.76)	1.23	(1.12, 1.35)	0.81	(0.67, 0.94)	1.30	(1.13, 1.48)	1.05	(0.94, 1.16)	1.71	(1.52, 1.90)	2.88	(2.62, 3.13)	2.28	(2.12, 2.44)
1998	1.08	(0.92, 1.23)	1.48	(1.29, 1.66)	1.27	(1.15, 1.39)	0.73	(0.60, 0.85)	1.51	(1.32, 1.69)	1.11	(1.00, 1.22)	1.81	(1.61, 2.00)	2.98	(2.72, 3.24)	2.38	(2.22, 2.54)
1999	0.94	(0.80, 1.08)	1.47	(1.29, 1.66)	1.20	(1.08, 1.31)	0.60	(0.49, 0.72)	1.15	(0.99, 1.31)	0.87	(0.77, 0.97)	1.54	(1.36, 1.72)	2.63	(2.38, 2.87)	2.07	(1.92, 2.22)
2000	0.74	(0.62, 0.87)	1.25	(1.09, 1.42)	0.99	(0.89, 1.1)	0.66	(0.54, 0.78)	1.21	(1.05, 1.38)	0.93	(0.83, 1.03)	1.40	(1.23, 1.58)	2.47	(2.23, 2.7)	1.92	(1.78, 2.07)
2001	0.73	(0.61, 0.86)	1.38	(1.20, 1.56)	1.05	(0.94, 1.16)	0.72	(0.60, 0.85)	1.30	(1.13, 1.47)	1.00	(0.9, 1.11)	1.46	(1.28, 1.63)	2.68	(2.43, 2.92)	2.05	(1.90, 2.20)
2002	0.71	(0.59, 0.83)	1.33	(1.15, 1.5)	1.01	(0.90, 1.12)	0.82	(0.69, 0.95)	1.43	(1.25, 1.61)	1.12	(1.01, 1.23)	1.53	(1.35, 1.71)	2.75	(2.50, 3.00)	2.13	(1.97, 2.28)
2003	0.48	(0.38, 0.58)	0.96	(0.82, 1.11)	0.72	(0.63, 0.81)	0.87	(0.73, 1.01)	1.50	(1.31, 1.68)	1.18	(1.06, 1.29)	1.35	(1.18, 1.52)	2.46	(2.23, 2.70)	1.89	(1.75, 2.04)
2004	0.62	(0.51, 0.74)	1.23	(1.06, 1.39)	0.92	(0.82, 1.02)	0.81	(0.67, 0.94)	1.26	(1.09, 1.43)	1.02	(0.92, 1.13)	1.43	(1.25, 1.61)	2.48	(2.24, 2.72)	1.94	(1.79, 2.09)
2005	0.73	(0.61, 0.86)	1.35	(1.17, 1.52)	1.03	(0.92, 1.14)	0.79	(0.65, 0.92)	1.41	(1.23, 1.59)	1.09	(0.98, 1.2)	1.52	(1.34, 1.70)	2.75	(2.5, 3.00)	2.12	(1.97, 2.27)
2006	0.65	(0.53, 0.77)	1.18	(1.02, 1.35)	0.91	(0.81, 1.01)	0.93	(0.78, 1.07)	1.53	(1.34, 1.72)	1.22	(1.1, 1.34)	1.58	(1.39, 1.76)	2.71	(2.46, 2.96)	2.13	(1.97, 2.28)
2007	0.78	(0.65, 0.91)	1.27	(1.10, 1.45)	1.02	(0.91, 1.13)	0.65	(0.53, 0.77)	1.19	(1.03, 1.36)	0.91	(0.81, 1.02)	1.43	(1.25, 1.61)	2.47	(2.23, 2.71)	1.93	(1.79, 2.08)

Table E-3: Incidence of children who had an adenoidectomy (ICD-10-AM 41801-00) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

Year	PUBLIC						PRIVATE						TOTAL					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
1997	1.31	(1.14, 1.48)	0.81	(0.67, 0.94)	1.07	(0.96, 1.17)	1.95	(1.74, 2.15)	1.19	(1.03, 1.36)	1.58	(1.45, 1.71)	3.26	(2.99, 3.52)	2.00	(1.79, 2.21)	2.65	(2.48, 2.82)
1998	1.19	(1.03, 1.35)	0.92	(0.78, 1.06)	1.06	(0.95, 1.16)	1.74	(1.55, 1.94)	1.01	(0.86, 1.17)	1.39	(1.26, 1.51)	2.93	(2.68, 3.18)	1.93	(1.73, 2.14)	2.44	(2.28, 2.61)
1999	1.05	(0.9, 1.21)	0.76	(0.63, 0.89)	0.91	(0.81, 1.01)	1.36	(1.19, 1.53)	1.13	(0.97, 1.29)	1.25	(1.13, 1.36)	2.41	(2.18, 2.64)	1.89	(1.68, 2.1)	2.16	(2, 2.31)
2000	1.03	(0.89, 1.18)	0.82	(0.68, 0.95)	0.93	(0.83, 1.03)	1.44	(1.26, 1.61)	1.30	(1.13, 1.47)	1.37	(1.25, 1.49)	2.47	(2.24, 2.7)	2.12	(1.9, 2.34)	2.30	(2.14, 2.46)
2001	1.08	(0.93, 1.23)	0.77	(0.64, 0.9)	0.93	(0.83, 1.03)	1.66	(1.47, 1.85)	1.39	(1.21, 1.57)	1.53	(1.4, 1.66)	2.74	(2.5, 2.98)	2.16	(1.94, 2.39)	2.46	(2.29, 2.62)
2002	1.16	(1.01, 1.32)	0.76	(0.63, 0.89)	0.97	(0.86, 1.07)	1.91	(1.7, 2.11)	1.53	(1.34, 1.71)	1.72	(1.58, 1.86)	3.07	(2.81, 3.33)	2.29	(2.06, 2.51)	2.69	(2.52, 2.86)
2003	1.01	(0.86, 1.16)	0.57	(0.46, 0.69)	0.80	(0.7, 0.89)	1.65	(1.46, 1.84)	1.05	(0.89, 1.2)	1.36	(1.23, 1.48)	2.66	(2.42, 2.9)	1.62	(1.43, 1.81)	2.15	(2, 2.31)
2004	0.88	(0.75, 1.02)	0.71	(0.58, 0.83)	0.80	(0.7, 0.89)	1.67	(1.48, 1.86)	1.07	(0.91, 1.23)	1.38	(1.25, 1.5)	2.55	(2.32, 2.79)	1.78	(1.57, 1.98)	2.17	(2.02, 2.33)
2005	0.84	(0.71, 0.98)	0.62	(0.5, 0.74)	0.74	(0.65, 0.83)	1.63	(1.44, 1.82)	1.23	(1.06, 1.4)	1.44	(1.31, 1.56)	2.47	(2.24, 2.7)	1.86	(1.65, 2.06)	2.17	(2.02, 2.33)
2006	0.79	(0.66, 0.92)	0.57	(0.45, 0.68)	0.68	(0.59, 0.77)	1.67	(1.48, 1.86)	1.28	(1.11, 1.45)	1.48	(1.35, 1.61)	2.46	(2.23, 2.69)	1.85	(1.64, 2.05)	2.16	(2, 2.32)
2007	0.83	(0.7, 0.97)	0.65	(0.53, 0.77)	0.74	(0.65, 0.83)	1.21	(1.05, 1.37)	0.84	(0.7, 0.98)	1.03	(0.92, 1.14)	2.04	(1.83, 2.26)	1.49	(1.31, 1.68)	1.78	(1.63, 1.92)

Table E-4: Incidence of children who had an adenotonsillectomy (ICD-10-AM 41789-01) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	**Male**		**Female**		**Total**		**Male**		**Female**		**Total**		**Male**		**Female**		**Total**	
1997	2.13	(1.92, 2.34)	2.05	(1.84, 2.27)	2.09	(1.94, 2.24)	2.85	(2.61, 3.1)	2.90	(2.64, 3.15)	2.87	(2.7, 3.05)	4.98	(4.66, 5.31)	4.95	(4.62, 5.28)	4.97	(4.73, 5.2)
1998	1.99	(1.78, 2.2)	2.06	(1.84, 2.27)	2.02	(1.87, 2.17)	2.42	(2.2, 2.65)	2.58	(2.34, 2.82)	2.50	(2.33, 2.66)	4.41	(4.1, 4.72)	4.64	(4.31, 4.96)	4.52	(4.3, 4.74)
1999	1.89	(1.69, 2.09)	2.12	(1.9, 2.34)	2.00	(1.85, 2.15)	2.15	(1.94, 2.37)	2.02	(1.81, 2.23)	2.09	(1.94, 2.24)	4.05	(3.75, 4.34)	4.14	(3.83, 4.45)	4.09	(3.88, 4.3)
2000	1.44	(1.27, 1.62)	1.63	(1.44, 1.82)	1.53	(1.4, 1.66)	2.08	(1.87, 2.29)	2.00	(1.79, 2.21)	2.04	(1.89, 2.19)	3.52	(3.25, 3.8)	3.63	(3.34, 3.92)	3.58	(3.38, 3.77)
2001	1.80	(1.61, 2)	1.74	(1.54, 1.94)	1.77	(1.63, 1.91)	2.64	(2.4, 2.88)	2.46	(2.23, 2.7)	2.55	(2.39, 2.72)	4.44	(4.13, 4.75)	4.20	(3.9, 4.51)	4.33	(4.11, 4.55)
2002	1.85	(1.65, 2.05)	1.59	(1.4, 1.78)	1.72	(1.58, 1.86)	3.11	(2.85, 3.36)	2.90	(2.64, 3.15)	3.00	(2.82, 3.19)	4.96	(4.63, 5.28)	4.48	(4.16, 4.8)	4.73	(4.5, 4.96)
2003	1.54	(1.36, 1.73)	1.52	(1.33, 1.7)	1.53	(1.4, 1.66)	2.58	(2.34, 2.82)	2.51	(2.27, 2.75)	2.55	(2.38, 2.72)	4.12	(3.82, 4.42)	4.03	(3.73, 4.33)	4.08	(3.86, 4.29)
2004	1.84	(1.64, 2.04)	1.90	(1.69, 2.11)	1.87	(1.73, 2.02)	2.84	(2.59, 3.08)	2.42	(2.18, 2.65)	2.63	(2.46, 2.8)	4.68	(4.36, 5)	4.32	(4, 4.63)	4.50	(4.28, 4.73)
2005	1.74	(1.54, 1.93)	1.74	(1.54, 1.94)	1.74	(1.6, 1.88)	2.76	(2.52, 3.01)	2.60	(2.36, 2.85)	2.68	(2.51, 2.86)	4.50	(4.18, 4.81)	4.34	(4.03, 4.66)	4.42	(4.2, 4.65)
2006	2.02	(1.81, 2.23)	1.93	(1.71, 2.14)	1.97	(1.82, 2.12)	3.20	(2.93, 3.46)	2.82	(2.56, 3.07)	3.01	(2.83, 3.2)	5.21	(4.88, 5.55)	4.74	(4.41, 5.08)	4.99	(4.75, 5.22)
2007	1.95	(1.74, 2.15)	1.68	(1.48, 1.88)	1.82	(1.67, 1.96)	2.34	(2.11, 2.56)	2.25	(2.02, 2.48)	2.29	(2.13, 2.46)	4.28	(3.97, 4.59)	3.93	(3.63, 4.23)	4.11	(3.89, 4.33)

Table E-5: Incidence of children who had an myringotomy with/without tympanostomy tube insertion performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	Male		Female		Total		Male		Female		Total		Male		Female		Total	
1997	6.58	(6.21, 6.96)	4.65	(4.33, 4.97)	5.64	(5.39, 5.89)	10.29	(9.82, 10.76)	7.68	(7.27, 8.1)	9.02	(8.71, 9.33)	16.88	(16.27, 17.48)	12.33	(11.81, 12.86)	14.66	(14.26, 15.06)
1998	5.43	(5.09, 5.77)	4.48	(4.16, 4.8)	4.96	(4.73, 5.2)	8.28	(7.86, 8.71)	6.41	(6.03, 6.79)	7.37	(7.08, 7.65)	13.71	(13.17, 14.25)	10.88	(10.39, 11.38)	12.33	(11.97, 12.7)
1999	5.16	(4.83, 5.49)	4.26	(3.95, 4.57)	4.72	(4.49, 4.95)	7.11	(6.72, 7.5)	5.61	(5.25, 5.96)	6.38	(6.11, 6.64)	12.27	(11.76, 12.78)	9.87	(9.39, 10.34)	11.10	(10.75, 11.45)
2000	4.91	(4.58, 5.23)	3.54	(3.26, 3.83)	4.24	(4.02, 4.46)	7.60	(7.2, 8)	6.20	(5.82, 6.57)	6.92	(6.64, 7.19)	12.51	(11.99, 13.02)	9.74	(9.27, 10.21)	11.16	(10.81, 11.51)
2001	4.97	(4.64, 5.3)	3.76	(3.47, 4.05)	4.38	(4.16, 4.6)	8.10	(7.68, 8.52)	6.18	(5.81, 6.56)	7.17	(6.88, 7.45)	13.07	(12.54, 13.6)	9.95	(9.47, 10.42)	11.55	(11.19, 11.9)
2002	4.84	(4.52, 5.16)	3.54	(3.25, 3.82)	4.20	(3.99, 4.42)	8.34	(7.91, 8.76)	6.24	(5.87, 6.62)	7.32	(7.03, 7.6)	13.18	(12.64, 13.71)	9.78	(9.31, 10.25)	11.52	(11.16, 11.88)
2003	4.24	(3.94, 4.55)	3.05	(2.79, 3.32)	3.66	(3.46, 3.86)	7.98	(7.57, 8.4)	5.78	(5.41, 6.14)	6.91	(6.63, 7.19)	12.22	(11.71, 12.74)	8.83	(8.38, 9.28)	10.57	(10.23, 10.91)
2004	4.26	(3.96, 4.57)	3.30	(3.02, 3.58)	3.80	(3.59, 4)	8.45	(8.02, 8.88)	6.27	(5.89, 6.65)	7.39	(7.1, 7.67)	12.71	(12.19, 13.24)	9.57	(9.1, 10.03)	11.18	(10.83, 11.54)
2005	4.18	(3.88, 4.48)	3.04	(2.77, 3.3)	3.62	(3.42, 3.83)	8.11	(7.69, 8.53)	5.60	(5.24, 5.96)	6.89	(6.61, 7.16)	12.29	(11.77, 12.81)	8.64	(8.19, 9.08)	10.51	(10.17, 10.86)
2006	4.33	(4.02, 4.64)	3.32	(3.04, 3.6)	3.84	(3.63, 4.05)	8.75	(8.31, 9.19)	6.75	(6.36, 7.15)	7.78	(7.48, 8.07)	13.07	(12.54, 13.61)	10.07	(9.59, 10.56)	11.61	(11.25, 11.98)
2007	4.06	(3.76, 4.36)	2.87	(2.62, 3.13)	3.48	(3.28, 3.68)	5.59	(5.23, 5.94)	4.35	(4.04, 4.67)	4.99	(4.75, 5.22)	9.64	(9.18, 10.1)	7.23	(6.82, 7.64)	8.47	(8.16, 8.78)

Table E-6: Incidence of children who had a tonsillectomy (ICD-10-AM code 41789-00) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	**Male**		**Female**		**Total**		**Male**		**Female**		**Total**		**Male**		**Female**		**Total**	
0	0.01	(-0.01, 0.03)	0.00	(0, 0)	0.01	(-0.01, 0.02)	0.01	(-0.01, 0.03)	0.01	(-0.01, 0.04)	0.01	(0, 0.03)	0.02	(-0.01, 0.06)	0.01	(-0.01, 0.04)	0.02	(0, 0.04)
1	0.12	(0.05, 0.2)	0.06	(0.01, 0.11)	0.09	(0.05, 0.14)	0.26	(0.15, 0.36)	0.21	(0.12, 0.31)	0.24	(0.16, 0.31)	0.38	(0.25, 0.51)	0.27	(0.16, 0.39)	0.33	(0.24, 0.41)
2	0.71	(0.54, 0.89)	0.31	(0.19, 0.43)	0.52	(0.41, 0.62)	0.62	(0.46, 0.79)	0.71	(0.53, 0.89)	0.67	(0.55, 0.79)	1.34	(1.1, 1.57)	1.02	(0.81, 1.23)	1.18	(1.02, 1.34)
3	1.17	(0.95, 1.39)	0.76	(0.58, 0.94)	0.97	(0.82, 1.11)	1.09	(0.88, 1.31)	1.10	(0.88, 1.32)	1.10	(0.94, 1.25)	2.26	(1.95, 2.57)	1.86	(1.57, 2.15)	2.06	(1.85, 2.28)
4	1.28	(1.05, 1.51)	1.02	(0.81, 1.23)	1.15	(1, 1.31)	1.52	(1.27, 1.78)	0.95	(0.75, 1.16)	1.25	(1.08, 1.41)	2.80	(2.46, 3.14)	1.98	(1.68, 2.27)	2.40	(2.17, 2.62)
5	1.35	(1.12, 1.59)	1.10	(0.88, 1.32)	1.23	(1.07, 1.39)	1.17	(0.95, 1.39)	1.07	(0.85, 1.28)	1.12	(0.97, 1.27)	2.52	(2.2, 2.85)	2.17	(1.86, 2.47)	2.35	(2.13, 2.57)
6	1.46	(1.22, 1.7)	1.21	(0.99, 1.44)	1.34	(1.17, 1.5)	1.11	(0.9, 1.32)	1.21	(0.99, 1.44)	1.16	(1, 1.31)	2.56	(2.25, 2.88)	2.42	(2.1, 2.74)	2.50	(2.27, 2.72)
7	1.20	(0.98, 1.41)	1.51	(1.26, 1.76)	1.35	(1.18, 1.52)	0.97	(0.77, 1.16)	1.26	(1.03, 1.49)	1.11	(0.96, 1.26)	2.16	(1.87, 2.46)	2.77	(2.43, 3.11)	2.46	(2.24, 2.68)
8	0.99	(0.79, 1.19)	1.30	(1.07, 1.53)	1.14	(0.99, 1.29)	0.92	(0.73, 1.11)	1.07	(0.86, 1.28)	0.99	(0.85, 1.13)	1.91	(1.63, 2.18)	2.37	(2.05, 2.68)	2.13	(1.93, 2.34)
9	0.74	(0.57, 0.91)	1.17	(0.95, 1.38)	0.95	(0.81, 1.09)	0.55	(0.41, 0.7)	0.96	(0.76, 1.16)	0.75	(0.63, 0.88)	1.29	(1.07, 1.52)	2.13	(1.83, 2.42)	1.70	(1.52, 1.89)
10	0.87	(0.69, 1.05)	1.28	(1.05, 1.51)	1.07	(0.93, 1.22)	0.67	(0.51, 0.83)	1.28	(1.05, 1.51)	0.97	(0.83, 1.11)	1.54	(1.3, 1.79)	2.57	(2.24, 2.89)	2.04	(1.84, 2.24)
11	0.76	(0.59, 0.94)	1.55	(1.3, 1.8)	1.14	(0.99, 1.29)	0.67	(0.51, 0.82)	1.26	(1.04, 1.49)	0.96	(0.82, 1.09)	1.43	(1.2, 1.66)	2.81	(2.47, 3.15)	2.10	(1.9, 2.3)
12	0.63	(0.47, 0.78)	1.61	(1.36, 1.87)	1.11	(0.96, 1.26)	0.73	(0.56, 0.9)	1.31	(1.08, 1.54)	1.01	(0.87, 1.15)	1.36	(1.13, 1.58)	2.92	(2.58, 3.27)	2.12	(1.92, 2.32)
13	0.87	(0.68, 1.05)	2.07	(1.78, 2.36)	1.45	(1.28, 1.62)	0.74	(0.57, 0.9)	1.40	(1.16, 1.64)	1.06	(0.91, 1.2)	1.60	(1.36, 1.85)	3.47	(3.09, 3.84)	2.51	(2.29, 2.73)
14	0.80	(0.62, 0.97)	2.05	(1.76, 2.33)	1.41	(1.24, 1.58)	0.82	(0.64, 1)	1.94	(1.67, 2.22)	1.37	(1.21, 1.53)	1.62	(1.37, 1.87)	3.99	(3.59, 4.39)	2.78	(2.55, 3.01)
15	0.78	(0.61, 0.95)	2.67	(2.34, 2.99)	1.70	(1.52, 1.88)	0.85	(0.67, 1.03)	2.98	(2.63, 3.32)	1.89	(1.69, 2.08)	1.63	(1.38, 1.88)	5.65	(5.17, 6.12)	3.59	(3.32, 3.85)
16	0.71	(0.55, 0.88)	3.36	(2.99, 3.72)	2.00	(1.81, 2.2)	1.31	(1.09, 1.53)	3.75	(3.37, 4.14)	2.50	(2.28, 2.72)	2.02	(1.74, 2.29)	7.11	(6.58, 7.64)	4.51	(4.21, 4.8)
17	0.84	(0.67, 1.02)	2.76	(2.43, 3.09)	1.77	(1.59, 1.95)	1.22	(1, 1.43)	3.82	(3.43, 4.21)	2.47	(2.26, 2.69)	2.06	(1.78, 2.33)	6.58	(6.07, 7.09)	4.24	(3.96, 4.53)

Table E-7: Incidence of children who had an adenoidectomy (ICD-10-AM code 41801-00) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	Male		Female		Total		Male		Female		Total		Male		Female		Total	
0	0.08	(0.02, 0.14)	0.10	(0.03, 0.16)	0.09	(0.04, 0.13)	0.31	(0.19, 0.43)	0.13	(0.05, 0.21)	0.23	(0.15, 0.3)	0.39	(0.26, 0.53)	0.23	(0.13, 0.33)	0.31	(0.23, 0.4)
1	0.86	(0.67, 1.06)	0.48	(0.33, 0.62)	0.68	(0.55, 0.8)	3.39	(3.01, 3.77)	2.17	(1.85, 2.48)	2.80	(2.55, 3.05)	4.25	(3.82, 4.68)	2.65	(2.3, 2.99)	3.47	(3.2, 3.75)
2	2.03	(1.73, 2.32)	1.24	(1.01, 1.47)	1.64	(1.45, 1.83)	4.43	(3.99, 4.86)	2.90	(2.55, 3.26)	3.68	(3.4, 3.96)	6.45	(5.93, 6.97)	4.14	(3.72, 4.57)	5.33	(4.99, 5.66)
3	2.66	(2.32, 2.99)	1.41	(1.16, 1.66)	2.05	(1.84, 2.26)	4.74	(4.29, 5.19)	3.42	(3.03, 3.81)	4.09	(3.8, 4.39)	7.40	(6.84, 7.96)	4.83	(4.37, 5.3)	6.14	(5.78, 6.51)
4	3.51	(3.13, 3.89)	2.09	(1.79, 2.39)	2.82	(2.57, 3.06)	5.01	(4.56, 5.47)	3.26	(2.88, 3.64)	4.16	(3.86, 4.46)	8.53	(7.93, 9.12)	5.35	(4.86, 5.83)	6.98	(6.59, 7.36)
5	2.83	(2.49, 3.17)	2.23	(1.92, 2.54)	2.54	(2.31, 2.77)	4.19	(3.77, 4.6)	3.10	(2.73, 3.46)	3.65	(3.38, 3.93)	7.02	(6.48, 7.56)	5.33	(4.85, 5.81)	6.19	(5.83, 6.55)
6	2.24	(1.94, 2.53)	1.86	(1.58, 2.13)	2.05	(1.85, 2.26)	3.34	(2.98, 3.71)	2.70	(2.36, 3.03)	3.03	(2.78, 3.28)	5.58	(5.11, 6.05)	4.55	(4.11, 4.99)	5.08	(4.76, 5.4)
7	2.12	(1.83, 2.41)	1.53	(1.28, 1.79)	1.83	(1.64, 2.03)	2.46	(2.15, 2.78)	1.67	(1.41, 1.94)	2.08	(1.87, 2.28)	4.58	(4.16, 5.01)	3.21	(2.84, 3.57)	3.91	(3.63, 4.19)
8	1.27	(1.04, 1.49)	1.01	(0.8, 1.21)	1.14	(0.99, 1.29)	1.39	(1.16, 1.63)	1.38	(1.14, 1.62)	1.39	(1.22, 1.56)	2.66	(2.34, 2.99)	2.39	(2.08, 2.71)	2.53	(2.3, 2.76)
9	0.92	(0.73, 1.11)	0.74	(0.56, 0.91)	0.83	(0.7, 0.96)	1.18	(0.96, 1.4)	0.81	(0.63, 1)	1.00	(0.86, 1.14)	2.10	(1.81, 2.39)	1.55	(1.3, 1.8)	1.83	(1.64, 2.02)
10	0.66	(0.5, 0.82)	0.55	(0.4, 0.7)	0.61	(0.5, 0.72)	0.76	(0.59, 0.93)	0.65	(0.48, 0.81)	0.71	(0.59, 0.82)	1.42	(1.19, 1.66)	1.20	(0.98, 1.42)	1.31	(1.15, 1.48)
11	0.47	(0.33, 0.6)	0.46	(0.33, 0.6)	0.47	(0.37, 0.56)	0.74	(0.58, 0.91)	0.56	(0.41, 0.71)	0.65	(0.54, 0.77)	1.21	(1, 1.43)	1.02	(0.82, 1.22)	1.12	(0.97, 1.27)
12	0.41	(0.28, 0.53)	0.37	(0.25, 0.49)	0.39	(0.3, 0.48)	0.40	(0.28, 0.52)	0.51	(0.37, 0.66)	0.45	(0.36, 0.55)	0.81	(0.63, 0.98)	0.88	(0.69, 1.07)	0.84	(0.71, 0.97)
13	0.35	(0.23, 0.46)	0.22	(0.13, 0.32)	0.29	(0.21, 0.36)	0.60	(0.45, 0.75)	0.42	(0.29, 0.55)	0.51	(0.41, 0.61)	0.95	(0.76, 1.14)	0.64	(0.48, 0.8)	0.80	(0.67, 0.92)
14	0.29	(0.18, 0.39)	0.14	(0.06, 0.21)	0.21	(0.15, 0.28)	0.32	(0.21, 0.43)	0.32	(0.21, 0.44)	0.32	(0.24, 0.4)	0.61	(0.46, 0.76)	0.46	(0.32, 0.59)	0.53	(0.43, 0.64)
15	0.19	(0.1, 0.27)	0.14	(0.07, 0.22)	0.17	(0.11, 0.22)	0.23	(0.14, 0.33)	0.20	(0.11, 0.28)	0.22	(0.15, 0.28)	0.42	(0.29, 0.55)	0.34	(0.22, 0.46)	0.38	(0.3, 0.47)
16	0.12	(0.05, 0.18)	0.13	(0.06, 0.2)	0.12	(0.08, 0.17)	0.23	(0.14, 0.33)	0.13	(0.06, 0.2)	0.18	(0.13, 0.24)	0.35	(0.24, 0.47)	0.27	(0.16, 0.37)	0.31	(0.23, 0.39)
17	0.04	(0, 0.08)	0.12	(0.05, 0.19)	0.08	(0.04, 0.12)	0.09	(0.03, 0.14)	0.15	(0.08, 0.23)	0.12	(0.07, 0.17)	0.12	(0.06, 0.19)	0.28	(0.17, 0.38)	0.20	(0.14, 0.26)

Table E-8: Incidence of children who had an adenotonsillectomy (ICD-10-AM code 41789-01) performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	Male		Female		Total		Male		Female		Total		Male		Female		Total	
0	0.05	(0, 0.09)	0.05	(0, 0.1)	0.05	(0.01, 0.08)	0.07	(0.01, 0.13)	0.01	(-0.01, 0.04)	0.04	(0.01, 0.07)	0.12	(0.04, 0.19)	0.06	(0.01, 0.11)	0.09	(0.04, 0.13)
1	0.81	(0.62, 0.99)	0.58	(0.42, 0.75)	0.70	(0.57, 0.82)	2.69	(2.35, 3.03)	1.67	(1.39, 1.95)	2.20	(1.98, 2.42)	3.50	(3.11, 3.89)	2.25	(1.93, 2.57)	2.90	(2.64, 3.15)
2	3.71	(3.32, 4.11)	1.73	(1.46, 2.01)	2.75	(2.5, 2.99)	7.40	(6.85, 7.96)	5.22	(4.74, 5.7)	6.34	(5.97, 6.71)	11.12	(10.43, 11.8)	6.96	(6.4, 7.51)	9.09	(8.64, 9.53)
3	5.48	(5, 5.96)	4.09	(3.66, 4.51)	4.80	(4.48, 5.12)	10.81	(10.14, 11.49)	7.53	(6.96, 8.11)	9.21	(8.76, 9.65)	16.29	(15.46, 17.12)	11.62	(10.91, 12.34)	14.00	(13.45, 14.55)
4	6.49	(5.98, 7.01)	4.77	(4.31, 5.22)	5.65	(5.31, 6)	9.60	(8.96, 10.23)	7.50	(6.93, 8.08)	8.58	(8.15, 9)	16.09	(15.27, 16.91)	12.27	(11.54, 13.01)	14.23	(13.68, 14.78)
5	5.84	(5.35, 6.33)	5.46	(4.98, 5.95)	5.65	(5.31, 6)	7.83	(7.26, 8.4)	7.21	(6.65, 7.76)	7.52	(7.13, 7.92)	13.67	(12.92, 14.41)	12.67	(11.93, 13.41)	13.18	(12.65, 13.7)
6	4.58	(4.16, 5.01)	4.51	(4.07, 4.94)	4.55	(4.24, 4.85)	5.49	(5.02, 5.95)	5.82	(5.32, 6.31)	5.65	(5.31, 5.99)	10.07	(9.44, 10.7)	10.32	(9.67, 10.98)	10.19	(9.74, 10.65)
7	3.72	(3.34, 4.11)	3.80	(3.41, 4.2)	3.76	(3.49, 4.04)	3.26	(2.9, 3.63)	4.07	(3.65, 4.48)	3.66	(3.38, 3.93)	6.99	(6.46, 7.51)	7.87	(7.3, 8.44)	7.42	(7.03, 7.81)
8	1.91	(1.63, 2.18)	2.76	(2.42, 3.1)	2.32	(2.11, 2.54)	2.20	(1.9, 2.49)	2.66	(2.33, 2.99)	2.42	(2.2, 2.65)	4.11	(3.7, 4.51)	5.42	(4.94, 5.89)	4.75	(4.44, 5.06)
9	1.62	(1.37, 1.87)	1.98	(1.69, 2.26)	1.80	(1.61, 1.99)	1.33	(1.1, 1.56)	2.02	(1.73, 2.31)	1.67	(1.49, 1.85)	2.95	(2.61, 3.29)	4.00	(3.59, 4.4)	3.47	(3.2, 3.73)
10	1.04	(0.84, 1.24)	1.74	(1.47, 2.01)	1.38	(1.22, 1.55)	1.03	(0.83, 1.23)	1.76	(1.49, 2.03)	1.39	(1.22, 1.55)	2.07	(1.79, 2.36)	3.50	(3.12, 3.88)	2.77	(2.53, 3)
11	0.73	(0.57, 0.9)	1.48	(1.24, 1.73)	1.10	(0.95, 1.25)	0.94	(0.75, 1.13)	1.59	(1.34, 1.84)	1.26	(1.1, 1.41)	1.68	(1.42, 1.93)	3.08	(2.72, 3.43)	2.36	(2.14, 2.57)
12	0.56	(0.41, 0.71)	1.06	(0.85, 1.26)	0.80	(0.68, 0.93)	0.73	(0.56, 0.9)	1.14	(0.93, 1.36)	0.93	(0.79, 1.07)	1.29	(1.06, 1.51)	2.20	(1.9, 2.5)	1.73	(1.55, 1.92)
13	0.53	(0.39, 0.67)	0.81	(0.63, 0.99)	0.66	(0.55, 0.78)	0.53	(0.39, 0.67)	0.65	(0.49, 0.81)	0.59	(0.48, 0.7)	1.06	(0.85, 1.26)	1.46	(1.22, 1.7)	1.25	(1.1, 1.41)
14	0.42	(0.29, 0.55)	0.79	(0.61, 0.97)	0.60	(0.49, 0.71)	0.40	(0.28, 0.52)	0.78	(0.6, 0.96)	0.59	(0.48, 0.69)	0.82	(0.64, 1)	1.57	(1.32, 1.82)	1.19	(1.03, 1.34)
15	0.23	(0.14, 0.33)	0.67	(0.51, 0.83)	0.45	(0.35, 0.54)	0.23	(0.14, 0.33)	0.68	(0.52, 0.84)	0.45	(0.36, 0.54)	0.47	(0.34, 0.6)	1.35	(1.12, 1.58)	0.90	(0.77, 1.03)
16	0.13	(0.06, 0.2)	0.41	(0.28, 0.53)	0.26	(0.19, 0.34)	0.20	(0.11, 0.28)	0.54	(0.4, 0.69)	0.36	(0.28, 0.45)	0.32	(0.21, 0.43)	0.95	(0.76, 1.14)	0.63	(0.52, 0.74)
17	0.08	(0.02, 0.13)	0.24	(0.14, 0.33)	0.15	(0.1, 0.21)	0.11	(0.04, 0.17)	0.38	(0.26, 0.5)	0.24	(0.17, 0.3)	0.18	(0.1, 0.26)	0.61	(0.46, 0.77)	0.39	(0.3, 0.48)

Table E-9: Incidence of children who had a myringotomy with/without tympanostomy tube insertion performed during an admission in a South Australian hospital for the period 1997-2007 (incidence per 1000 children, 95% confidence intervals).

	PUBLIC						PRIVATE						TOTAL					
Year	Male		Female		Total		Male		Female		Total		Male		Female		Total	
0	4.06	(3.64, 4.49)	2.81	(2.45, 3.18)	3.45	(3.17, 3.73)	10.83	(10.13, 11.52)	8.30	(7.68, 8.92)	9.59	(9.12, 10.06)	14.89	(14.08, 15.7)	11.11	(10.39, 11.83)	13.04	(12.5, 13.59)
1	16.82	(15.97, 17.68)	11.34	(10.62, 12.06)	14.16	(13.6, 14.72)	39.91	(38.59, 41.22)	29.21	(28.05, 30.36)	34.72	(33.84, 35.6)	56.73	(55.17, 58.29)	40.54	(39.18, 41.91)	48.88	(47.84, 49.92)
2	13.77	(13.01, 14.53)	9.01	(8.38, 9.64)	11.45	(10.95, 11.94)	26.38	(25.32, 27.43)	18.44	(17.54, 19.34)	22.50	(21.8, 23.2)	40.14	(38.84, 41.44)	27.45	(26.35, 28.55)	33.95	(33.09, 34.8)
3	12.31	(11.59, 13.03)	8.35	(7.74, 8.96)	10.37	(9.9, 10.84)	22.73	(21.75, 23.71)	16.31	(15.46, 17.16)	19.58	(18.93, 20.23)	35.04	(33.82, 36.26)	24.66	(23.61, 25.7)	29.95	(29.15, 30.76)
4	13.47	(12.73, 14.22)	9.51	(8.87, 10.16)	11.54	(11.05, 12.04)	21.55	(20.6, 22.49)	15.28	(14.47, 16.1)	18.49	(17.86, 19.12)	35.02	(33.82, 36.23)	24.80	(23.76, 25.84)	30.04	(29.24, 30.83)
5	12.20	(11.49, 12.9)	9.69	(9.05, 10.34)	10.97	(10.49, 11.45)	16.50	(15.68, 17.32)	13.59	(12.83, 14.35)	15.08	(14.52, 15.64)	28.70	(27.61, 29.78)	23.29	(22.29, 24.28)	26.05	(25.31, 26.79)
6	9.20	(8.6, 9.8)	7.50	(6.94, 8.06)	8.37	(7.96, 8.79)	12.09	(11.4, 12.78)	10.31	(9.66, 10.97)	11.23	(10.75, 11.71)	21.29	(20.37, 22.21)	17.81	(16.95, 18.67)	19.60	(18.97, 20.24)
7	6.70	(6.18, 7.21)	5.46	(4.98, 5.93)	6.09	(5.74, 6.44)	7.29	(6.75, 7.83)	5.88	(5.39, 6.38)	6.60	(6.23, 6.97)	13.98	(13.24, 14.73)	11.34	(10.65, 12.03)	12.69	(12.18, 13.2)
8	4.00	(3.61, 4.4)	3.62	(3.24, 4.01)	3.82	(3.54, 4.1)	4.28	(3.87, 4.69)	3.68	(3.29, 4.07)	3.99	(3.7, 4.27)	8.29	(7.71, 8.86)	7.30	(6.75, 7.85)	7.80	(7.41, 8.2)
9	2.61	(2.28, 2.93)	2.22	(1.92, 2.53)	2.42	(2.2, 2.64)	3.03	(2.68, 3.37)	2.00	(1.71, 2.29)	2.52	(2.3, 2.75)	5.63	(5.16, 6.1)	4.22	(3.81, 4.64)	4.94	(4.63, 5.26)
10	1.66	(1.41, 1.92)	1.52	(1.27, 1.77)	1.59	(1.41, 1.77)	1.73	(1.47, 1.99)	1.62	(1.37, 1.88)	1.68	(1.5, 1.86)	3.40	(3.03, 3.76)	3.14	(2.78, 3.5)	3.27	(3.02, 3.53)
11	1.23	(1.01, 1.45)	1.12	(0.9, 1.33)	1.18	(1.02, 1.33)	1.30	(1.08, 1.52)	1.31	(1.08, 1.54)	1.30	(1.14, 1.46)	2.53	(2.22, 2.84)	2.42	(2.11, 2.74)	2.48	(2.26, 2.7)
12	0.90	(0.71, 1.08)	1.08	(0.87, 1.29)	0.99	(0.85, 1.13)	0.83	(0.65, 1.01)	0.80	(0.62, 0.98)	0.81	(0.69, 0.94)	1.73	(1.47, 1.98)	1.88	(1.6, 2.15)	1.80	(1.61, 1.99)
13	0.78	(0.6, 0.95)	0.80	(0.62, 0.98)	0.79	(0.66, 0.91)	0.92	(0.73, 1.1)	0.79	(0.61, 0.97)	0.85	(0.72, 0.98)	1.69	(1.44, 1.95)	1.59	(1.33, 1.84)	1.64	(1.46, 1.82)
14	0.66	(0.5, 0.82)	0.54	(0.39, 0.69)	0.60	(0.49, 0.71)	0.57	(0.42, 0.72)	0.37	(0.25, 0.5)	0.47	(0.38, 0.57)	1.23	(1.01, 1.44)	0.92	(0.72, 1.11)	1.07	(0.93, 1.22)
15	0.40	(0.28, 0.52)	0.41	(0.28, 0.54)	0.41	(0.32, 0.49)	0.42	(0.29, 0.55)	0.37	(0.25, 0.49)	0.40	(0.31, 0.48)	0.82	(0.65, 1)	0.78	(0.61, 0.96)	0.80	(0.68, 0.93)
16	0.25	(0.16, 0.35)	0.38	(0.26, 0.5)	0.31	(0.24, 0.39)	0.28	(0.18, 0.39)	0.32	(0.2, 0.43)	0.30	(0.22, 0.37)	0.54	(0.39, 0.68)	0.69	(0.53, 0.86)	0.61	(0.5, 0.72)
17	0.15	(0.08, 0.23)	0.21	(0.12, 0.31)	0.18	(0.12, 0.24)	0.23	(0.14, 0.32)	0.32	(0.21, 0.43)	0.27	(0.2, 0.34)	0.38	(0.26, 0.5)	0.53	(0.39, 0.68)	0.45	(0.36, 0.55)

Table E-10: Underlying diagnoses for separations where tonsillectomy (ICD-10-AM code 41789-00) was performed during a paediatric admission in a South Australian hospital for the period 1997-2007 (incidence per 1,000 children).

Age	Primary Diagnosis			Total
(years)	Tonsillitis	Sleep Apnoea	Other	
0	0.012	0.006	0.000	0.018
1	0.237	0.058	0.035	0.329
2	0.841	0.219	0.123	1.183
3	1.670	0.315	0.079	2.064
4	1.982	0.266	0.149	2.397
5	2.088	0.147	0.114	2.349
6	2.273	0.164	0.058	2.495
7	2.264	0.122	0.074	2.460
8	1.927	0.137	0.069	2.133
9	1.565	0.073	0.063	1.701
10	1.906	0.103	0.031	2.040
11	2.003	0.061	0.036	2.100
12	2.008	0.061	0.051	2.121
13	2.363	0.046	0.102	2.511
14	2.622	0.041	0.117	2.780
15	3.395	0.055	0.135	3.585
16	4.253	0.075	0.180	4.508
17	4.050	0.064	0.129	4.243

Table E-11: Underlying diagnoses for separations where adenoidectomy (ICD-10-AM code 41789-01) was performed during a paediatric admission in a South Australian hospital for the period 1997-2007 (incidence per 1,000 children).

Age	Primary Diagnosis				Total
(years)	Tonsillitis	Sleep Apnoea	Otitis Media	Other	
0	0.006	0.130	0.089	0.178	0.314
1	0.127	0.803	1.907	2.543	3.473
2	0.219	1.530	2.831	3.576	5.325
3	0.276	1.968	2.936	3.898	6.142
4	0.321	2.464	3.073	4.191	6.976
5	0.234	2.093	2.767	3.866	6.193
6	0.169	1.671	2.099	3.241	5.081
7	0.112	1.339	1.440	2.460	3.911
8	0.106	0.950	0.734	1.473	2.529
9	0.073	0.743	0.414	1.016	1.832
10	0.046	0.484	0.242	0.783	1.314
11	0.036	0.419	0.194	0.664	1.119
12	0.010	0.302	0.143	0.531	0.843
13	0.010	0.348	0.113	0.440	0.798
14	0.010	0.193	0.051	0.331	0.535
15	0.010	0.115	0.040	0.256	0.381
16	0.010	0.130	0.020	0.170	0.309
17	0.005	0.049	0.005	0.143	0.198

Table E-12: Underlying diagnoses for separations where adenotonsillectomy (ICD-10-AM code 41789-01) was performed during a paediatric admission in a South Australian hospital for the period 1997-2007 (incidence per 1,000 children).

Age (years)	Primary Diagnosis				Total
	Tonsillitis	Sleep Apnoea	Otitis Media	Other	
0	0.030	0.053	0.000	0.006	0.089
1	1.375	1.225	0.127	0.295	2.895
2	4.798	3.543	0.303	0.746	9.086
3	8.521	4.308	0.540	1.175	14.004
4	9.174	3.853	0.609	1.201	14.229
5	9.335	2.898	0.397	0.946	13.179
6	7.492	2.094	0.243	0.608	10.193
7	5.559	1.467	0.096	0.393	7.419
8	3.739	0.792	0.058	0.216	4.747
9	2.827	0.471	0.042	0.168	3.465
10	2.174	0.407	0.057	0.185	2.767
11	1.870	0.358	0.015	0.128	2.356
12	1.431	0.225	0.000	0.077	1.732
13	1.018	0.174	0.005	0.061	1.253
14	0.967	0.158	0.005	0.061	1.186
15	0.762	0.075	0.005	0.060	0.898
16	0.543	0.070	0.000	0.015	0.628
17	0.361	0.025	0.000	0.005	0.391

Table E-13: Underlying diagnoses for separations where MTTI (ICD-10-AM code 41626-00, 41626-01, 41632-00, 41632-01) was performed during a paediatric admission in a South Australian hospital for the period 1997-2007 (incidence per 1,000 children).

Age (years)	Primary Diagnosis				Total
	Otitis Media with Effusion	Other Otitis Media	Tonsil & Adenoid Conditions	Other	
0	7.843	3.477	0.089	1.635	13.044
1	31.622	13.950	1.583	1.728	48.883
2	20.291	8.116	4.075	1.463	33.946
3	17.396	5.832	5.259	1.468	29.955
4	18.044	5.138	5.459	1.401	30.041
5	15.843	4.431	4.355	1.424	26.053
6	11.658	3.669	3.125	1.153	19.604
7	7.610	2.290	1.871	0.919	12.690
8	4.568	1.399	1.067	0.771	7.805
9	2.863	0.995	0.560	0.523	4.942
10	1.680	0.660	0.448	0.484	3.272
11	1.364	0.475	0.276	0.363	2.478
12	0.940	0.317	0.174	0.368	1.799
13	0.895	0.312	0.148	0.286	1.642
14	0.453	0.244	0.153	0.224	1.074
15	0.306	0.150	0.120	0.226	0.802
16	0.239	0.110	0.100	0.165	0.613
17	0.114	0.084	0.079	0.178	0.455

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
70	Adelaide (C)	4390.4	4	6.1	66.0	(17.8, 169.1)	4099.2	10	10.8	92.6	(44.3, 170.3)
121	Adelaide Hills (DC) - Central	11398.8	16	16.7	95.8	(54.7, 155.6)	10213	23	28.1	82.0	(52, 123)
124	Adelaide Hills (DC) - North	6630.4	13	9.9	131.3	(69.9, 224.6)	6133.4	30	16.7	179.5	(121.1, 256.3)
125	Adelaide Hills (DC) - Ranges	9587.2	8	14.2	56.3	(24.3, 111)	8555.4	8	23.1	34.7	(14.9, 68.3)
128	Adelaide Hills (DC) Bal	7795.2	23	11.5	199.9	(126.7, 299.9)	7334.6	29	18.8	154.0	(103.1, 221.1)
221	Alexandrina (DC) - Coastal	8043	11	11.8	93.2	(46.5, 166.8)	7533.4	15	19.7	76.3	(42.7, 125.8)
224	Alexandrina (DC) - Strathalbyn	7849.8	16	11.6	138.5	(79.1, 224.9)	7660.8	27	20.0	135.3	(89.1, 196.8)
311	Barossa (DC) - Angaston	6682.2	5	9.8	51.1	(16.5, 119.3)	6008.8	7	15.1	46.4	(18.6, 95.6)
314	Barossa (DC) - Barossa	7320.6	10	10.6	94.2	(45.1, 173.3)	6994.4	17	18.3	93.0	(54.1, 148.9)
315	Barossa (DC) - Tanunda	3840.2	9	5.6	159.8	(72.9, 303.3)	3423	5	9.4	53.3	(17.2, 124.3)
430	Barunga West (DC)	2137.8	3	3.1	98.0	(19.7, 286.3)	1694	5	4.1	121.7	(39.2, 284.1)
521	Berri & Barmera (DC) - Barmera	3808	3	5.7	53.0	(10.7, 154.9)	3411.8	12	9.3	128.6	(66.4, 224.6)
524	Berri & Barmera (DC) - Berri	6169.8	8	9.1	87.8	(37.8, 173.1)	6298.6	28	15.9	175.8	(116.8, 254.1)
701	Burnside (C) - North-East	15520.4	13	23.0	56.5	(30.1, 96.7)	14868	21	43.7	48.0	(29.7, 73.4)
704	Burnside (C) - South-West	14588	20	21.7	92.2	(56.3, 142.4)	15075.2	38	43.4	87.6	(62, 120.2)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
911	Campbelltown (C) - East	21996.8	31	32.4	95.7	(65, 135.9)	19930.4	40	54.4	73.5	(52.5, 100.1)
914	Campbelltown (C) - West	12780.6	17	18.6	91.3	(53.2, 146.3)	12346.6	26	31.9	81.5	(53.2, 119.4)
1010	Ceduna (DC)	3766	9	5.6	161.4	(73.7, 306.4)	3416	9	8.2	110.4	(50.4, 209.5)
1061	Charles Sturt (C) - Coastal	19773.6	23	29.0	79.4	(50.3, 119.1)	18176.2	31	49.2	63.0	(42.8, 89.5)
1064	Charles Sturt (C) - Inner East	14933.8	19	21.8	87.0	(52.4, 135.9)	14799.4	35	36.3	96.4	(67.1, 134.1)
1065	Charles Sturt (C) - Inner West	17010	18	25.1	71.8	(42.5, 113.5)	16025.8	46	42.0	109.5	(80.2, 146.1)
1068	Charles Sturt (C) - North-East	19489.4	16	28.1	57.0	(32.5, 92.5)	18785.2	39	47.9	81.5	(57.9, 111.4)
1140	Clare and Gilbert Valleys (DC)	7218.4	15	10.6	141.7	(79.3, 233.7)	6742.4	16	17.9	89.5	(51.1, 145.3)
1190	Cleve (DC)	1786.4	12	2.7	440.8	(227.5, 770.1)	1681.4	16	4.2	379.8	(216.9, 616.8)
1330	Coober Pedy (DC)	1608.6	3	2.4	127.1	(25.5, 371.3)	1544.2	6	3.7	160.6	(58.7, 349.6)
1560	Copper Coast (DC)	8729	11	12.8	85.7	(42.7, 153.3)	8486.8	37	22.7	163.0	(114.7, 224.6)
1750	Elliston (DC)	1096.2	2	1.6	126.3	(14.2, 455.9)	1072.4	5	2.6	195.5	(63, 456.2)
1830	Flinders Ranges (DC)	1689.8	1	2.5	40.2	(0.5, 223.8)	1407	2	3.6	55.0	(6.2, 198.6)
1960	Franklin Harbor (DC)	1135.4	6	1.7	355.3	(129.7, 773.3)	1036	3	2.4	122.6	(24.6, 358.3)
2030	Gawler (M)	16286.2	24	23.9	100.4	(64.3, 149.5)	15568	31	42.4	73.1	(49.7, 103.8)
2110	Goyder (DC)	3697.4	7	5.5	127.6	(51.1, 262.8)	3438.4	3	9.0	33.5	(6.7, 97.9)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
2250	Grant (DC)	7427	17	11.1	153.5	(89.4, 245.9)	6966.4	25	17.9	139.5	(90.2, 205.9)
2601	Holdfast Bay (C) - North	10222.8	18	15.1	119.1	(70.6, 188.3)	10206	28	28.2	99.4	(66, 143.7)
2604	Holdfast Bay (C) - South	8395.8	16	12.3	130.5	(74.6, 212)	8030.4	12	22.2	54.0	(27.9, 94.3)
2750	Kangaroo Island (DC)	3715.6	3	5.3	56.2	(11.3, 164.1)	3518.2	11	9.0	122.7	(61.1, 219.5)
3080	Karoonda East Murray (DC)	1006.6	2	1.5	131.8	(14.8, 475.8)	1050	2	2.8	71.7	(8.1, 258.9)
3220	Kimba (DC)	996.8	0	1.5	0.0	-	963.2	2	2.4	82.1	(9.2, 296.5)
3360	Lacepede (DC)	2132.2	6	3.1	196.2	(71.6, 427.1)	1860.6	13	5.0	260.8	(138.7, 446)
3570	Le Hunte (DC)	1184.4	3	1.7	175.3	(35.2, 512.3)	1272.6	9	3.1	294.1	(134.2, 558.4)
3650	Light (DC)	11855.2	18	17.6	102.1	(60.5, 161.4)	10941	30	28.8	104.2	(70.3, 148.8)
3710	Lower Eyre Peninsula (DC)	4242	17	6.3	268.8	(156.5, 430.4)	3894.8	23	10.1	226.7	(143.7, 340.3)
3791	Loxton Waikerie (DC) - East	6767.6	4	10.0	40.2	(10.8, 102.9)	6168.4	13	16.0	81.4	(43.3, 139.3)
3794	Loxton Waikerie (DC) - West	4246.2	4	6.2	64.6	(17.4, 165.4)	3768.8	6	9.9	60.4	(22.1, 131.5)
3920	Mallala (DC)	7767.2	3	11.5	26.2	(5.3, 76.5)	7291.2	13	19.3	67.2	(35.8, 114.9)
4061	Marion (C) - Central	22212.4	18	32.6	55.2	(32.7, 87.2)	20032.6	45	54.5	82.6	(60.3, 110.5)
4064	Marion (C) - North	16360.4	16	23.9	66.9	(38.2, 108.6)	15373.4	32	39.3	81.4	(55.6, 114.9)
4065	Marion (C) - South	20076	22	29.6	74.4	(46.6, 112.6)	19782	31	54.2	57.2	(38.8, 81.2)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
4210	Mid Murray (DC)	6077.4	12	8.9	134.1	(69.2, 234.3)	6027	20	16.0	125.4	(76.5, 193.6)
4341	Mitcham (C) - Hills	18529	24	27.4	87.5	(56.1, 130.2)	17039.4	32	46.7	68.5	(46.9, 96.8)
4344	Mitcham (C) - North-East	11741.8	18	17.4	103.5	(61.3, 163.5)	11396	31	32.2	96.3	(65.4, 136.7)
4345	Mitcham (C) - West	16751	15	24.6	61.1	(34.1, 100.7)	16109.8	28	40.3	69.5	(46.1, 100.4)
4551	Mount Barker (DC) - Central	16683.8	65	24.5	265.8	(205.1, 338.7)	16177	86	41.4	207.8	(166.2, 256.7)
4554	Mount Barker (DC) Bal	8317.4	16	12.3	129.8	(74.1, 210.8)	7896	19	21.2	89.8	(54.1, 140.3)
4620	Mount Gambier (C)	21000	56	30.6	182.8	(138.1, 237.4)	21133	98	53.8	182.1	(147.8, 221.9)
4830	Mount Remarkable (DC)	2529.8	4	3.7	108.2	(29.1, 277.1)	2282	6	6.2	96.3	(35.2, 209.5)
5040	Murray Bridge (RC)	15545.6	28	22.7	123.3	(81.9, 178.2)	14992.6	54	38.4	140.5	(105.5, 183.3)
5090	Naracoorte and Lucindale (DC)	7442.4	21	10.9	192.6	(119.2, 294.5)	6837.6	35	17.6	199.0	(138.6, 276.7)
5120	Northern Areas (DC)	4512.2	2	6.6	30.2	(3.4, 108.9)	4005.4	12	10.4	115.0	(59.4, 200.9)
5291	Norw. P'ham St Ptrs (C) - East	9734.2	13	14.2	91.7	(48.8, 156.8)	9195.2	16	22.9	69.9	(39.9, 113.4)
5294	Norw. P'ham St Ptrs (C) - West	11060	4	16.3	24.6	(6.6, 62.9)	9828	19	26.4	72.1	(43.4, 112.6)
5341	Onkaparinga (C) - Hackham	13823.6	24	20.3	118.3	(75.8, 176)	12831	33	33.4	98.9	(68.1, 138.9)
5342	Onkaparinga (C) - Hills	10194.8	10	15.0	66.7	(32, 122.7)	9781.8	15	27.4	54.8	(30.6, 90.4)
5343	Onkaparinga (C) - Morphett	20515.6	21	30.3	69.3	(42.9, 106)	18845.4	42	48.5	86.5	(62.3, 116.9)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
5344	Onkaparinga (C) - North Coast	13636	24	20.1	119.3	(76.4, 177.6)	12993.4	32	33.9	94.5	(64.6, 133.4)
5345	Onkaparinga (C) - Reservoir	23749.6	31	35.1	88.4	(60, 125.4)	22400	65	61.4	105.9	(81.7, 134.9)
5346	Onkaparinga (C) - South Coast	22912.4	31	33.2	93.4	(63.4, 132.5)	21252	48	55.9	85.9	(63.3, 113.8)
5347	Onkaparinga (C) - Woodcroft	31693.2	58	46.6	124.6	(94.6, 161.1)	31091.2	86	80.7	106.6	(85.3, 131.7)
5400	Orroroo/Carrieton (DC)	820.4	2	1.3	155.2	(17.4, 560.3)	764.4	5	2.1	235.1	(75.8, 548.7)
5540	Peterborough (DC)	1605.8	2	2.5	81.5	(9.2, 294.2)	1583.4	5	4.1	122.0	(39.3, 284.6)
5681	Playford (C) - East Central	21540.4	16	31.5	50.8	(29, 82.5)	20363	32	51.8	61.7	(42.2, 87.1)
5683	Playford (C) - Elizabeth	22996.4	24	33.4	71.8	(46, 106.9)	22052.8	50	55.3	90.4	(67.1, 119.2)
5684	Playford (C) - Hills	3333.4	9	4.9	185.4	(84.6, 352.1)	2879.8	15	7.7	194.3	(108.7, 320.5)
5686	Playford (C) - West	8775.2	12	13.2	91.2	(47.1, 159.3)	8176	21	21.0	100.1	(62, 153.1)
5688	Playford (C) - West Central	14408.8	27	20.9	129.0	(85, 187.6)	14030.8	31	34.6	89.6	(60.8, 127.1)
5891	Port Adel. Enfield (C) - Coast	21121.8	28	31.1	90.1	(59.9, 130.3)	20526.8	51	54.4	93.7	(69.8, 123.2)
5894	Port Adel. Enfield (C) - East	21138.6	16	30.2	52.9	(30.2, 86)	19836.6	34	48.9	69.5	(48.1, 97.2)
5895	Port Adel. Enfield (C) - Inner	14704.2	42	21.3	197.0	(142, 266.3)	13570.2	77	33.3	231.4	(182.6, 289.2)
5898	Port Adel. Enfield (C) - Port	19259.8	14	27.9	50.1	(27.4, 84.1)	18197.2	36	46.3	77.7	(54.4, 107.6)
6090	Port Augusta (C)	12896.8	33	18.9	174.9	(120.4, 245.7)	12210.8	56	31.0	180.4	(136.2, 234.2)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
6300	Port Lincoln (C)	13105.4	45	19.1	235.7	(171.9, 315.4)	12254.2	60	31.9	188.3	(143.7, 242.4)
6451	Port Pirie C, Dists (M) - City	12455.8	29	18.3	158.7	(106.2, 227.9)	11907	44	30.0	146.7	(106.6, 197)
6454	Port Pirie C, Dists (M) Bal	3509.8	3	5.2	57.2	(11.5, 167.2)	3246.6	3	9.0	33.5	(6.7, 97.8)
6510	Prospect (C)	14193.2	10	20.6	48.6	(23.3, 89.5)	13398	26	33.2	78.2	(51.1, 114.6)
6671	Renmark Paringa (DC) - Paringa	1671.6	0	2.4	0.0	-	1395.8	4	3.4	116.0	(31.2, 296.9)
6674	Renmark Paringa (DC) - Renmark	7247.8	3	10.6	28.2	(5.7, 82.4)	6903.4	9	17.9	50.3	(23, 95.6)
6860	Robe (DC)	1261.4	1	1.9	53.7	(0.7, 298.9)	1237.6	5	3.0	166.6	(53.7, 388.8)
6970	Roxby Downs (M)	4389	7	6.4	109.7	(43.9, 226)	4225.2	14	8.5	164.4	(89.8, 275.9)
7141	Salisbury (C) - Central	24528	37	36.0	102.8	(72.4, 141.7)	23731.4	53	62.4	84.9	(63.6, 111.1)
7143	Salisbury (C) - Inner North	26254.2	30	38.9	77.1	(52, 110)	24540.6	58	62.4	92.9	(70.6, 120.1)
7144	Salisbury (C) - North-East	19544	20	28.7	69.6	(42.5, 107.4)	18425.4	40	48.8	82.0	(58.6, 111.6)
7146	Salisbury (C) - South-East	29376.2	37	42.9	86.2	(60.7, 118.8)	25936.4	47	65.9	71.4	(52.4, 94.9)
7148	Salisbury (C) Bal	8491	6	12.1	49.7	(18.1, 108.1)	7912.8	17	19.5	87.3	(50.8, 139.7)
7290	Southern Mallee (DC)	1941.8	1	2.8	36.2	(0.5, 201.3)	2077.6	8	4.9	162.6	(70, 320.5)
7490	Streaky Bay (DC)	1813	3	2.6	114.7	(23.1, 335.3)	1703.8	2	4.0	49.5	(5.6, 178.5)
7630	Tatiara (DC)	6855.8	11	10.0	109.5	(54.6, 196)	6356	40	15.7	254.1	(181.5, 346)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
7701	Tea Tree Gully (C) - Central	21856.8	31	31.7	97.9	(66.5, 139)	21103.6	47	55.2	85.1	(62.5, 113.2)
7704	Tea Tree Gully (C) - Hills	9797.2	21	14.5	144.8	(89.6, 221.4)	9451.4	23	24.7	93.3	(59.1, 140)
7705	Tea Tree Gully (C) - North	27108.2	39	40.1	97.2	(69.1, 132.9)	26226.2	68	71.4	95.3	(74, 120.8)
7708	Tea Tree Gully (C) - South	24698.8	32	36.3	88.1	(60.3, 124.4)	22962.8	57	62.1	91.8	(69.5, 118.9)
7800	The Coorong (DC)	5122.6	14	7.6	185.2	(101.2, 310.8)	5181.4	23	12.9	178.9	(113.4, 268.5)
7910	Tumby Bay (DC)	1978.2	9	2.9	314.3	(143.4, 596.7)	1825.6	7	4.8	145.9	(58.5, 300.7)
7981	Unincorp. Far North	12814.2	14	18.7	74.8	(40.9, 125.5)	12720.4	20	32.3	61.9	(37.8, 95.7)
7984	Unincorp. Flinders Ranges	10844.4	17	15.8	107.6	(62.6, 172.3)	11673.2	25	31.9	78.4	(50.7, 115.8)
8050	Unincorp. Pirie	7530.6	20	11.1	179.9	(109.8, 277.9)	6696.2	29	17.8	163.2	(109.3, 234.4)
8130	Unincorp. West Coast	5922	6	8.6	69.5	(25.4, 151.2)	5618.2	11	14.6	75.2	(37.5, 134.5)
8260	Unincorp. Whyalla	4692.8	10	7.0	143.0	(68.5, 263.1)	4599	12	13.7	87.6	(45.2, 153.1)
8341	Unley (C) - East	2987.6	5	4.4	114.6	(36.9, 267.5)	2699.2	15	7.0	214.5	(120, 353.8)
8344	Unley (C) - West	8146.6	21	12.0	175.3	(108.5, 267.9)	7877.8	24	20.4	117.9	(75.5, 175.4)
8411	Victor Harbor (DC)	14166.6	15	20.3	74.0	(41.4, 122)	13069	21	31.2	67.2	(41.6, 102.8)
8414	Wakefield (DC)	18172	21	26.6	79.0	(48.9, 120.8)	17425.8	40	45.4	88.0	(62.9, 119.8)
8540	Walkerville (M)	20756.4	34	30.4	111.8	(77.4, 156.3)	19300.4	57	49.0	116.2	(88, 150.6)

Table E-14: Standardised Admission Ratios (SAR) for South Australia – Tonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
8750	Wattle Range (DC) - East	2808.4	2	4.2	47.8	(5.4, 172.6)	2961	10	8.0	124.8	(59.8, 229.6)
8831	Wattle Range (DC) - West	5842.2	3	8.6	34.8	(7, 101.7)	5234.6	17	13.5	125.7	(73.2, 201.2)
8834	West Torrens (C) - East	3021.2	8	4.4	182.5	(78.6, 359.6)	2728.6	10	7.1	140.3	(67.2, 258.1)
9249	West Torrens (C) - West	553	0	0.8	0.0	-	446.6	1	0.9	112.8	(1.5, 627.8)
9389	Whyalla (C)	137.2	1	0.2	484.6	(6.3, 2696)	134.4	0	0.4	0.0	-
9459	Yankalilla (DC)	225.4	0	0.3	0.0	-	180.6	0	0.3	0.0	-
9529	Yorke Peninsula (DC) - North	1191.4	1	1.7	57.2	(0.7, 318.5)	953.4	1	2.3	42.7	(0.6, 237.6)
9589	Yorke Peninsula (DC) - South	4634	3	7.0	42.9	(8.6, 125.3)	4473	8	10.9	73.4	(31.6, 144.7)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
70	Adelaide (C)	4390.4	8	18.4	43.4	(18.7, 85.6)	4099.2	12	14.9	80.8	(41.7, 141.1)
121	Adelaide Hills (DC) - Central	11398.8	38	49.0	77.5	(54.8, 106.4)	10213	30	41.5	72.3	(48.7, 103.2)
124	Adelaide Hills (DC) - North	6630.4	34	28.4	119.6	(82.8, 167.1)	6133.4	44	25.4	173.1	(125.8, 232.4)
125	Adelaide Hills (DC) - Ranges	9587.2	18	39.0	46.2	(27.3, 73)	8555.4	22	35.7	61.6	(38.6, 93.3)
128	Adelaide Hills (DC) Bal	7795.2	41	35.7	114.9	(82.5, 155.9)	7334.6	25	31.4	79.5	(51.4, 117.4)
221	Alexandrina (DC) - Coastal	8043	33	34.4	96.0	(66, 134.8)	7533.4	30	32.4	92.5	(62.4, 132.1)
224	Alexandrina (DC) - Strathalbyn	7849.8	14	33.9	41.3	(22.5, 69.2)	7660.8	19	33.0	57.7	(34.7, 90)
311	Barossa (DC) - Angaston	6682.2	36	29.6	121.8	(85.3, 168.6)	6008.8	30	26.5	113.0	(76.2, 161.3)
314	Barossa (DC) - Barossa	7320.6	32	31.8	100.6	(68.8, 142)	6994.4	14	31.0	45.2	(24.7, 75.9)
315	Barossa (DC) - Tanunda	3840.2	12	17.4	69.2	(35.7, 120.8)	3423	15	14.4	104.3	(58.3, 172)
430	Barunga West (DC)	2137.8	10	9.0	111.6	(53.4, 205.2)	1694	5	7.6	65.7	(21.2, 153.2)
521	Berri & Barmera (DC) - Barmera	3808	11	16.9	65.0	(32.4, 116.3)	3411.8	5	14.1	35.4	(11.4, 82.6)
524	Berri & Barmera (DC) - Berri	6169.8	13	30.2	43.0	(22.9, 73.5)	6298.6	17	27.6	61.6	(35.9, 98.7)
701	Burnside (C) - North-East	15520.4	36	62.4	57.7	(40.4, 79.9)	14868	31	57.5	53.9	(36.6, 76.5)
704	Burnside (C) - South-West	14588	41	64.2	63.9	(45.8, 86.7)	15075.2	58	59.3	97.9	(74.3, 126.5)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
911	Campbelltown (C) - East	21996.8	121	97.7	123.9	(102.8, 148)	19930.4	101	82.8	122.0	(99.4, 148.3)
914	Campbelltown (C) - West	12780.6	52	59.9	86.7	(64.8, 113.8)	12346.6	58	53.8	107.8	(81.8, 139.3)
1010	Ceduna (DC)	3766	50	18.8	265.6	(197.1, 350.2)	3416	42	16.1	260.2	(187.5, 351.7)
1061	Charles Sturt (C) - Coastal	19773.6	75	84.5	88.8	(69.8, 111.3)	18176.2	70	76.0	92.1	(71.8, 116.4)
1064	Charles Sturt (C) - Inner East	14933.8	111	72.2	153.7	(126.4, 185.1)	14799.4	86	67.3	127.9	(102.3, 157.9)
1065	Charles Sturt (C) - Inner West	17010	92	77.5	118.7	(95.7, 145.6)	16025.8	106	68.5	154.8	(126.8, 187.3)
1068	Charles Sturt (C) - North-East	19489.4	107	92.4	115.8	(94.9, 139.9)	18785.2	82	82.5	99.4	(79.1, 123.4)
1140	Clare and Gilbert Valleys (DC)	7218.4	49	32.8	149.5	(110.6, 197.6)	6742.4	36	28.0	128.6	(90.1, 178.1)
1190	Cleve (DC)	1786.4	8	9.4	84.9	(36.5, 167.2)	1681.4	9	7.3	124.0	(56.6, 235.4)
1330	Coober Pedy (DC)	1608.6	7	7.9	88.6	(35.5, 182.7)	1544.2	4	6.4	62.0	(16.7, 158.8)
1560	Copper Coast (DC)	8729	25	39.8	62.9	(40.7, 92.8)	8486.8	25	35.1	71.3	(46.1, 105.3)
1750	Elliston (DC)	1096.2	1	6.0	16.6	(0.2, 92.2)	1072.4	2	5.1	39.1	(4.4, 141.1)
1830	Flinders Ranges (DC)	1689.8	11	7.7	142.5	(71, 254.9)	1407	3	6.3	47.5	(9.6, 138.9)
1960	Franklin Harbor (DC)	1135.4	2	5.4	37.0	(4.2, 133.6)	1036	3	4.3	70.0	(14.1, 204.4)
2030	Gawler (M)	16286.2	80	72.4	110.5	(87.7, 137.6)	15568	71	63.1	112.5	(87.8, 141.8)
2110	Goyder (DC)	3697.4	19	16.1	118.2	(71.1, 184.6)	3438.4	10	14.6	68.4	(32.7, 125.8)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
2250	Grant (DC)	7427	15	32.9	45.5	(25.5, 75.1)	6966.4	7	29.6	23.6	(9.5, 48.7)
2601	Holdfast Bay (C) - North	10222.8	46	44.5	103.4	(75.7, 138)	10206	42	40.8	102.9	(74.1, 139.1)
2604	Holdfast Bay (C) - South	8395.8	47	35.6	131.8	(96.9, 175.3)	8030.4	21	32.4	64.8	(40.1, 99.1)
2750	Kangaroo Island (DC)	3715.6	15	16.4	91.4	(51.1, 150.8)	3518.2	12	15.8	75.8	(39.1, 132.5)
3080	Karoonda East Murray (DC)	1006.6	2	4.2	47.1	(5.3, 170.1)	1050	1	4.2	23.8	(0.3, 132.4)
3220	Kimba (DC)	996.8	4	4.1	97.6	(26.3, 249.9)	963.2	9	4.2	213.8	(97.6, 405.9)
3360	Lacepede (DC)	2132.2	5	8.8	56.7	(18.3, 132.2)	1860.6	7	7.9	88.3	(35.4, 182)
3570	Le Hunte (DC)	1184.4	4	5.4	74.1	(19.9, 189.8)	1272.6	0	5.6	0.0	-
3650	Light (DC)	11855.2	72	55.8	129.1	(101, 162.5)	10941	72	46.7	154.3	(120.7, 194.3)
3710	Lower Eyre Peninsula (DC)	4242	5	19.6	25.5	(8.2, 59.4)	3894.8	10	16.8	59.6	(28.5, 109.6)
3791	Loxton Waikerie (DC) - East	6767.6	16	29.9	53.4	(30.5, 86.8)	6168.4	11	26.6	41.3	(20.6, 73.9)
3794	Loxton Waikerie (DC) - West	4246.2	14	20.0	69.9	(38.2, 117.3)	3768.8	9	16.0	56.1	(25.6, 106.5)
3920	Mallala (DC)	7767.2	19	33.5	56.7	(34.1, 88.5)	7291.2	46	30.7	149.8	(109.7, 199.8)
4061	Marion (C) - Central	22212.4	105	100.1	104.9	(85.8, 127)	20032.6	86	82.3	104.5	(83.6, 129.1)
4064	Marion (C) - North	16360.4	77	80.7	95.4	(75.3, 119.2)	15373.4	73	66.6	109.7	(86, 137.9)
4065	Marion (C) - South	20076	73	87.2	83.7	(65.6, 105.2)	19782	42	80.2	52.3	(37.7, 70.8)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
4210	Mid Murray (DC)	6077.4	21	26.9	78.1	(48.3, 119.3)	6027	15	25.0	60.0	(33.5, 98.9)
4341	Mitcham (C) - Hills	18529	45	80.5	55.9	(40.8, 74.8)	17039.4	45	70.3	64.0	(46.7, 85.7)
4344	Mitcham (C) - North-East	11741.8	48	46.8	102.6	(75.7, 136.1)	11396	39	45.4	85.9	(61.1, 117.4)
4345	Mitcham (C) - West	16751	75	80.8	92.8	(73, 116.3)	16109.8	58	71.4	81.3	(61.7, 105.1)
4551	Mount Barker (DC) - Central	16683.8	55	80.8	68.0	(51.2, 88.6)	16177	44	71.1	61.9	(44.9, 83.1)
4554	Mount Barker (DC) Bal	8317.4	18	37.6	47.9	(28.4, 75.7)	7896	10	33.8	29.6	(14.2, 54.4)
4620	Mount Gambier (C)	21000	88	100.9	87.2	(70, 107.5)	21133	70	92.8	75.4	(58.8, 95.3)
4830	Mount Remarkable (DC)	2529.8	6	10.6	56.4	(20.6, 122.8)	2282	11	9.6	114.6	(57.1, 205.1)
5040	Murray Bridge (RC)	15545.6	35	70.8	49.4	(34.4, 68.7)	14992.6	44	65.2	67.5	(49, 90.6)
5090	Naracoorte and Lucindale (DC)	7442.4	26	33.4	77.8	(50.8, 113.9)	6837.6	21	30.1	69.8	(43.2, 106.6)
5120	Northern Areas (DC)	4512.2	21	20.1	104.2	(64.5, 159.4)	4005.4	9	17.6	51.0	(23.3, 96.8)
5291	Norw. P'ham St Ptrs (C) - East	9734.2	56	48.1	116.4	(87.9, 151.1)	9195.2	40	41.0	97.6	(69.7, 132.9)
5294	Norw. P'ham St Ptrs (C) - West	11060	45	44.6	101.0	(73.6, 135.1)	9828	30	40.8	73.5	(49.6, 104.9)
5341	Onkaparinga (C) - Hackham	13823.6	60	62.0	96.8	(73.8, 124.5)	12831	47	55.8	84.3	(61.9, 112.1)
5342	Onkaparinga (C) - Hills	10194.8	26	43.0	60.5	(39.5, 88.7)	9781.8	27	39.4	68.6	(45.2, 99.8)
5343	Onkaparinga (C) - Morphett	20515.6	75	95.6	78.5	(61.7, 98.4)	18845.4	69	81.7	84.5	(65.7, 106.9)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
5344	Onkaparinga (C) - North Coast	13636	50	63.3	79.0	(58.7, 104.2)	12993.4	51	56.4	90.5	(67.4, 118.9)
5345	Onkaparinga (C) - Reservoir	23749.6	105	101.7	103.2	(84.4, 124.9)	22400	78	91.9	84.9	(67.1, 106)
5346	Onkaparinga (C) - South Coast	22912.4	103	104.9	98.2	(80.2, 119.1)	21252	92	91.5	100.6	(81.1, 123.4)
5347	Onkaparinga (C) - Woodcroft	31693.2	176	149.0	118.1	(101.3, 136.9)	31091.2	132	134.4	98.2	(82.1, 116.4)
5400	Orroroo/Carrieton (DC)	820.4	4	3.9	102.4	(27.5, 262)	764.4	1	2.8	35.5	(0.5, 197.5)
5540	Peterborough (DC)	1605.8	8	8.2	97.9	(42.2, 192.9)	1583.4	10	6.8	146.3	(70, 269)
5681	Playford (C) - East Central	21540.4	96	101.2	94.9	(76.8, 115.8)	20363	80	90.3	88.6	(70.2, 110.2)
5683	Playford (C) - Elizabeth	22996.4	132	110.0	120.0	(100.4, 142.3)	22052.8	140	99.5	140.6	(118.3, 166)
5684	Playford (C) - Hills	3333.4	46	14.7	312.8	(229, 417.2)	2879.8	40	12.0	332.3	(237.4, 452.5)
5686	Playford (C) - West	8775.2	63	41.1	153.3	(117.8, 196.1)	8176	43	35.5	121.0	(87.6, 163)
5688	Playford (C) - West Central	14408.8	81	69.8	116.0	(92.1, 144.1)	14030.8	75	63.2	118.6	(93.3, 148.7)
5891	Port Adel. Enfield (C) - Coast	21121.8	120	96.7	124.2	(102.9, 148.5)	20526.8	94	87.1	107.9	(87.2, 132)
5894	Port Adel. Enfield (C) - East	21138.6	65	101.2	64.3	(49.6, 81.9)	19836.6	68	89.2	76.2	(59.2, 96.6)
5895	Port Adel. Enfield (C) - Inner	14704.2	102	71.1	143.4	(116.9, 174.1)	13570.2	109	58.6	186.1	(152.8, 224.5)
5898	Port Adel. Enfield (C) - Port	19259.8	128	91.9	139.4	(116.3, 165.7)	18197.2	90	79.1	113.7	(91.4, 139.8)
6090	Port Augusta (C)	12896.8	76	59.6	127.5	(100.4, 159.5)	12210.8	73	52.2	139.8	(109.6, 175.8)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
6300	Port Lincoln (C)	13105.4	49	61.4	79.8	(59, 105.5)	12254.2	57	53.2	107.2	(81.2, 138.9)
6451	Port Pirie C, Dists (M) - City	12455.8	72	58.7	122.6	(95.9, 154.4)	11907	71	53.1	133.6	(104.3, 168.5)
6454	Port Pirie C, Dists (M) Bal	3509.8	8	15.7	50.9	(21.9, 100.4)	3246.6	7	13.1	53.5	(21.4, 110.1)
6510	Prospect (C)	14193.2	48	67.8	70.8	(52.2, 93.9)	13398	37	58.8	62.9	(44.3, 86.7)
6671	Renmark Paringa (DC) - Paringa	1671.6	5	7.1	70.4	(22.7, 164.4)	1395.8	3	6.2	48.4	(9.7, 141.5)
6674	Renmark Paringa (DC) - Renmark	7247.8	16	34.4	46.5	(26.6, 75.5)	6903.4	12	30.5	39.3	(20.3, 68.6)
6860	Robe (DC)	1261.4	1	6.2	16.2	(0.2, 90)	1237.6	3	5.2	58.0	(11.7, 169.6)
6970	Roxby Downs (M)	4389	23	23.7	97.0	(61.5, 145.6)	4225.2	15	22.3	67.3	(37.6, 111)
7141	Salisbury (C) - Central	24528	148	108.7	136.2	(115.1, 160)	23731.4	112	101.1	110.8	(91.3, 133.4)
7143	Salisbury (C) - Inner North	26254.2	153	127.4	120.1	(101.8, 140.7)	24540.6	143	110.5	129.4	(109.1, 152.5)
7144	Salisbury (C) - North-East	19544	90	88.8	101.4	(81.5, 124.6)	18425.4	95	78.0	121.9	(98.6, 149)
7146	Salisbury (C) - South-East	29376.2	159	141.7	112.2	(95.5, 131.1)	25936.4	118	113.7	103.8	(85.9, 124.3)
7148	Salisbury (C) Bal	8491	57	42.1	135.5	(102.6, 175.5)	7912.8	62	35.8	173.1	(132.7, 222)
7290	Southern Mallee (DC)	1941.8	10	9.1	110.0	(52.6, 202.2)	2077.6	14	9.1	154.3	(84.3, 258.9)
7490	Streaky Bay (DC)	1813	14	8.4	167.6	(91.6, 281.3)	1703.8	11	8.0	137.6	(68.6, 246.1)
7630	Tatiara (DC)	6855.8	15	32.0	46.9	(26.2, 77.4)	6356	19	28.8	66.0	(39.7, 103.1)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
7701	Tea Tree Gully (C) - Central	21856.8	129	97.9	131.8	(110.1, 156.6)	21103.6	95	90.1	105.4	(85.3, 128.9)
7704	Tea Tree Gully (C) - Hills	9797.2	48	43.3	110.7	(81.6, 146.8)	9451.4	37	40.3	91.8	(64.7, 126.6)
7705	Tea Tree Gully (C) - North	27108.2	142	123.2	115.2	(97.1, 135.8)	26226.2	135	109.6	123.2	(103.3, 145.8)
7708	Tea Tree Gully (C) - South	24698.8	135	114.0	118.4	(99.3, 140.1)	22962.8	117	95.4	122.7	(101.4, 147)
7800	The Coorong (DC)	5122.6	22	24.2	90.9	(57, 137.7)	5181.4	21	22.5	93.5	(57.8, 142.9)
7910	Tumby Bay (DC)	1978.2	3	8.3	36.1	(7.3, 105.5)	1825.6	4	7.8	51.0	(13.7, 130.5)
7981	Unincorp. Far North	12814.2	51	64.1	79.6	(59.2, 104.6)	12720.4	42	54.9	76.5	(55.1, 103.4)
7984	Unincorp. Flinders Ranges	10844.4	49	52.3	93.6	(69.3, 123.8)	11673.2	44	49.7	88.6	(64.4, 118.9)
8050	Unincorp. Pirie	7530.6	22	32.5	67.7	(42.4, 102.5)	6696.2	27	28.3	95.3	(62.8, 138.6)
8130	Unincorp. West Coast	5922	25	25.8	97.1	(62.8, 143.3)	5618.2	32	24.1	132.8	(90.8, 187.5)
8260	Unincorp. Whyalla	4692.8	26	20.6	126.5	(82.6, 185.4)	4599	13	17.8	73.0	(38.8, 124.9)
8341	Unley (C) - East	2987.6	4	14.5	27.5	(7.4, 70.4)	2699.2	4	11.5	34.6	(9.3, 88.7)
8344	Unley (C) - West	8146.6	25	38.1	65.7	(42.5, 97)	7877.8	19	33.7	56.4	(33.9, 88)
8411	Victor Harbor (DC)	14166.6	62	70.1	88.4	(67.8, 113.3)	13069	56	59.3	94.4	(71.3, 122.6)
8414	Wakefield (DC)	18172	118	83.3	141.7	(117.3, 169.7)	17425.8	116	75.7	153.2	(126.6, 183.7)
8540	Walkerville (M)	20756.4	111	96.2	115.4	(94.9, 138.9)	19300.4	144	82.8	173.9	(146.7, 204.8)

Table E-15: Standardised Admission Ratios (SAR) for South Australia – Adenotonsillectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
8750	Wattle Range (DC) - East	2808.4	6	11.9	50.3	(18.4, 109.4)	2961	6	12.2	49.1	(17.9, 106.9)
8831	Wattle Range (DC) - West	5842.2	24	25.1	95.6	(61.2, 142.2)	5234.6	33	22.3	147.7	(101.7, 207.5)
8834	West Torrens (C) - East	3021.2	23	14.0	164.7	(104.4, 247.1)	2728.6	12	12.2	98.8	(51, 172.5)
9249	West Torrens (C) - West	553	2	2.8	71.8	(8.1, 259.4)	446.6	3	2.6	117.2	(23.5, 342.4)
9389	Whyalla (C)	137.2	0	0.8	0.0	-	134.4	1	0.6	164.3	(2.1, 913.9)
9459	Yankalilla (DC)	225.4	0	1.3	0.0	-	180.6	1	0.9	112.2	(1.5, 624.3)
9529	Yorke Peninsula (DC) - North	1191.4	3	6.0	50.0	(10, 146.1)	953.4	6	4.1	145.7	(53.2, 317.2)
9589	Yorke Peninsula (DC) - South	4634	18	23.3	77.4	(45.8, 122.3)	4473	9	20.6	43.8	(20, 83.1)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
70	Adelaide (C)	4390.4	8	10.5	76.2	(32.8, 150.1)	4099.2	4	6.6	60.6	(16.3, 155.2)
121	Adelaide Hills (DC) - Central	11398.8	34	27.7	122.6	(84.9, 171.4)	10213	25	18.0	138.8	(89.8, 204.8)
124	Adelaide Hills (DC) - North	6630.4	22	15.8	139.4	(87.3, 211)	6133.4	18	10.9	164.5	(97.4, 259.9)
125	Adelaide Hills (DC) - Ranges	9587.2	11	22.2	49.7	(24.8, 88.8)	8555.4	8	15.5	51.8	(22.3, 102)
128	Adelaide Hills (DC) Bal	7795.2	18	19.8	91.0	(53.9, 143.9)	7334.6	11	13.8	79.7	(39.7, 142.6)
221	Alexandrina (DC) - Coastal	8043	15	19.4	77.5	(43.3, 127.8)	7533.4	7	14.1	49.5	(19.8, 102)
224	Alexandrina (DC) - Strathalbyn	7849.8	10	19.1	52.2	(25, 96.1)	7660.8	10	14.2	70.5	(33.8, 129.7)
311	Barossa (DC) - Angaston	6682.2	19	16.6	114.7	(69, 179.2)	6008.8	15	11.6	128.8	(72, 212.4)
314	Barossa (DC) - Barossa	7320.6	23	18.0	127.9	(81.1, 191.9)	6994.4	12	13.2	90.6	(46.7, 158.2)
315	Barossa (DC) - Tanunda	3840.2	15	9.8	153.8	(86, 253.6)	3423	9	6.2	144.3	(65.8, 273.9)
430	Barunga West (DC)	2137.8	8	5.0	159.2	(68.5, 313.7)	1694	1	3.3	30.8	(0.4, 171.1)
521	Berri & Barmera (DC) - Barmera	3808	4	9.4	42.6	(11.5, 109.1)	3411.8	4	6.2	65.0	(17.5, 166.4)
524	Berri & Barmera (DC) - Berri	6169.8	14	16.8	83.4	(45.5, 139.9)	6298.6	5	12.1	41.4	(13.3, 96.5)
701	Burnside (C) - North-East	15520.4	37	35.0	105.7	(74.4, 145.7)	14868	23	24.7	93.1	(59, 139.7)
704	Burnside (C) - South-West	14588	38	35.7	106.4	(75.3, 146)	15075.2	30	25.8	116.5	(78.6, 166.3)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
911	Campbelltown (C) - East	21996.8	45	54.7	82.2	(60, 110.1)	19930.4	37	35.9	103.2	(72.6, 142.2)
914	Campbelltown (C) - West	12780.6	36	33.4	107.7	(75.4, 149.1)	12346.6	30	23.5	127.6	(86.1, 182.2)
1010	Ceduna (DC)	3766	24	10.4	229.8	(147.2, 341.9)	3416	11	7.0	156.4	(78, 279.9)
1061	Charles Sturt (C) - Coastal	19773.6	47	47.7	98.6	(72.4, 131.1)	18176.2	36	33.0	108.9	(76.3, 150.8)
1064	Charles Sturt (C) - Inner East	14933.8	44	40.2	109.4	(79.5, 146.8)	14799.4	32	29.5	108.5	(74.2, 153.2)
1065	Charles Sturt (C) - Inner West	17010	56	43.3	129.3	(97.7, 167.9)	16025.8	37	29.6	125.1	(88.1, 172.5)
1068	Charles Sturt (C) - North-East	19489.4	44	51.8	84.9	(61.7, 113.9)	18785.2	33	36.0	91.8	(63.2, 128.9)
1140	Clare and Gilbert Valleys (DC)	7218.4	25	18.4	135.8	(87.8, 200.4)	6742.4	11	12.2	90.5	(45.1, 162)
1190	Cleve (DC)	1786.4	5	5.1	97.4	(31.4, 227.3)	1681.4	3	3.2	94.3	(19, 275.5)
1330	Coober Pedy (DC)	1608.6	0	4.4	0.0	-	1544.2	0	2.9	0.0	-
1560	Copper Coast (DC)	8729	10	22.3	44.8	(21.4, 82.3)	8486.8	6	15.1	39.9	(14.6, 86.8)
1750	Elliston (DC)	1096.2	0	3.3	0.0	-	1072.4	1	2.2	45.7	(0.6, 254.5)
1830	Flinders Ranges (DC)	1689.8	1	4.3	23.3	(0.3, 129.4)	1407	1	2.7	36.7	(0.5, 204.4)
1960	Franklin Harbor (DC)	1135.4	1	3.0	33.3	(0.4, 185.5)	1036	1	1.9	52.6	(0.7, 292.7)
2030	Gawler (M)	16286.2	44	40.4	109.0	(79.2, 146.4)	15568	34	27.3	124.7	(86.4, 174.3)
2110	Goyder (DC)	3697.4	7	9.0	77.7	(31.1, 160.1)	3438.4	7	6.3	110.5	(44.3, 227.7)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
2250	Grant (DC)	7427	14	18.4	76.0	(41.5, 127.6)	6966.4	13	12.8	101.6	(54, 173.8)
2601	Holdfast Bay (C) - North	10222.8	24	25.0	95.8	(61.4, 142.6)	10206	26	17.7	146.6	(95.7, 214.8)
2604	Holdfast Bay (C) - South	8395.8	17	20.0	85.2	(49.6, 136.4)	8030.4	12	14.0	85.7	(44.2, 149.7)
2750	Kangaroo Island (DC)	3715.6	11	9.3	118.6	(59.1, 212.3)	3518.2	11	6.7	163.4	(81.4, 292.3)
3080	Karoonda East Murray (DC)	1006.6	0	2.4	0.0	-	1050	1	1.8	55.3	(0.7, 307.4)
3220	Kimba (DC)	996.8	3	2.3	128.8	(25.9, 376.2)	963.2	2	1.8	109.4	(12.3, 395.1)
3360	Lacepede (DC)	2132.2	12	5.0	239.3	(123.5, 418.1)	1860.6	7	3.4	205.8	(82.5, 424.1)
3570	Le Hunte (DC)	1184.4	2	3.1	64.8	(7.3, 234.1)	1272.6	1	2.4	41.1	(0.5, 228.5)
3650	Light (DC)	11855.2	33	30.9	106.7	(73.5, 149.9)	10941	38	20.3	187.5	(132.7, 257.3)
3710	Lower Eyre Peninsula (DC)	4242	4	10.9	36.7	(9.9, 93.9)	3894.8	4	7.2	55.6	(15, 142.3)
3791	Loxton Waikerie (DC) - East	6767.6	13	16.7	77.8	(41.4, 133.1)	6168.4	10	11.6	86.5	(41.4, 159.1)
3794	Loxton Waikerie (DC) - West	4246.2	6	11.2	53.5	(19.6, 116.5)	3768.8	3	7.0	42.9	(8.6, 125.2)
3920	Mallala (DC)	7767.2	15	19.0	79.1	(44.2, 130.5)	7291.2	11	13.2	83.1	(41.4, 148.8)
4061	Marion (C) - Central	22212.4	67	55.9	119.8	(92.8, 152.1)	20032.6	30	35.8	83.9	(56.6, 119.7)
4064	Marion (C) - North	16360.4	54	44.9	120.3	(90.3, 156.9)	15373.4	29	29.1	99.5	(66.6, 142.9)
4065	Marion (C) - South	20076	48	49.0	98.0	(72.2, 129.9)	19782	37	34.6	107.1	(75.4, 147.6)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
4210	Mid Murray (DC)	6077.4	14	15.1	92.9	(50.7, 155.8)	6027	9	10.9	82.8	(37.8, 157.3)
4341	Mitcham (C) - Hills	18529	38	45.4	83.7	(59.2, 114.9)	17039.4	37	30.4	121.9	(85.8, 168)
4344	Mitcham (C) - North-East	11741.8	29	26.4	109.9	(73.6, 157.9)	11396	28	19.6	143.1	(95.1, 206.8)
4345	Mitcham (C) - West	16751	30	44.7	67.1	(45.3, 95.9)	16109.8	28	31.3	89.4	(59.4, 129.2)
4551	Mount Barker (DC) - Central	16683.8	31	45.1	68.8	(46.7, 97.6)	16177	26	30.9	84.0	(54.9, 123.1)
4554	Mount Barker (DC) Bal	8317.4	14	21.1	66.3	(36.2, 111.3)	7896	8	14.5	55.0	(23.7, 108.4)
4620	Mount Gambier (C)	21000	63	56.2	112.2	(86.2, 143.5)	21133	59	40.4	146.2	(111.2, 188.5)
4830	Mount Remarkable (DC)	2529.8	1	6.0	16.6	(0.2, 92.1)	2282	2	4.1	48.6	(5.5, 175.4)
5040	Murray Bridge (RC)	15545.6	20	39.7	50.4	(30.8, 77.9)	14992.6	11	28.2	39.0	(19.4, 69.7)
5090	Naracoorte and Lucindale (DC)	7442.4	45	18.9	238.4	(173.9, 319)	6837.6	23	13.0	176.5	(111.8, 264.8)
5120	Northern Areas (DC)	4512.2	6	11.3	52.9	(19.3, 115.2)	4005.4	0	7.6	0.0	-
5291	Norw. P'ham St Ptrs (C) - East	9734.2	33	26.7	123.5	(85, 173.5)	9195.2	24	18.0	133.4	(85.4, 198.5)
5294	Norw. P'ham St Ptrs (C) - West	11060	24	25.2	95.2	(61, 141.6)	9828	21	17.8	118.1	(73.1, 180.5)
5341	Onkaparinga (C) - Hackham	13823.6	42	34.7	121.0	(87.2, 163.6)	12831	18	24.2	74.3	(44, 117.4)
5342	Onkaparinga (C) - Hills	10194.8	27	24.4	110.8	(73, 161.2)	9781.8	20	16.8	118.7	(72.5, 183.4)
5343	Onkaparinga (C) - Morphett	20515.6	53	53.1	99.8	(74.7, 130.5)	18845.4	38	35.5	107.0	(75.7, 146.8)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
5344	Onkaparinga (C) - North Coast	13636	36	35.3	101.8	(71.3, 141)	12993.4	27	24.5	110.2	(72.6, 160.3)
5345	Onkaparinga (C) - Reservoir	23749.6	85	57.0	149.2	(119.2, 184.5)	22400	37	39.7	93.2	(65.6, 128.5)
5346	Onkaparinga (C) - South Coast	22912.4	58	59.0	98.3	(74.7, 127.1)	21252	63	39.6	159.0	(122.2, 203.5)
5347	Onkaparinga (C) - Woodcroft	31693.2	97	83.1	116.7	(94.6, 142.3)	31091.2	74	58.3	127.0	(99.7, 159.4)
5400	Orroroo/Carrieton (DC)	820.4	0	2.1	0.0	-	764.4	0	1.2	0.0	-
5540	Peterborough (DC)	1605.8	1	4.5	22.2	(0.3, 123.6)	1583.4	0	3.0	0.0	-
5681	Playford (C) - East Central	21540.4	34	56.5	60.1	(41.6, 84)	20363	26	39.1	66.5	(43.4, 97.4)
5683	Playford (C) - Elizabeth	22996.4	45	61.5	73.2	(53.4, 97.9)	22052.8	20	43.3	46.2	(28.2, 71.4)
5684	Playford (C) - Hills	3333.4	20	8.2	242.7	(148.2, 374.9)	2879.8	15	5.2	289.0	(161.6, 476.7)
5686	Playford (C) - West	8775.2	27	22.7	118.8	(78.3, 172.8)	8176	18	15.4	116.8	(69.2, 184.5)
5688	Playford (C) - West Central	14408.8	37	38.9	95.2	(67, 131.2)	14030.8	18	27.6	65.3	(38.7, 103.2)
5891	Port Adel. Enfield (C) - Coast	21121.8	75	53.8	139.4	(109.6, 174.7)	20526.8	44	37.6	117.0	(85, 157.1)
5894	Port Adel. Enfield (C) - East	21138.6	56	56.7	98.7	(74.5, 128.1)	19836.6	28	39.3	71.3	(47.4, 103.1)
5895	Port Adel. Enfield (C) - Inner	14704.2	48	39.8	120.6	(88.9, 159.9)	13570.2	31	25.8	120.2	(81.7, 170.7)
5898	Port Adel. Enfield (C) - Port	19259.8	48	51.4	93.4	(68.8, 123.8)	18197.2	31	34.6	89.7	(60.9, 127.3)
6090	Port Augusta (C)	12896.8	21	33.2	63.2	(39.1, 96.6)	12210.8	11	22.8	48.2	(24, 86.2)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
6300	Port Lincoln (C)	13105.4	16	34.4	46.5	(26.5, 75.4)	12254.2	17	23.1	73.5	(42.8, 117.7)
6451	Port Pirie C, Dists (M) - City	12455.8	29	32.8	88.3	(59.1, 126.9)	11907	20	23.1	86.5	(52.8, 133.6)
6454	Port Pirie C, Dists (M) Bal	3509.8	5	8.7	57.4	(18.5, 134)	3246.6	4	5.6	71.3	(19.2, 182.4)
6510	Prospect (C)	14193.2	36	37.9	95.1	(66.6, 131.6)	13398	30	25.7	116.6	(78.7, 166.5)
6671	Renmark Paringa (DC) - Paringa	1671.6	4	4.1	98.1	(26.4, 251.2)	1395.8	4	2.7	147.8	(39.8, 378.5)
6674	Renmark Paringa (DC) - Renmark	7247.8	24	19.0	126.4	(81, 188.1)	6903.4	16	13.2	121.1	(69.2, 196.7)
6860	Robe (DC)	1261.4	6	3.4	176.9	(64.6, 385)	1237.6	8	2.3	352.8	(151.9, 695.1)
6970	Roxby Downs (M)	4389	3	13.0	23.1	(4.6, 67.6)	4225.2	3	9.8	30.5	(6.1, 89.2)
7141	Salisbury (C) - Central	24528	59	60.9	96.9	(73.7, 125)	23731.4	36	43.9	81.9	(57.4, 113.4)
7143	Salisbury (C) - Inner North	26254.2	76	70.7	107.6	(84.7, 134.6)	24540.6	57	48.0	118.8	(90, 153.9)
7144	Salisbury (C) - North-East	19544	51	49.3	103.4	(77, 136)	18425.4	29	33.8	85.7	(57.4, 123.1)
7146	Salisbury (C) - South-East	29376.2	81	78.8	102.8	(81.7, 127.8)	25936.4	55	49.8	110.4	(83.2, 143.7)
7148	Salisbury (C) Bal	8491	22	23.5	93.8	(58.7, 142)	7912.8	9	15.6	57.5	(26.2, 109.2)
7290	Southern Mallee (DC)	1941.8	3	5.1	59.3	(11.9, 173.3)	2077.6	4	4.0	101.0	(27.2, 258.7)
7490	Streaky Bay (DC)	1813	6	4.8	125.2	(45.7, 272.4)	1703.8	1	3.5	28.7	(0.4, 159.4)
7630	Tatiara (DC)	6855.8	43	17.9	239.9	(173.6, 323.1)	6356	31	12.5	249.0	(169.1, 353.4)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
7701	Tea Tree Gully (C) - Central	21856.8	56	55.2	101.5	(76.7, 131.8)	21103.6	43	39.2	109.8	(79.4, 147.9)
7704	Tea Tree Gully (C) - Hills	9797.2	34	24.3	139.8	(96.8, 195.3)	9451.4	23	17.5	131.7	(83.5, 197.6)
7705	Tea Tree Gully (C) - North	27108.2	79	68.6	115.2	(91.2, 143.6)	26226.2	51	47.3	107.9	(80.4, 141.9)
7708	Tea Tree Gully (C) - South	24698.8	73	63.6	114.9	(90, 144.4)	22962.8	45	41.6	108.2	(78.9, 144.8)
7800	The Coorong (DC)	5122.6	9	13.5	66.7	(30.5, 126.7)	5181.4	8	9.8	81.5	(35.1, 160.6)
7910	Tumby Bay (DC)	1978.2	3	4.8	63.1	(12.7, 184.4)	1825.6	1	3.3	29.9	(0.4, 166.5)
7981	Unincorp. Far North	12814.2	47	35.6	132.1	(8.5, 81.2)	12720.4	32	24.2	132.5	(0.1, 62)
7984	Unincorp. Flinders Ranges	10844.4	44	29.2	150.6	(0.4, 167.2)	11673.2	25	21.7	115.3	(12.5, 403.4)
8050	Unincorp. Pirie	7530.6	14	18.3	76.6	-	6696.2	13	12.3	106.1	-
8130	Unincorp. West Coast	5922	9	14.6	61.7	(0.8, 357.7)	5618.2	7	10.4	67.4	(1.2, 494)
8260	Unincorp. Whyalla	4692.8	16	11.5	139.2	-	4599	7	7.7	91.3	-
8341	Unley (C) - East	2987.6	9	8.2	110.4	(97.1, 175.7)	2699.2	7	5.0	140.2	(90.6, 187)
8344	Unley (C) - West	8146.6	24	21.3	112.9	(109.4, 202.1)	7877.8	15	14.6	102.6	(74.6, 170.2)
8411	Victor Harbor (DC)	14166.6	28	39.1	71.6	(41.9, 128.6)	13069	12	26.0	46.1	(56.4, 181.4)
8414	Wakefield (DC)	18172	64	46.7	137.1	(28.2, 117.2)	17425.8	42	33.0	127.4	(27, 139)
8540	Walkerville (M)	20756.4	36	53.8	66.9	(79.5, 226.1)	19300.4	19	36.3	52.3	(36.6, 188.2)

Table E-16: Standardised Admission Ratios (SAR) for South Australia – Adenoidectomy, 2001-2007

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
8750	Wattle Range (DC) - East	2808.4	4	6.8	59.1	(50.4, 209.5)	2961	3	5.2	58.2	(56.2, 288.9)
8831	Wattle Range (DC) - West	5842.2	8	14.1	56.6	(72.3, 168)	5234.6	7	9.7	72.1	(57.4, 169.2)
8834	West Torrens (C) - East	3021.2	1	7.9	12.7	(47.6, 103.5)	2728.6	3	5.2	57.9	(23.8, 80.6)
9249	West Torrens (C) - West	553	1	1.6	64.3	(105.6, 175.1)	446.6	1	1.1	88.8	(91.8, 172.2)
9389	Whyalla (C)	137.2	0	0.4	0.0	(46.9, 92.6)	134.4	0	0.3	0.0	(31.5, 81.8)
9459	Yankalilla (DC)	225.4	0	0.7	0.0	(15.9, 151.4)	180.6	0	0.4	0.0	(11.7, 170.2)
9529	Yorke Peninsula (DC) - North	1191.4	1	3.3	30.0	(24.4, 111.5)	953.4	2	1.8	111.7	(28.9, 148.6)
9589	Yorke Peninsula (DC) - South	4634	4	12.6	31.7	(0.2, 70.5)	4473	1	9.0	11.1	(11.6, 169.2)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
70	Adelaide (C)	4390.4	59	57.2	103.2	(78.6, 133.1)	4099.2	46	36.5	126.2	(92.4, 168.3)
121	Adelaide Hills (DC) - Central	11398.8	186	129.3	143.8	(123.9, 166)	10213	124	86.4	143.5	(119.3, 171.1)
124	Adelaide Hills (DC) - North	6630.4	136	70.4	193.2	(162.1, 228.6)	6133.4	103	50.7	203.2	(165.9, 246.5)
125	Adelaide Hills (DC) - Ranges	9587.2	52	102.4	50.8	(37.9, 66.6)	8555.4	38	74.7	50.9	(36, 69.8)
128	Adelaide Hills (DC) Bal	7795.2	108	92.1	117.3	(96.2, 141.6)	7334.6	72	69.5	103.6	(81.1, 130.5)
221	Alexandrina (DC) - Coastal	8043	81	89.2	90.8	(72.1, 112.8)	7533.4	54	69.1	78.1	(58.7, 101.9)
224	Alexandrina (DC) - Strathalbyn	7849.8	71	89.5	79.3	(61.9, 100.1)	7660.8	48	68.1	70.5	(51.9, 93.4)
311	Barossa (DC) - Angaston	6682.2	99	79.7	124.3	(101, 151.3)	6008.8	48	59.7	80.4	(59.3, 106.6)
314	Barossa (DC) - Barossa	7320.6	66	85.6	77.1	(59.6, 98.1)	6994.4	52	61.1	85.1	(63.6, 111.6)
315	Barossa (DC) - Tanunda	3840.2	50	46.5	107.5	(79.8, 141.8)	3423	38	30.4	125.0	(88.4, 171.6)
430	Barunga West (DC)	2137.8	32	24.0	133.5	(91.3, 188.5)	1694	6	15.6	38.5	(14, 83.7)
521	Berri & Barmera (DC) - Barmera	3808	44	43.9	100.1	(72.7, 134.4)	3411.8	30	29.7	100.9	(68.1, 144.1)
524	Berri & Barmera (DC) - Berri	6169.8	68	82.5	82.4	(64, 104.5)	6298.6	52	59.8	87.0	(64.9, 114)
701	Burnside (C) - North-East	15520.4	133	159.9	83.2	(69.6, 98.5)	14868	95	114.6	82.9	(67.1, 101.3)
704	Burnside (C) - South-West	14588	193	166.9	115.6	(99.9, 133.1)	15075.2	133	124.1	107.2	(89.8, 127)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
911	Campbelltown (C) - East	21996.8	215	258.9	83.0	(72.3, 94.9)	19930.4	192	171.6	111.9	(96.6, 128.9)
914	Campbelltown (C) - West	12780.6	148	163.5	90.5	(76.5, 106.3)	12346.6	94	117.8	79.8	(64.5, 97.6)
1010	Ceduna (DC)	3766	48	49.7	96.7	(71.3, 128.2)	3416	33	35.3	93.5	(64.3, 131.3)
1061	Charles Sturt (C) - Coastal	19773.6	143	224.2	63.8	(53.8, 75.1)	18176.2	147	160.3	91.7	(77.5, 107.8)
1064	Charles Sturt (C) - Inner East	14933.8	153	198.7	77.0	(65.3, 90.2)	14799.4	104	151.0	68.9	(56.3, 83.5)
1065	Charles Sturt (C) - Inner West	17010	228	205.0	111.2	(97.2, 126.6)	16025.8	150	141.6	105.9	(89.6, 124.3)
1068	Charles Sturt (C) - North-East	19489.4	185	256.1	72.2	(62.2, 83.4)	18785.2	113	178.2	63.4	(52.2, 76.2)
1140	Clare and Gilbert Valleys (DC)	7218.4	95	87.2	108.9	(88.1, 133.1)	6742.4	48	58.7	81.8	(60.3, 108.4)
1190	Cleve (DC)	1786.4	30	24.0	124.8	(84.2, 178.2)	1681.4	27	15.5	174.7	(115.1, 254.2)
1330	Coober Pedy (DC)	1608.6	4	21.1	19.0	(5.1, 48.5)	1544.2	7	14.8	47.3	(19, 97.6)
1560	Copper Coast (DC)	8729	75	104.5	71.8	(56.4, 90)	8486.8	42	69.8	60.1	(43.3, 81.3)
1750	Elliston (DC)	1096.2	10	16.7	59.9	(28.7, 110.1)	1072.4	8	10.3	77.8	(33.5, 153.4)
1830	Flinders Ranges (DC)	1689.8	10	19.2	52.0	(24.9, 95.6)	1407	3	13.2	22.7	(4.6, 66.2)
1960	Franklin Harbor (DC)	1135.4	9	14.4	62.6	(28.5, 118.8)	1036	3	9.9	30.3	(6.1, 88.4)
2030	Gawler (M)	16286.2	218	189.3	115.2	(100.4, 131.5)	15568	142	129.7	109.5	(92.2, 129)
2110	Goyder (DC)	3697.4	48	41.1	116.9	(86.2, 155)	3438.4	25	30.7	81.5	(52.7, 120.4)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
2250	Grant (DC)	7427	60	85.1	70.5	(53.8, 90.8)	6966.4	57	61.9	92.1	(69.7, 119.3)
2601	Holdfast Bay (C) - North	10222.8	197	120.4	163.6	(141.6, 188.2)	10206	140	87.1	160.8	(135.3, 189.8)
2604	Holdfast Bay (C) - South	8395.8	113	93.9	120.3	(99.2, 144.7)	8030.4	68	67.8	100.2	(77.8, 127.1)
2750	Kangaroo Island (DC)	3715.6	34	43.9	77.4	(53.6, 108.2)	3518.2	25	31.1	80.5	(52.1, 118.8)
3080	Karoonda East Murray (DC)	1006.6	7	10.4	67.3	(27, 138.6)	1050	1	8.7	11.5	(0.1, 63.7)
3220	Kimba (DC)	996.8	12	10.3	116.6	(60.2, 203.6)	963.2	7	9.1	76.5	(30.7, 157.7)
3360	Lacepede (DC)	2132.2	25	23.0	108.6	(70.3, 160.3)	1860.6	25	15.6	159.8	(103.4, 236)
3570	Le Hunte (DC)	1184.4	8	15.7	50.9	(21.9, 100.4)	1272.6	3	12.0	25.0	(5, 73.1)
3650	Light (DC)	11855.2	192	144.8	132.6	(114.5, 152.7)	10941	147	98.9	148.7	(125.6, 174.8)
3710	Lower Eyre Peninsula (DC)	4242	40	50.7	78.9	(56.3, 107.4)	3894.8	40	33.7	118.7	(84.8, 161.6)
3791	Loxton Waikerie (DC) - East	6767.6	98	77.9	125.9	(102.2, 153.4)	6168.4	69	56.1	123.1	(95.7, 155.7)
3794	Loxton Waikerie (DC) - West	4246.2	68	53.7	126.5	(98.2, 160.4)	3768.8	36	34.5	104.2	(73, 144.3)
3920	Mallala (DC)	7767.2	81	87.9	92.1	(73.2, 114.5)	7291.2	73	61.4	118.8	(93.1, 149.4)
4061	Marion (C) - Central	22212.4	329	271.3	121.3	(108.5, 135.1)	20032.6	182	175.9	103.5	(89, 119.7)
4064	Marion (C) - North	16360.4	267	222.2	120.2	(106.2, 135.5)	15373.4	159	148.8	106.8	(90.9, 124.8)
4065	Marion (C) - South	20076	197	229.4	85.9	(74.3, 98.7)	19782	133	163.5	81.4	(68.1, 96.4)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	**Name**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**
4210	Mid Murray (DC)	6077.4	54	69.7	77.4	(58.2, 101)	6027	29	52.6	55.1	(36.9, 79.1)
4341	Mitcham (C) - Hills	18529	218	214.1	101.8	(88.7, 116.3)	17039.4	165	144.2	114.5	(97.7, 133.3)
4344	Mitcham (C) - North-East	11741.8	146	121.2	120.4	(101.7, 141.6)	11396	135	91.2	148.1	(124.2, 175.3)
4345	Mitcham (C) - West	16751	234	217.3	107.7	(94.3, 122.4)	16109.8	156	161.6	96.6	(82, 113)
4551	Mount Barker (DC) - Central	16683.8	197	216.9	90.8	(78.6, 104.4)	16177	150	153.4	97.8	(82.7, 114.7)
4554	Mount Barker (DC) Bal	8317.4	53	97.8	54.2	(40.6, 70.9)	7896	30	68.3	43.9	(29.6, 62.7)
4620	Mount Gambier (C)	21000	369	275.4	134.0	(120.7, 148.4)	21133	273	202.0	135.2	(119.6, 152.2)
4830	Mount Remarkable (DC)	2529.8	3	28.1	10.7	(2.1, 31.2)	2282	10	19.1	52.5	(25.1, 96.5)
5040	Murray Bridge (RC)	15545.6	127	189.2	67.1	(56, 79.9)	14992.6	86	137.6	62.5	(50, 77.2)
5090	Naracoorte and Lucindale (DC)	7442.4	115	90.2	127.5	(105.2, 153)	6837.6	83	63.1	131.5	(104.7, 163)
5120	Northern Areas (DC)	4512.2	27	51.3	52.7	(34.7, 76.6)	4005.4	21	35.8	58.7	(36.3, 89.7)
5291	Norw. P'ham St Ptrs (C) - East	9734.2	165	132.3	124.7	(106.4, 145.3)	9195.2	94	92.0	102.2	(82.6, 125)
5294	Norw. P'ham St Ptrs (C) - West	11060	150	121.3	123.6	(104.6, 145.1)	9828	121	89.0	135.9	(112.7, 162.4)
5341	Onkaparinga (C) - Hackham	13823.6	132	164.7	80.2	(67.1, 95.1)	12831	99	118.5	83.5	(67.9, 101.7)
5342	Onkaparinga (C) - Hills	10194.8	90	111.5	80.7	(64.9, 99.2)	9781.8	89	75.9	117.3	(94.2, 144.4)
5343	Onkaparinga (C) - Morphett	20515.6	187	254.4	73.5	(63.4, 84.8)	18845.4	179	176.8	101.3	(87, 117.2)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
5344	Onkaparinga (C) - North Coast	13636	119	167.9	70.9	(58.7, 84.8)	12993.4	100	120.1	83.2	(67.7, 101.2)
5345	Onkaparinga (C) - Reservoir	23749.6	421	262.5	160.4	(145.4, 176.4)	22400	251	188.0	133.5	(117.5, 151.1)
5346	Onkaparinga (C) - South Coast	22912.4	237	285.7	83.0	(72.7, 94.2)	21252	160	192.6	83.1	(70.7, 97)
5347	Onkaparinga (C) - Woodcroft	31693.2	613	400.1	153.2	(141.3, 165.8)	31091.2	374	284.9	131.3	(118.3, 145.3)
5400	Orroroo/Carrieton (DC)	820.4	1	9.5	10.6	(0.1, 58.8)	764.4	4	5.8	69.5	(18.7, 177.9)
5540	Peterborough (DC)	1605.8	9	21.0	42.8	(19.5, 81.2)	1583.4	4	14.7	27.2	(7.3, 69.7)
5681	Playford (C) - East Central	21540.4	172	271.3	63.4	(54.3, 73.6)	20363	158	192.0	82.3	(69.9, 96.2)
5683	Playford (C) - Elizabeth	22996.4	267	303.1	88.1	(77.8, 99.3)	22052.8	178	215.2	82.7	(71, 95.8)
5684	Playford (C) - Hills	3333.4	119	37.9	313.8	(259.9, 375.5)	2879.8	90	24.3	370.6	(298, 455.6)
5686	Playford (C) - West	8775.2	98	103.6	94.6	(76.8, 115.2)	8176	72	73.9	97.4	(76.2, 122.6)
5688	Playford (C) - West Central	14408.8	157	189.9	82.7	(70.2, 96.7)	14030.8	106	137.9	76.9	(62.9, 93)
5891	Port Adel. Enfield (C) - Coast	21121.8	348	254.4	136.8	(76.3, 103.2)	20526.8	227	181.3	125.2	(118.2, 158.7)
5894	Port Adel. Enfield (C) - East	21138.6	224	285.0	78.6	(122.8, 151.9)	19836.6	127	205.1	61.9	(109.4, 142.6)
5895	Port Adel. Enfield (C) - Inner	14704.2	175	196.6	89.0	(68.6, 89.6)	13570.2	184	134.0	137.3	(51.6, 73.7)
5898	Port Adel. Enfield (C) - Port	19259.8	160	253.0	63.2	(53.8, 73.8)	18197.2	92	173.3	53.1	(42.8, 65.1)
6090	Port Augusta (C)	12896.8	128	161.0	79.5	(66.3, 94.5)	12210.8	71	115.7	61.4	(47.9, 77.4)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	Name	Population	Obs	Exp	SAR	95%CI	Population	Obs	Exp	SAR	95%CI
6300	Port Lincoln (C)	13105.4	112	169.3	66.1	(54.5, 79.6)	12254.2	116	114.2	101.6	(83.9, 121.9)
6451	Port Pirie C, Dists (M) - City	12455.8	106	155.8	68.0	(55.7, 82.3)	11907	69	114.2	60.4	(47, 76.5)
6454	Port Pirie C, Dists (M) Bal	3509.8	12	39.9	30.1	(15.5, 52.6)	3246.6	19	26.1	72.7	(43.8, 113.6)
6510	Prospect (C)	14193.2	168	187.7	89.5	(76.5, 104.1)	13398	136	131.5	103.4	(86.8, 122.3)
6671	Renmark Paringa (DC) - Paringa	1671.6	16	20.7	77.2	(44.1, 125.4)	1395.8	13	13.3	97.7	(52, 167)
6674	Renmark Paringa (DC) - Renmark	7247.8	70	89.8	78.0	(60.8, 98.5)	6903.4	51	63.5	80.3	(59.8, 105.5)
6860	Robe (DC)	1261.4	13	16.3	79.8	(42.4, 136.4)	1237.6	17	11.6	146.4	(85.2, 234.5)
6970	Roxby Downs (M)	4389	28	63.1	44.4	(29.5, 64.1)	4225.2	21	51.6	40.7	(25.2, 62.3)
7141	Salisbury (C) - Central	24528	310	287.7	107.7	(96.1, 120.4)	23731.4	208	215.0	96.8	(84.1, 110.8)
7143	Salisbury (C) - Inner North	26254.2	322	336.7	95.6	(85.5, 106.7)	24540.6	299	236.7	126.3	(112.4, 141.5)
7144	Salisbury (C) - North-East	19544	257	234.1	109.8	(96.8, 124.1)	18425.4	169	164.6	102.7	(87.8, 119.4)
7146	Salisbury (C) - South-East	29376.2	374	382.7	97.7	(88.1, 108.1)	25936.4	265	251.6	105.3	(93, 118.8)
7148	Salisbury (C) Bal	8491	156	120.1	129.8	(110.3, 151.9)	7912.8	87	79.1	109.9	(88, 135.6)
7290	Southern Mallee (DC)	1941.8	30	24.2	123.7	(83.5, 176.6)	2077.6	29	20.0	145.2	(97.2, 208.6)
7490	Streaky Bay (DC)	1813	28	23.2	120.5	(80, 174.1)	1703.8	11	17.4	63.1	(31.5, 112.9)
7630	Tatiara (DC)	6855.8	115	83.9	137.1	(113.2, 164.6)	6356	108	60.7	177.9	(145.9, 214.8)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	**Name**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**
7701	Tea Tree Gully (C) - Central	21856.8	309	272.7	113.3	(101, 126.7)	21103.6	204	191.0	106.8	(92.7, 122.5)
7704	Tea Tree Gully (C) - Hills	9797.2	156	115.0	135.6	(115.2, 158.7)	9451.4	97	86.1	112.7	(91.4, 137.4)
7705	Tea Tree Gully (C) - North	27108.2	467	319.4	146.2	(133.2, 160.1)	26226.2	331	224.5	147.4	(132, 164.2)
7708	Tea Tree Gully (C) - South	24698.8	372	308.0	120.8	(108.8, 133.7)	22962.8	213	203.9	104.5	(90.9, 119.5)
7800	The Coorong (DC)	5122.6	46	63.6	72.3	(52.9, 96.4)	5181.4	33	48.9	67.4	(46.4, 94.7)
7910	Tumby Bay (DC)	1978.2	10	22.7	44.0	(21.1, 80.9)	1825.6	13	15.9	81.7	(43.5, 139.7)
7981	Unincorp. Far North	12814.2	184	176.0	104.6	(6.8, 28.2)	12720.4	142	124.3	114.3	(6.3, 32.5)
7984	Unincorp. Flinders Ranges	10844.4	187	144.0	129.9	(43, 138.4)	11673.2	140	108.8	128.6	(63.8, 229.1)
8050	Unincorp. Pirie	7530.6	84	84.1	99.9	-	6696.2	72	59.6	120.9	(0.6, 247.3)
8130	Unincorp. West Coast	5922	48	68.7	69.9	(98.6, 303)	5618.2	37	50.5	73.3	(163.1, 463.7)
8260	Unincorp. Whyalla	4692.8	50	52.0	96.2	(11.8, 380.2)	4599	37	36.0	102.9	-
8341	Unley (C) - East	2987.6	35	40.4	86.7	(90, 120.8)	2699.2	20	24.1	83.1	(96.3, 134.7)
8344	Unley (C) - West	8146.6	127	101.0	125.8	(111.9, 149.9)	7877.8	79	70.7	111.7	(108.2, 151.8)
8411	Victor Harbor (DC)	14166.6	151	201.7	74.9	(79.7, 123.7)	13069	94	136.2	69.0	(94.6, 152.3)
8414	Wakefield (DC)	18172	294	228.7	128.6	(51.5, 92.7)	17425.8	205	163.1	125.7	(51.6, 101.1)
8540	Walkerville (M)	20756.4	187	255.7	73.1	(71.4, 126.8)	19300.4	142	183.6	77.3	(72.4, 141.8)

Table E-17: Standardised Admission Ratios (SAR) for South Australia – Myringotomy with/without Tympanostomy Tube Insertion, 2001-2007.

Statistical Local Area		Males					Females				
Code	**Name**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**	**Population**	**Obs**	**Exp**	**SAR**	**95%CI**
8750	Wattle Range (DC) - East	2808.4	26	31.0	84.0	(60.4, 120.6)	2961	19	23.4	81.1	(50.8, 128.4)
8831	Wattle Range (DC) - West	5842.2	42	64.4	65.3	(104.8, 149.6)	5234.6	17	46.2	36.8	(88.4, 139.2)
8834	West Torrens (C) - East	3021.2	32	36.9	86.7	(63.4, 87.8)	2728.6	10	23.5	42.5	(55.8, 84.4)
9249	West Torrens (C) - West	553	14	7.8	180.6	(114.3, 144.1)	446.6	16	5.6	285.5	(109, 144.1)
9389	Whyalla (C)	137.2	2	1.9	105.3	(63, 84.4)	134.4	0	1.4	0.0	(65.1, 91.2)
9459	Yankalilla (DC)	225.4	0	3.1	0.0	(54.8, 123)	180.6	1	2.2	44.5	(48.8, 126.7)
9529	Yorke Peninsula (DC) - North	1191.4	13	16.1	80.9	(47, 88.2)	953.4	11	8.6	128.0	(21.4, 58.9)
9589	Yorke Peninsula (DC) - South	4634	9	60.5	14.9	(59.3, 122.4)	4473	7	44.4	15.8	(20.4, 78.2)