Exploring the nutrition knowledge, attitudes and practices of pregnant women in Australia

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This thesis is submitted for the degree of Doctor of Philosophy

Discipline of Paediatrics

School of Paediatrics and Reproductive Health

Faculty of Heath Sciences

The University of Adelaide

April 2015

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ABSTRACT

Maternal nutrition from preconception through to lactation can influence the growth, development and long-term health of children. Understanding the modifiable individual factors influencing dietary choices and compliance with nutrition recommendations is key to increasing compliance with recommendations. A self-administered web-based questionnaire was developed to assess women's knowledge, attitudes and practices regarding nutrition during pregnancy. Using the theory of planned behaviour (TPB) as a framework, this study aimed to increase understanding of the psychosocial factors influencing women's dietary quality and intention to consume a healthy balanced diet during pregnancy. Discrete choice experiment (DCE) methodology was also used to examine pregnant women's preferences for dietary supplements. A total of 857 pregnant Australian women completed the survey between June and November 2013. This included a national sample of 455 women recruited using an online panel provider and a South Australian sample of 402 women recruited through the antenatal clinic of a large public maternity hospital in Adelaide. Analysis revealed poor knowledge of and poor compliance with the dietary and supplement recommendations in pregnancy. Pregnant women were also found to be poor judges of dietary adequacy, with over half of the sample perceiving their diets to be healthy despite the majority not complying with recommendations. Stronger subjective norm and greater perceived behavioural control emerged as the strongest predictors of healthy eating intention in pregnancy, with positive attitude being less important. While successfully predicting healthy eating intention, the TPB model was found to be a relatively poor predictor of dietary quality in pregnancy. Findings from the DCE revealed four distinct consumer segments with unique preferences for dietary supplements. Nutrient levels and endorsement were the most important factors influencing choice in the largest segment (44% of sample), with the

strongest preferences found for products with higher levels of folate and iodine and those endorsed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Dietitian's Association of Australia. Overall, the study findings indicate a need to increase knowledge regarding the importance, dose and timing of folic acid and iodine supplementation, and to improve women's ability to evaluate the healthiness of their dietary intake. Main healthcare providers may be best positioned to provide this nutrition education, based on the finding that they were the most influential and preferred sources of pregnancy-related nutrition information. Further, intervention strategies aiming to increase healthy eating intentions in pregnancy should focus on increasing women's self-efficacy and perceptions of control over healthy eating in pregnancy, and should also target influential social sources (main healthcare providers, female family members, pregnant or previously pregnant friends, and partners). It is particularly important that these key influencers have the necessary resources to support and encourage pregnant women to eat a healthy diet during pregnancy. Lastly, the findings regarding the different product attributes influencing choice of dietary supplements among different consumer segments revealed that there is no one-size-fits-all strategy for guiding pregnant women towards making appropriate supplement choices. Thus, information and recommendations regarding supplementation and the sources of this information need to be targeted to the different consumer segments in order to more effectively influence the wider population of pregnant women.

DECLARATION

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

Section 2.1 of this thesis is part of a review paper in a peer-reviewed publication, with me as first author and main contributor to the paper, written with and under the guidance of my supervisors Prof Maria Makrides, Dr Shao Jia Zhou and Assoc Prof Wendy Umberger.

I consent to this copy of my thesis being deposited in the University of Adelaide Library to be available for loans and photocopying (subject to the provisions of the Copyright Act 1968). I acknowledge that copyright of published works contained within this thesis resides with the copyright holder(s) of those works. I also give permission for the digital version of this work to be made available on the web, via the Australasian Digital Theses Program (ADTP) and also through web search engines.

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ACKNOWLEDGEMENTS

This study was carried out during the years 2011-2014 at the Women's and Children's Health Research Institute (WCHRI) and the University of Adelaide in South Australia. Completion of this multidisciplinary research project would not have been possible without the help and guidance of a range of people and funding sources.

Firstly, I would like to express my deep appreciation and gratitude to my supervisors. I could not have asked for a better project or for better role models. I would like to thank Dr Jo Zhou for always making time to review my work and answer my many questions, and for encouraging me to pursue my PhD; Prof Maria Makrides for providing invaluable advice at crucial points along the way; Assoc Prof Wendy Umberger for introducing me to discrete choice experiments (DCE), and for providing invaluable guidance and feedback; and Dr Carmel Collins for her advice with the qualitative component of my study. Mostly, I am truly grateful for the many hours my supervisors spent scrupulously proof-reading my drafts; their constant encouragement and unwavering belief in me; and the many wonderful opportunities they afforded me to present my work at both national and international conferences. My trip to Montreal, Canada, where I presented two oral presentations was a particular highlight of my PhD journey.

Without question, my use of DCE methodology in this study would not have been possible without the help of three people in particular. Many thanks go to Dr Terry Flynn who helped design the DCE, Dr Elisabeth Huynh who showed me how to analyse discrete choice data, and Dr Edward Wei who not only programmed and monitored the online survey but was also very generous with his advice regarding DCE data analysis.

This study would also not have been possible without the participants, whom I thank for their time and insights. Also worthy of acknowledgement are the research staff at WCHRI who helped in the recruitment of my focus group participants: Dianne Pepper, Jacky Aldis, Linda Tully, Helen Loudis, Heather Garreffa and Daniela Calderisi. Thank you also to Mandy Anderson who provided useful feedback on my work in the final stages.

I am also very grateful for the financial support provided by the following scholarships and grants: WCHRI, Faculty of Health Sciences Divisional Scholarship, Women's and Children's Hospital Foundation Population Health PhD Top-Up Scholarship, CSIRO Preventative Healthy Flagship grant, and Healthy Development Adelaide Travel grant. This support not only allowed me to pursue my PhD, but also to attend a number of courses and conferences.

I feel privileged to have been part of the WCHRI team and feel fortunate that I not only leave with a PhD qualification but also with lifelong friends and colleagues. In particular, I would like to acknowledge Jacky, Nicola, Melinda, Ashlee, Naomi and Anoja for making my PhD journey a time to remember. Despite the endless hours of work, I truly enjoyed the experience and will look back on my PhD years very fondly.

Finally, I would like to thank my parents and my fiancé, Jason, for their unconditional support and unwavering tolerance. In particular, all your efforts to make life easier for me so that I could focus on my work are greatly appreciated, and probably weren't acknowledged enough.

LIST OF ABBREVIATIONS

CA	Conjoint analysis
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAA	Dietitians Association of Australia
DCE	Discrete choice experiment
FFQ	Food frequency questionnaire
GP	General practitioner
HCP	Healthcare provider
NHMRC	National Health and Medical Research Council
NTD	Neural tube defect
PBC	Perceived behavioral control
RUT	Random utility theory
SA	South Australia
TPB	Theory of planned behaviour
WCH	Women’s and Children’s Hospital
WTP	Willingness to pay

Chapter 1: Introduction

Study background and rationale

Nutrition in early life, from preconception through to lactation, can influence the growth, development and long-term health of children [1]. Dietary recommendations exist, which aim to improve the nutritional status of mothers and reduce the risks of adverse pregnancy outcomes [2-6]. For example, most countries have government-endorsed dietary guidelines which recommend the number of daily servings from each food group required to ensure a nutritionally adequate diet in pregnancy [2, 3]. Other dietary recommendations also exist which relate to food safety, in particular listeria risk and mercury in fish [5, 6]. In Australia, dietary guidelines were recently updated in February 2013, with changes being made to the recommended number of servings from some food groups in pregnancy. Dietary changes are generally required to meet the recommendations during pregnancy. However, despite a substantial body of scientific evidence documenting the benefits of certain dietary changes [7-10], women do not always adopt these recommendations and the reasons for this are poorly understood [11-20].

Studies from Australia [21-25] and other developed countries including New Zealand [26], the UK [13], USA [27-29] and Canada [30] have consistently shown overall poor compliance with food group recommendations during pregnancy. The available literature suggests that pregnant women struggle to consume the recommended amounts from some food groups more than others, with intake of vegetables and grain foods being particularly low. In addition to studies finding poor compliance with recommended food group servings, studies assessing women's dietary quality during pregnancy have consistently found dietary quality to be suboptimal, further highlighting that there is much room for improvement [27, 28, 30-

32]. In particular, the low dietary quality reported in the literature reflects poor adherence with dietary guidelines.

Notably, this lack of compliance is not limited to the dietary guidelines, but also extends to recommendations for supplement use. Along with the almost universal recommendation for daily supplementation with 400µg of folic acid at least one month preconception and during the first trimester [33], daily supplementation with 150µg of iodine is recommended for women in Australia who are pregnant, lactating or considering pregnancy [34]. Interestingly, while there is low compliance with supplement recommendations, use of dietary supplements in general has become common practice during pregnancy in Australia [15, 16, 18, 35] and worldwide [36-45]. Studies published in the last decade have reported high rates of supplement use during pregnancy, ranging from 66-97%, with usage rates varying throughout pregnancy. Thus, while a high proportion of women appear to be taking dietary supplements, they do not always take supplements with the recommended nutrients, in the recommended doses and at the recommended times. This would suggest that desire to comply with recommendations may not be the key motivator of supplement use.

Further, use of dietary supplements has been found to be more likely among women who are older, have completed higher levels of education, are married, have a lower pre-pregnancy body mass index (BMI), are pregnant for the first time or have not given birth previously, planned their pregnancy, are non-smokers, and who generally have healthier diets and lifestyles [19, 35, 37, 40, 42, 45-54]. This supports the 'inverse supplement hypothesis', which suggests that those least likely to need supplements are those most likely to be taking them [40, 55-57]. Consequently, there are increasing concerns that intake of some nutrients may be in excess of requirements, potentially introducing new health risks for both the mother and the unborn child [36].

Research shows that dietary choices are influenced by a complex set of physiological, psychological, social and economic factors [58-62]. As individuals are often unaware of the role that these factors (e.g. attitudes, perceptions, beliefs and norms) play in their decision-making and behaviour, data on such factors can be difficult to obtain. Further, while these influencing factors may differ on an individual basis, consumer behaviour research plays a vital role in providing insights to key obstacles and success factors when developing nutrition and health products and recommendations that will be adopted by target consumers. A comprehensive understanding of the motivating factors behind women's dietary choices in pregnancy, including choices around both food and dietary supplements, is essential to developing effective strategies for encouraging healthier dietary behaviours and increasing compliance with evidence-based guidelines.

Study aim and objectives

This study's overall aim was to assess women's knowledge, attitudes and practices regarding nutrition during pregnancy. There was a particular emphasis on explaining healthy eating behaviour and dietary supplement choices made in pregnancy. The key objectives of the study are listed below:

1. To compare dietary intake in pregnancy with the dietary guidelines and determine whether women make dietary changes specifically for pregnancy.
2. To compare perceived diet quality with actual diet quality during pregnancy.
3. To increase understanding of the psycho-social factors influencing women's intention to eat a healthy balanced diet during pregnancy and dietary quality using the theory of planned behaviour framework.
4. To determine the prevalence of supplement use in preconception and pregnancy, and compliance with folic acid and iodine supplement recommendations.

5. To use a discrete choice experiment to determine the factors influencing women's preferences for dietary supplements, including nutritionally-fortified foods and beverages, and supplement tablets during pregnancy. Specifically, determine:
    a. Whether pregnant women prefer nutritionally-fortified food products, nutritionally-fortified beverages or supplement tablets.
    b. The relative importance of key pregnancy-related nutrients (e.g. folate, iodine, vitamin D and omega-3 fatty acids) and nutrient levels, versus other product attributes, including: daily cost, brand, endorsement, absorption and information regarding potential health benefits.
    c. Whether knowledge and/or reinforcement of information about health benefits of nutrients influences pregnant women's choices around dietary supplements.
6. To identify the most influential and preferred sources of pregnancy-related nutrition information.

Overview of upcoming chapters

Chapter 2 provides an overview of the current literature regarding modifiable individual and environmental factors influencing dietary choices in pregnancy. A description is also provided of the two key methodologies, the theory of planned behaviour (TPB) and discrete choice experiments (DCE), which were used to address the study objectives.

Chapter 3 describes the methods used to develop the online survey; provides details regarding the study samples, including eligibility criteria and recruitment; and presents summary statistics which characterise the samples in terms of socio-demographic and pregnancy-related variables. This is followed by a brief discussion regarding the representativeness of the study samples.

Chapter 4 presents and discusses the findings regarding pregnant women's nutritional knowledge, practise and information sources.

Chapter 5 starts with a short literature review regarding previous use of the TPB framework to explain dietary and health-related behaviours in pregnancy. This is followed by a description of the methods used to construct the TPB questionnaire used in the present study. The findings from the questionnaire are then presented, and the results and their implications are discussed.

Chapter 6 first provides a review of the literature regarding use of DCEs to elicit consumer preferences for dietary supplements for pregnancy. This is followed by a description of the choice experiment used in this study and the methods used in designing the choice experiment. Results from the choice experiment are then presented and their implications discussed.

Finally in Chapter 7, there is a general discussion of the study findings and their broader implications, after which suggestions are made for future research that may further enhance our understanding of women's dietary choices in pregnancy.

Chapter 2: Literature review and conceptual framework for the study

Literature review: Understanding drivers of dietary behaviour before and during pregnancy in industrialised countries

The following review presents findings from a systematic synthesis of studies which assessed modifiable individual and environmental factors influencing dietary behaviour during preconception and pregnancy. Web of Knowledge and the databases EMBASE, PubMed and PsycINFO were searched. The following search terms were used: maternal, gestation, pregnancy, prenatal, preconception, dietary intake, food intake, food consumption, supplement, knowledge, attitudes, beliefs, motivators, barriers, enablers, influence. Pregnant women of any gestational age and women of childbearing age planning pregnancy or having previously been pregnant were included in the studies. To increase the relevance of the findings, only studies conducted in industrialised countries and published between 1993 and November 2014 were included. In total, 37 relevant studies were identified. The studies used a variety of qualitative and/or quantitative research methods to assess factors influencing either dietary behaviour or use of supplements during preconception or pregnancy. Table 1 provides an overview of each of the studies. The paragraphs below highlight the key individual and environmental factors influencing dietary choices, which in this review refer to both food consumption and supplement use during preconception or pregnancy.

Individual factors influencing dietary choices

Perceptions regarding benefits, risks and need

One of the main drivers of women’s dietary behaviour was beliefs regarding the beneficial effects of diet on fetal health [15, 18, 35, 63-82]. This finding was reported in 23/37 studies and was consistent for women in both low-income and more socio-demographically diverse samples. Nineteen of the 23 studies also identified perceived benefits to maternal health and wellbeing as a driver of dietary choices [15, 35, 64, 66-75, 77-82].

Several qualitative studies found risk avoidance was a strong motivator of dietary change during pregnancy [17, 65, 74, 77, 79, 81, 83, 84] . Specifically, not wanting to 'jeopardise' their own life or their unborn baby's life led women to make dietary changes to avoid preventable adverse pregnancy outcomes [74]. However, larger quantitative studies [17, 67, 69] reported mixed findings. While two found that perceived risk was not a significant predictor of women's intentions to consume a healthier diet (i.e. more fruits and vegetables and less high-fat foods) during pregnancy [67] or to permanently follow a high-folate diet [69], one found that perceived susceptibility to adverse pregnancy outcomes influenced folic acid supplementation with women more likely to supplement with folic acid if they felt susceptible to the risks of folic acid deficiency [17].

Generally speaking, women who indicated they did not make dietary changes during preconception or pregnancy appear to share the belief that dietary intake has limited or no effect on pregnancy outcomes [77]. Likewise, common barriers to supplement use include lack of knowledge regarding benefits, doubts regarding efficacy, and a belief that their diet already provides adequate nutrients [18, 35, 46, 63, 71, 79, 85, 86].

Psychological factors

Psychological factors were found to influence dietary choices in four of the five studies in which they were assessed [32, 79, 87, 88]. Stress, anxiety, and depression had a negative impact on eating habits, dietary quality and supplement use during pregnancy among low-income women [32] and more socially advantaged women [79, 87, 88].

Self-efficacy and control beliefs

Greater perceived ability (or 'self-efficacy') to make healthy dietary choices positively influenced dietary intake in all five studies assessing this factor [65, 66, 69, 72, 82]. Four studies also showed dietary choices were influenced by women's beliefs about the degree of control they had over their health and nutrition [69, 72, 89, 90]. Greater perceived behavioural control was positively associated with daily milk consumption [72] and intention to permanently follow a high-folate diet [69] in studies involving low-income women. Likewise, healthier eating patterns [90] and supplementation with folic acid and other vitamins [89] were more common among socio-demographically diverse women who believed their personal behaviour had a stronger influence on their nutrition and health than external factors.

Specific control factors inhibiting healthy dietary choices were reported in seven studies [63, 66, 68, 72, 74, 79, 82]. Lack of time was the most common perceived barrier [63, 66, 68, 74, 79, 82]. Poor memory thought to be caused by pregnancy [79] was also a barrier to remembering to take supplements. Some women believed taking supplements during pregnancy was an inconvenience and simply stopped taking supplements when they became tired of taking them [15].

Nutrition knowledge

Twelve of 15 studies found that women's nutrition knowledge significantly influenced dietary choices [18, 46, 63, 65, 68, 71, 74, 79, 82-86]. For example, barriers to healthy diet choices included: lack of knowledge regarding the quantity of certain foods required to ensure nutritional adequacy [83]; exposure to confusing and frequently changing dietary information (e.g. mercury and fish) [65, 84]; and misconceptions about healthy choices and alternatives [68, 74]. Furthermore, barriers to use of folic acid and prenatal supplements included: confusion regarding the dose and timing of folic acid supplementation [71] and lack of knowledge regarding the benefits of folic acid [63, 71, 85, 86] and other nutrients [18, 79].

Financial constraints

Personal financial constraints were found to be a barrier to healthy dietary choices in seven of the eight studies assessing the influence financial factors [46, 71, 82, 85, 88, 91] [74]. These findings are supported by other studies which found a significant relationship between poor diet quality and pregnant women from lower-income households or with food affordability issues [22, 27, 92-95].

Environmental factors influencing dietary choices

Social environment and perceived social pressure

Findings regarding the influence of the social environment were reported in 21 of the 37 studies (see Table 1). Perceived expectations from the social environment were found to influence dietary choices [81, 82, 84, 96] and motivate greater nutrition awareness [77] and use of prenatal supplements [79] in six of the 21 studies. Interestingly, support and information from family and friends were found to have both positive [32, 45, 66, 70, 72, 73, 77, 79-82, 84, 88, 91, 96] and negative effects [64, 74, 79, 81, 91] on dietary choices. Negative influences were reported in studies of low-income and/or non-Caucasian samples, and included family and friends encouraging women to consume larger portions of food and to eat when not hungry [64, 74], and discouraging the use of recommended prenatal supplements based on their own experiences [79]. One study found that although low-income women relied on their support systems for meals, they generally did not let others influence their dietary choices [68].

Healthcare providers

Twenty-two of the 23 studies which examined the role of healthcare providers (HCP) found them to be an important influencing factor [18, 35, 45, 46, 65, 66, 70-73, 75, 76, 78-82, 84, 85, 88, 96]. Women considered active promotion by their general practitioner (GP) to positively influence their use of peri-conceptual folic acid supplements [71]. Compared with non-pregnant women (matched for age and area of residence), pregnant women believed more strongly that their doctor 'wanted them to try healthier eating'. Pregnant women were also more motivated to comply with their doctor's recommendations [96] and reported making the specific dietary changes advised by their HCP even if the changes were not appealing [65]. However, women in two studies reported feeling overwhelmed and confused by the dietary advice provided by their HCPs [65, 84]. In particular, overweight women felt their HCP's advice was not individualised and therefore it was not directly applicable to them [65, 84]. Some women did not follow their HCP's advice as they disagreed with it, simply did not want to follow it, or they believed they knew what was best for their body [68]. Women also indicated that a barrier to regular use of prenatal supplements was the lack of adequate information from their HCP regarding the benefits of and need for supplementation [71, 79].

Food environment

Certain features of the food environment were found to influence dietary choices in studies of low-income women [66, 68, 74], overweight and obese women [74, 82], and adolescents [64, 73]. Factors which made healthier choices more difficult included easy access to unhealthy foods [74, 82], inconsistent access to healthy food [66, 68, 74], consumption of food obtained away-from-home [66, 68], and limited control over food purchases and meal preparation due to household status [74]. Women in one study noted that the ability to consume meals at home and the opportunity to prepare meals specifically for themselves were important factors enabling the development of healthy eating habits [66].

Critique of the available literature

Of the reviewed studies, 14 used qualitative research methods only (e.g. focus groups or in-depth interviews), 21 used quantitative methods only (e.g. self- or interviewer- administered questionnaires) and two used both qualitative and quantitative methods (see Table 1). The reviewed qualitative studies ranged in size from 10-150 women (half had 26 participants or less), and the quantitative studies ranged in size from 93-1076 (half had at least 248 participants). While the smaller sample sizes of the qualitative studies limited generalisability of the findings, it is not the aim of qualitative samples to be representative [97]. Rather than making inferences, generalisations and statements about the pregnant population, these studies increased understanding of and determined the range of factors influencing nutritional decisions, and provided insight into women’s perceptions regarding nutrition and supplement use during pregnancy. In particular, the semi-structured and flexible nature of focus groups and semi-structured interviews, allows the researcher to probe, clarify and expand on issues to obtain richer and more in-depth data from participants than would be possible with other more structured methods of data collection such as quantitative surveys [97-99]. However, despite providing insight into the types of factors influencing nutritional behaviour, findings from the reviewed qualitative studies say little about the relative influence of the different factors.

Quantitative research is better suited to determining and quantifying the relative influence of different factors on women’s nutritional decisions during pregnancy. While the reviewed quantitative studies all assessed modifiable individual characteristics alongside socio-demographic factors, few placed these factors within a psychological or psychosocial framework to demonstrate how the different factors were related to dietary behaviour and to each other. For example, which factors explained the most variance in dietary quality, what the strongest predictors of healthy dietary choices were, and which factors mediated others. This information is important for determining which factors to target in intervention strategies.

Only eight of the reviewed quantitative studies used psychosocial frameworks or principals to guide their analysis [17, 32, 67, 69, 72, 89, 90, 96]. None of these studies, however, modelled the psychosocial variables influencing healthy eating or healthy eating intention in pregnancy, where a healthy diet is defined as one that adheres to the national dietary guidelines for pregnancy. Three of the eight studies [17, 67, 69] based their analysis on the health belief model [100, 101], one of which [67] also used a construct from the TPB [102-104]. These studies examined compliance with the periconceptional folic acid supplement recommendation [17]; intention to permanently follow a high-folate diet [69]; and intentions to 1) increase consumption of fruits and vegetables, 2) reduce intake of saturated fat, and 3) reduce intake of high-sugar food [67]. While this latter study assessed different aspects of healthy eating, the sample size was relatively small (n=91-99 for each model), the influence of nutrition knowledge was not considered and it was conducted in the UK. The remaining studies which used psychosocial frameworks or principals, used the TPB to examine factors influencing milk consumption during pregnancy [72]; the theory of reasoned action [105, 106] to examine healthy eating intention in general, not specifically during pregnancy [96]; path analysis to determine direct, indirect and total effects of predictor variables on dietary quality [32]; and two studies focused on the locus of control (LOC) principal [107, 108], one assessing health LOC [89] and the other nutrition LOC [90]. Notably, none of these studies were conducted in Australia.

While three of the reviewed qualitative studies were conducted in Australia [71, 82, 83], these studies had important limitations. While Begley [83] identified barriers to initiating and maintaining dietary change for pregnancy, her data was collected over 10 years ago, and both dietary and supplement recommendations have since been updated in Australia; Mazza and Chapman [71] only assessed women's views on enablers of and barriers to preconception care uptake and periconceptional folate supplementation, and the participants were of reproductive age but not pregnant; and Sui and colleague's [82] investigation of enablers of and barriers to making healthy change during pregnancy only included overweight and obese women. Additionally, none of these studies used psychosocial models to examine the factors influencing intention to consume or consumption of a healthy balanced diet or different aspects of a healthy diet.

The next section describes the two key methodologies used to explain dietary behaviour of pregnant women in the present study.

Table 1. Key characteristics of reviewed studies

					Findings presented	
Reference	**Country & year of data collection**	**Design and setting**	**n**	**Participant characteristics**	**Individual factors**	**Environmental factors**
Studies assessing factors influencing food consumption						
Ferrari, 2013 [65]	USA 2003-2004	Focus group discussions. Groups stratified by ethnicity (African American, Caucasian, Hispanic) and BMI (overweight vs. not overweight). Recruited through newspaper advertisements, posted flyers, and prenatal clinics.	58	Mean GA 30wks. Parity NR. 52% college education	PB (+) PR (+) SEf (+) K (+)	HCP (+/0)
Groth, 2013 [68]	USA Year NR	Focus group discussions. Recruited from the WIC services and prenatal clinics in a medium-sized North Eastern city.	26	GA: 92% 10-30wks, 8% 31-40wks. Parity NR. Low-income. African American.	PB (+)	SE (0) HCP (0) FE (-)
Reyes, 2013 [74]	USA 2011	In-depth interviews Recruited from waiting room of a single university-affiliated outpatient prenatal care clinic in Philadelphia, PA.	21	71% TM1 or TM2. 76% multiparous. Low-income. African American. Overweight or obese. 48% unemployed 90% single but all lived with other adults or children.	PB (+) PR (+) K (+) F (-)	SE (-) FE (-)
Sui, 2013 [82]	Australia 2011	In-depth interviews. Women enrolled in RCT (LIMIT study [109]). Recruited from three public maternity hospitals across South Australian metropolitan area. Eligible if BMI ≥25 kg/m^2 at first antenatal visit between 10-20wks GA, and singleton pregnancy.	26	GA 28wks. Overweight or obese. 50% nulliparous.	PB (+) K (+) CB (-) SEf (+) F (-)	SE (+) HCP (+) FE (-)
Wennberg, 2013 [84]	Sweden 2007	Focus group discussions. Recruited from antenatal classes at 5 different healthcare clinics in rural areas and in a small and a mid-size town.	23	GA NR. All nulliparous. 70% university education. 91% living with partner.	PR (+/-) K (+)	SE (+) HCP (+/0)

					Findings presented	
Reference	Country & year of data collection	Design and setting	n	Participant characteristics	Individual factors	Environmental factors
Yeasmin, 2013 [81]	UK 2010	Focus group discussions or in-depth interviews. British Bangladeshi immigrants recruited by contacting participants individually and using snowballing technique. From area where 33% of the population are Bangladeshi.	26	Pregnant or non-pregnant with at least one child. British Bangladeshi immigrants living in the UK for ≥10 years. 90% formal education in Bangladesh. 38% completed primary school only.	PB (+) PR (+/-)	SE (+/-) HCP (+/0)
Gardner, 2012 [67]	UK (England) NR	Cross-sectional SAQ. Recruited from 1 hospital outpatient clinic and 5 community clinics in South-East England and 1 hospital outpatient clinic in North-East England.	103	Mean GA 27wks. Parity NR. 72% university education. 70% Caucasian.	PB (+) PR (0) CB (0)	SE (0)
Fowles, 2011 [32]	USA 2009-2010	Cross-sectional SAQ. Convenience sample recruited from 4 area clinics offering free or low-cost pregnancy testing to low-income women.	118	TM1. Low-income underinsured or uninsured. 38% Caucasian, 13% African-American, 47% Hispanic. 25% married.	PF (-) K (0)	SE (+/0)
Wise, 2011 [80]	USA 2009	Cross-sectional SAQ. Adolescents recruited from a local high school teen-parenting support group and a hospital-based prenatal clinical.	49	TM2 or TM3. Parity NR. Adolescents aged 15-19yo. 37% Hispanic, 21% African American, 17% Caucasian	PB (+)	SE (+) HCP (+)
Takimoto, 2011 [78]	Japan 2006	Cross-sectional SAQ returned by post. Consecutive pregnant women attending a single prenatal clinic in downtown Tokyo.	248 50% RR	Mean GA 28.6wks. 53% nulliparous. Lower income area (vs. average of Tokyo metropolitan area). 6% overweight or obese.	PB (-)	HCP (+)
Szwajcer, 2007 [77]	Netherlands Year NR	In-depth interviews. Selected through midwifery practices in different-sized cities, word of mouth advertising, distribution of letters in districts with many children, and recruitment through representative panels of selection agencies in the above-mentioned cities.	60	48 nulliparous (36 across all 3 TM, 12 planning pregnancy). 12 primiparous, end TM1. 50% low to average education level and other 50% high to academic educational level, spanning spectrum of Dutch education system.	PB (+) PR (+)	SE (+)

					Findings presented	
Reference	Country & year of data collection	Design and setting	n	Participant characteristics	Individual factors	Environmental factors
Thornton, 2006 [91]	USA 2000-2001	In-depth interviews with Latina mothers. Recruited by flyers and in-person at a federally qualified health centre, a WIC clinic, and a 'Baby Fair' run by community organization partners.	10	Pregnant or 6-12wks post-partum. Mixed parity. All born in Mexico. Lived in US average 3.3yrs. All married and 'housewives'. One also worked as labourer. Average household size 5 people (range 3–10).	F (-)	SE (+/-)
Fowles, 2005 [66]	USA 2003	Cross-sectional SAQ followed by small-group interview. Women enrolled in WIC recruited from 6 different agency sponsored prenatal classes.	18	Mean GA 24.8±18 wks. 61% nulliparous. Low-income. 67% Caucasian.	PB (+) PF (0) CB (-) SEf (+) K (+)	SE (+) HCP (+) FE (+/-)
Hurley, 2005 [87]	USA Year NR	Cross-sectional SAQ. Recruited through advertisements in local university publications and word-of-mouth.	134	TM 3. Parity NR. Mean years of schooling: 16.7y, range 12-20y. 85% Caucasian. 95% married.	PF (-)	SE (0)
Tuffery, 2005 [88]	UK (England) Year NR	Semi-structured IAQ. Recruited from 5 general medical practices in south-west England	39	Assessed at end of TM1 and TM3, and 6 months post-partum. Nulliparous. 77% from non-manual social classes (I-III).	PF (-) K (+) F (-)	SE (+) HCP (+)
Lewallen, 2004 [70]	USA Year NR	Individual face-to-face interview (2 open questions) Approached and interviewed at first (n=147) or second (n=3) prenatal visit at public prenatal clinic.	150	Mean GA 15wks. Mean 3 previous pregnancies & 1 live birth. Low-income. 56% African-American.	PB (+)	SE (+) HCP (+)
Begley, 2002 [83]	Australia 1999-2000	Focus group discussions. Clinic and community based sample from 2 randomly selected health service regions in Perth, Western Australia.	90	Child-bearing age, planning pregnancy or currently pregnant. GA and parity NR. Majority undertook some or completed university education.	K (+) PR (UK)	HCP (UK)

					Findings presented	
Reference	**Country & year of data collection**	**Design and setting**	**n**	**Participant characteristics**	**Individual factors**	**Environmental factors**
Kloeblen, 1999 [69]	USA 1997	Cross-sectional IAQ. Prenatal care clinic in a public hospital. Enrolled in or eligible for and waiting to enrol in WIC.	251 96% RR	84% TM1. 31% nulliparous. Low-income, socioeconomically disadvantaged. 92% African-American. 16% married.	PB (+) PR (0) SEf (+) CB (-) K (0)	-
Park, 1999 [72]	USA 1993	Cross-sectional SAQ. Attending first or regular clinic visit at two prenatal clinics in South Carolina which provide care to pregnant women eligible for or enrolled in WIC.	180 78% RR	21% TM1, 41% TM2, 38% TM3. 48% nulliparous. Low income. 37% 13-19yo. 19% post-secondary education. 52% Caucasian. 70% unmarried.	PB (+) SEf/CB (+)	SE (+) HCP (+)
Springer, 1994 [90]	USA Year NR	Cross-sectional SAQ completed as part of larger study. Administered during first prenatal visit.	943	GA and parity NR. 1% lived alone. 83% completed post-secondary education.	CB (+)	-
Anderson, 1993 [96]	UK (Scotland) Year NR	Cross-sectional SAQ. Consecutive women attending antenatal booking clinics at Aberdeen Maternity Hospital. Pregnant women matched for age and area residence with non-pregnant women identified from age/sex register from a large general practice.	93	Pregnant women (plus 94 non-pregnant women- characteristics and findings for this group not presented in table). 48% nulliparous. 28% from non-manual social classes (I-III); 44% from manual social classes (IV-V); 28% missing data. 77% married or living with partner.	PB (+)	SE (+/0) HCP (+)
Studies assessing factors influencing supplement use						
Fulford, 2014 [17]	France, Germany, Belgium, and Poland	Cross-sectional SAQ. Recruitment for the study was done by a healthcare research company (Opinion Health).	651	Planning pregnancy (n=325) or ≤18wks GA 50% nulliparous. 72% post-secondary education. 71% employed. 81% married or living with partner. 92% born in country of residence.	PR (+)	-

					Findings presented	
Reference	Country & year of data collection	Design and setting	n	Participant characteristics	Individual factors	Environmental factors
Martin, 2014 [18]	Australia 2011-2012	Cross-sectional SAQ. Antenatal classes and clinics from all birthing hospitals across Gippsland, Victoria.	200 Min. 45% RR	TM 3. 58% primigravid. 52% post-secondary education. 61% employed.	K (+) PB (+)	HCP (+)
Pouchieu, 2013 [45]	France 2009-2012	Cross-sectional online SAQ. Subset of women from large-scale population-based prospective cohort study (NutriNet-Sante). Eligible if pregnant when completed SAQ (2 months after study entry). Recruited via mass-media campaigns across France.	903	31% TM1; 36% TM2; 33% TM3. 57% nulliparous. 94% married or living with partner. 96% ≥12yrs of schooling 64% intermediate professions or executive and intellectual professions.	-	SE (+) HCP (+)
Sato, 2013 [75]	Japan 2010	Cross-sectional SAQ. Distributed at maternity hospitals and public health centres in 18 districts in Japan. Returned by post.	1076 30% RR	Mean GA 25.7±6.8wks. Parity NR.	PB (+) K (+)	SE (UK) HCP (UK)
Barbour, 2012 [63]	UK (Scotland) Year NR	Focus group discussions. Approached to complete SAQ at health visitor led baby clinics in National Health Service Fife when attending with infant <20wks old. All participants then invited to join focus group. Aimed to recruit women of all ages with a healthy first or subsequent child but concentrated efforts on low SES areas.	24	3-60wks postpartum. Mixed parity. 88% Caucasian.	PB (+) PN (+) CB (-)	-
Bodecs, 2011 [89]	Hungary 2008-2009	Cross-sectional IAQ. Completed during first prenatal visit at district nurse office. Women living in Szombathely, a county centre town in the north-west of Hungary. All pregnant mothers identified in 1yr period in 10/18 public health nurse district areas invited to participate.	307 95% RR	Mean GA 8.22±4.5wks. 84% employed. 39% completed post-secondary education.	CB (+/-)	-

					Findings presented	
Reference	Country & year of data collection	Design and setting	n	Participant characteristics	Individual factors	Environmental factors
Mazza, 2010 [71]	Australia 2007	Focus group discussions. Low and high SES areas of metro Melbourne and a rural area of Victoria. Responded to advertisements in local newspaper, and for rural women obtained convenience sample from local playgroup and Division of General Practice.	17	Childbearing-aged women. Parity NR.	PB (+) K (+) F (-)	HCP (+)
Forster, 2009 [35]	Australia 2003-2004	Cross-sectional SAQ. Recruited from public antenatal clinic and the Family Birth Centre clinic at large tertiary referral hospital in Melbourne, Australia.	588	Mean GA 38.45±1.3wks. 53% nulliparous. 42% university education. 54% born in Australia. 93% married or living with partner.	PB (+)	HCP (+)
Tessema, 2009 [79]	USA 2005	Focus group discussions. In 3 geographically and ethnically diverse regions. Groups segmented by race/ethnicity, consistency of prenatal supplement use and location. Professional research firm recruited participants and moderated discussions.	102	Gave birth to at least one child within last 5yrs. 64% completed post-secondary education. 54% African-American, 46.2% Hispanic.	PB (+) PR (+) PN (+) PF (-) CB (-) F (0)	SE (+/-) HCP (+)
Goldberg, 2006 [46]	USA 2003-2004	Cross-sectional IAQ via telephone. Population-based: women who called teratogen information services Self-selected for their health seeking behaviour.	327	Mean GA 12.5±7.6wks. 29% nulliparous. 92% completed ≥12yrs education. 55% Caucasian, non-Hispanic; 21% Hispanic.	PN (+) CB (-) F (-) K (+)	HCP (+)
Maats, 2002 [15]	Australia 2001	Cross-sectional IAQ. Attending antenatal clinic at a major public maternity hospital in Adelaide, South Australia.	211 89% RR	GA ≥26wks. Parity NR. Most Caucasian and married. No major demographic differences between study population and all women giving birth in South Australia in 1999.	PB (+) PN (+) CB (-)	-

					Findings presented	
Reference	Country & year of data collection	Design and setting	n	Participant characteristics	Individual factors	Environmental factors
Sen, 2001 [86]	England 1997-1998	Cross-sectional SAQ. Consecutive pregnant women attending hospital antenatal clinic. Industrial town in Staffordshire, and the neighbouring rural area of West Midlands.	300	GA ≥12wks. 41% nulliparous. 79% completed post-secondary education. 57% employed; 17% housewives by choice. 95% Caucasian.	K (+)	-
McGovern, 1997 [85]	UK (Scotland) Year NR	Cross-sectional SAQ. Delivered normal babies in 3 Glasgow maternity hospitals over 4wk period.	487 95% RR	Postpartum- before hospital discharge. 51% primiparous. 36% in deprivation categories 6 or 7 (scale of 1-7 with 7 representing postcodes with highest level of socio-economic deprivation)	PN (+) K (+) F (-)	HCP (+)
Sayers, 1997 [76]	UK (Ireland) Year NR	Cross-sectional IAQ. Community-based sample, multi-stage sampling method used. Stage 1: 1 higher social class and 2 lower social class study areas chosen. Stage 2: obtained list of streets, in each street, 1st house randomly selected and every subsequent 5th house interviewed.	335 84% RR	Childbearing-aged. 62% had children. 58% currently not working out of home. 47% from non-manual social classes 1-3 (vs. 48% Dublin as whole). 77% not eligible for free GP care and prescription drugs.	PB (+)	HCP (+)
Studies assessing factors influencing both food consumption and supplement use						
Everette, 2008 [64]	USA 1992-1995	In-depth interviews. Community-based convenience sample. Subset of women participating in the Healthy African American Family I Project (HAAF 1); interviewed during pregnancy and data on pregnancy outcomes collected. 6 delivered low birth weight and/or preterm infants; 13 delivered normal weight infants.	19	GA NR. 37% nulliparous. 14-22yo; 16 adolescents (14-18yo) 84% low-income. African-American women.	PB (+)	SE (+/-) FE (+)
Pope, 1997 [73]	USA Year NR	Cross-sectional IAQ and in-depth interviews. Adolescents recruited from rural and urban schools, health clinics, community programs for pregnant adolescents, and physicians' practices.	97	GA 28-35wks. 93% nulliparous. Adolescents (14-18yo). ~75% low and low-middle SES.	PB (+)	SE (+) HCP (+) FE (+/-)

Abbreviations: NR: not reported; SAQ: self-administered questionnaire; IAQ: interviewer administered questionnaire; RR: recruitment rate; GA: gestational age; TM: trimester; SES: socio-economic status; WIC: 'The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides Federal grants to States for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding postpartum women, and to infants and children up to age five who are found to be at nutritional risk' (http://www.fns.usda.gov/wic); RCT: randomised controlled trial; PB: perceived benefits; PR: perceived risk; PN: perceived need; PF: psychological factors; SEf: self-efficacy; CB: control beliefs; K: nutrition knowledge; F: financial constraints; SE: social environment/expectations; HCP: healthcare provider; FE: food environment; (0): no influence on dietary choices; (+) positive influence; (-) negative influence; (UK) has influence but unknown whether positive or negative.

Theoretical frameworks

A wide range of theoretical frameworks and methodologies have been used in the literature to examine dietary behaviour and dietary choices in different populations, including pregnant women. Below is a brief overview of the models and frameworks used by previous studies to investigate dietary behaviour. This is followed by a description of the methodologies used in the present study.

Reflecting the complexity and diversity of factors influencing dietary decisions, different fields of study have used various theoretical models to explain the factors influencing dietary behaviour of individuals as well as their decision process related to food choice [59-61, 110-112]. Different models consider different variables to be determinants of food choice and this leads to each discipline assuming a unique approach to the examination of dietary decisions.

Within the health and nutrition literature, psychosocial models of health behaviour are often applied to the study of dietary choice and dietary change. These include the Theory of Reasoned Action [105, 106], the TPB [102-104], the Health Belief Model [100, 101], Protection Motivation Theory [113, 114], Social Cognitive Theory [115], the Transtheoretical Model [116-118] and the Social-Ecological Model [119]. These models emphasise the psychosocial and cognitive processes mediating behaviours and have been used to explain and predict dietary behaviour as well as examine the factors influencing dietary change [69, 120-123].

In particular, the TPB is a model which, over the last 20 years, has been widely applied to the study of food choices in different contexts [62, 120, 124-135], and was the model chosen for explaining dietary behaviour in the present study. The TPB model is described in more detail in section 2.1.1.

Among other methods used to examine food choices, DCE and conjoint analysis (CA) methods come up as two popular methods of eliciting consumer preferences for different food products. DCE methodology was first applied in the transportation literature, after which it became an important statistical method in other social science areas including marketing research, environmental and agricultural economics and, more recently, it has emerged as a useful preference elicitation method in the areas of food and health [136-144]. DCE methodology is described in section 2.1.2

CA is another popular preference elicitation method, also widely used in the social and applied sciences. While CA has previously been used to elicit consumer preferences for a range of dietary products including nutritionally-fortified foods and supplements [145-148], an important distinction between DCE and CA methods is the underlying theory on which each method is based. While DCE methods are based on an underlying theory of human behaviour (Random Utility Theory, described in section 2.1.2), CA is based on the purely mathematical theory of 'conjoint measurement' [149, 150] which is concerned with '*the behaviour of sets of numbers in response to factorial manipulations of factor (attribute) levels'* [151]. Thus, when using CA methods to explain behaviour of humans (rather than numbers) one or more of the mathematical assumptions underlying conjoint measurement theory are usually violated, creating issues with model acceptance [151]. CA methodology has additional limitations which make it unsuitable for estimating choice models for people and these are discussed in Louviere et al. [151]. Overall, given the need to explain human preferences and choices, it makes sense to collect and analyse choice data using methods that are shaped by an underlying theory that is concerned with the behaviour of humans or human preferences.

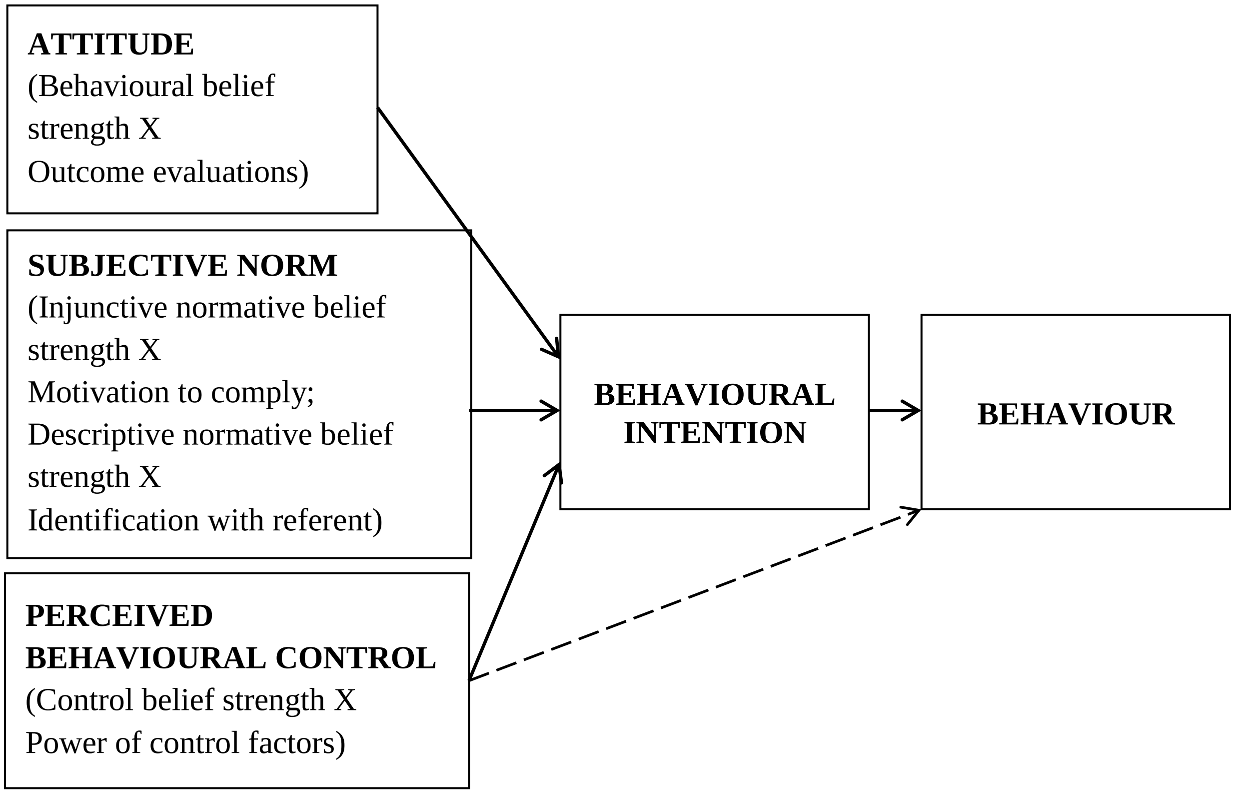
2.1.1 *The Theory of Planned Behaviour (TPB)*

The TPB is a well-established psychological framework used to quantitatively measure social and psychological factors influencing behaviour [102-104]. The framework can be used to predict and understand the motivational influences on healthy and unhealthy behaviour (e.g. adopting healthier eating habits) in order to identify strategies for changing behaviour. At its root, the TPB framework is based on expectancy value theory [152] which suggests that whether a behaviour is adopted by an individual is dependent on the individual's expectations regarding the outcomes of the behaviour, and the individual's valuation of those outcomes. Previous reviews have shown the TPB to be a successful model for predicting dietary behaviours and intentions [153, 154].

According to the TPB, the most important determinants of a specific behaviour are the individual's intention to perform the behaviour (behavioural intention) and the individual's actual control over performing the behaviour (see Figure 1) [102-104]. Behavioural intention is determined by an individual's 1) attitude toward a behaviour; 2) 'subjective norm' which refers to perceptions of the social pressure (e.g. from friends, family or health practitioners) to perform or not to perform a behaviour, and perceptions of the behavioural norms of specific reference groups; and 3) perceived behavioural control (PBC) which refers to the individual's beliefs about their ability to control and perform a specific behaviour, or in other words, their beliefs about the ease or difficulty of performing the behaviour.

Each of the three constructs, attitude, subjective norm and PBC, which determine behavioural intention, are themselves predicted by underlying and salient beliefs [102-104]. Attitudes towards a behaviour are influenced by an individual's 'behavioural beliefs', which refer to the individual's beliefs regarding behavioural outcomes and their evaluation of those outcomes; an individual's subjective norm is influenced by their 'injunctive normative beliefs' which refer to beliefs about what specific social sources think about a specific behaviour and their personal motivation to comply with these sources, as well as their 'descriptive normative beliefs' which refer to beliefs about what specific social sources do and their identification with these sources; and finally, PBC is influenced by 'control beliefs' which refer to the individual's beliefs about inhibiting and enabling factors, and how these factors influence their behaviour.

Figure 1. The Theory of Planned Behaviour (adapted from [104])



The most recent review by McEachan et al. [154], which reviewed 30 diet-related applications of the TPB, found that on average the TPB explained 21.2% of the variance in dietary behaviour and 50.3% of variance in intentions. Overall, most dietary and health-related TPB studies have found attitude to be the strongest predictor of behavioural intentions followed by PBC and subjective norm [102, 154, 155].

Further, in an effort to explain additional variance in behaviour and intention not accounted for by the TPB constructs, numerous studies have investigated the role of additional variables in the TPB model [156]. In a recent paper Ajzen [157] addressed this issue, confirming that the TPB can include additional variables, provided that certain criteria are met. Briefly, these criteria are: the variable should be behaviour-specific and compatible with measures of behavioural intention; there must exist the possibility of it being a causal factor in determining behaviour and intention; it should be conceptually independent of attitude, subjective norm and PBC; it should be applicable to a wide range of human behaviours; lastly, predictions of behaviour or intention should be consistently improved if the variable is to be incorporated into the theory [157]. This allowed the exploration of perceived stress, health value and self-identity as a healthy eater as potential predictors of healthy eating and healthy eating intention alongside the TPB constructs in the present study. The rationale for selecting these particular additional variables is provided in chapter five.

2.1.2 *Discrete Choice Experiments (DCE)*

A DCE is a quantitative valuation method which uses an individual's stated behaviour in a hypothetical setting to assess how individuals value goods and services [158]. The underlying aim of this research is to explain and predict consumer preference and choice based on choice experiment data collected using surveys.

Essentially, all goods and services can be described by a number of attributes, each of which can have different levels [158]. For example, when describing nutritionally-fortified food, attributes could include the nutrients with which the food will be fortified, the type of food product, brand and price; levels would be different nutrients (e.g. folate, iron), different food products (e.g. bread, milk), different brands (e.g. Nestle, Homebrand) and different prices. In choice experiments, respondents are presented with choice sets which simulate purchase scenarios. In each choice set, respondents are presented with two or more competing alternatives and it is the unique combination of attribute levels that differentiate alternatives within the choice set [158].

In a traditional DCE, respondents are required to select their most preferred alternative from each choice set [158]. A series of choice sets are presented to each respondent, requiring them to make a number of discrete choices. In making their choices, respondents make trade-offs between the attribute levels of each product in the choice set. Accordingly, the respondent's choice indicates their preference for a specific bundle of product attributes. After respondents make their selections from a number of choice sets, regression analysis, either at the group or individual level, is used to identify which particular attributes influence consumer preference [158-160]. In this way, DCEs can be used to help understand the decision-making processes of target consumer groups. Moreover, research has shown that discrete choice modelling can provide an accurate indication of actual behaviour or 'revealed preferences', and relative utilities for multiple product attributes, making DCEs a preferred research method [136, 158, 161, 162].

Additionally, some choice experiments provide respondents with the option to not choose any of the alternatives in the choice set or to delay their choice. Such choice scenarios more realistically represent real-life choice scenarios where consumers generally always have the option to choose one or none of the alternatives or to delay their choice [163]. Inclusion of a no choice option is particularly warranted when the objective is to determine consumer demand for different alternatives [163]. Not including a 'no choice' option forces respondents to make a choice and to make trade-offs between the attribute levels of the products presented, therefore providing more data on how the different attributes and attribute levels impact choice [163]. In the latter case, the choice model would be a conditional demand model, meaning that it would predict likelihood of choosing a particular alternative under the condition that respondents actually choose one of the alternatives [163]. The choice model estimated in the present study was a conditional demand model as the aim of the analysis was to assess the impact of different attributes and attribute levels on choice rather than to determine demand for products with specific attributes and attribute levels.

Statistical design methods are used to generate the alternatives (product profiles) used in a choice experiment (i.e. the different combinations of attribute levels that will be tested) [158, 164, 165]. Systematic variation of the alternatives in each choice set allows the researcher to evaluate the relative preferences for each of the attribute levels and to examine the trade-offs made between different levels of attributes [158]. If price is included as an attribute and is found to significantly influence choice, researchers can also estimate consumers' 'willingness to pay' (WTP) for different levels of attributes [158].

The underlying theory

DCEs are based on a comprehensive behavioural theory called 'random utility theory' (RUT). The theory was first proposed by Thurstone [166] in psychology to study choices between pairs of options. After being introduced to economics by Marschak [167], the theory was extended by McFadden [168] to understand and model choices between multiple options.

The term 'utility' refers to the satisfaction gained from (consuming) a good or service, such that a more preferred alternative will always represent greater utility [158]. According to RUT, utility is a latent construct that exists in the mind of the decision maker but is not observable by the analyst. Thus, as shown by the equation below, utility is comprised of two components:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad (1)$$

V_{ij}, a systematic and measurable component representing all of the observable factors related to individual i and product j. This includes the product attributes, socio-demographic characteristics of the individual and any psychosocial or other variables that may be measured in the survey. As shown by equation (2), this component is a function of X_{ij} which represents the attributes of product *j* and could also represent the measurable characteristics of the respondent *i*, and β_{ij} which represents the effect that X_{ij} has on utility.

$$V_{ij} = \beta_{ij} X_{ij} \tag{2}$$

Coming back to equation (1), ε_{ij} is the random and unmeasurable component of utility representing all of the unobservable factors influencing the utility individual *i* derives from option *j*. Due to this random and unobservable component of utility it is only possible to predict the probability of the decision maker choosing each of the alternatives; it is not possible to predict the exact alternative itself [168, 169]. Thus, choice models based on RUT are probabilistic, not deterministic.

In line with the utility maximisation assumption which underlies consumer behaviour theory [170], RUT assumes that people make rational decisions and when presented with a choice set of competing alternatives, will always choose the alternative from which they derive the greatest utility. Thus, as shown in equation (3), the probability of an individual (*n*) choosing a specific alternative (*i*) from a choice set (*C*) will be greatest if the utility derived from that alternative ($V_{in} + \varepsilon_{in}$) is greater than the utility derived from the other alternatives (*j*) in that choice set ($V_{jn} + \varepsilon_{jn}$, all $j \in C$).

$$P\,(i|C) = \text{Prob [171]} \tag{3}$$

Under the usual assumptions that the error terms follow a Type 1 Gumbel-distribution and that they are independently and identically distributed [168], the probability of a group of individuals choosing a specific alternative (*i*) from all alternatives (*j*) in a choice set (*C*) can be calculated using equation (4).

$$P\,(i) = e^{\Lambda V i} / \sum_{j \in C} e^{\Lambda V j} \tag{4}$$

This equation can be estimated using a multinomial logit regression, the most widely used discrete choice model, and the one used in the present study [172]. A new and noteworthy parameter in this equation is λ. This is a scale parameter which represents the variance of the error term and is usually assumed to be equal to one, suggesting constant error variance. There is an inverse relationship between the scale parameter and error variance such that as the scale value approaches infinity, error variance approaches zero and as such the choice model becomes more deterministic rather than probabilistic.

Further advantages of using DCE methods

The DCE task used in the present study differs to the traditional pick-one DCE task in that it requires respondents to choose both their most and least preferred option from each choice set. In this way, it is the same task as used in multi-profile case best-worst scaling (BWS), one of the three types of BWS which, like DCEs, is based on RUT [173-176].

Overall, best-worst tasks have several advantages over pick-one choice experiment tasks. In general, best-worst tasks seem to be easy for people to complete with research showing that people have a tendency to *'identify and respond more consistently to extreme options'* [175]. Another major advantage of DCEs which use a best-worst approach over traditional DCEs is the ability to elicit more preference information per respondent using the same number of choice sets and with minimal additional respondent burden. Assuming that respondents evaluate all alternatives in a choice set before selecting their most preferred option in a traditional DCE, asking them to select their worst option (in addition to their best) creates minimal additional cognitive burden and provides more information about their preferences [177]. Thus, best-worst DCEs produce more observations without needing to increase the sample size.

Additionally, in choice experiments such as the one used in the present study where there are three alternatives per choice set, the full preference ranking order can be obtained for individuals. Overall, compared to traditional pick one DCE's, best-worst task DCEs increase both the quantity and quality of preference information as the additional information regarding the respondent's worst options improves the characterisation of preference heterogeneity and allows respondents to be better classified into segments with similar preferences [178].

Summary

Overall, the literature review in section 0 highlights the diverse factors influencing women's dietary choices during the key life stages of preconception and pregnancy. Further, the reviewed studies suggest factors influence women differently. Although only key modifiable individual and environmental factors were discussed in this review, other factors such as socio-demographic characteristics [46, 50-54, 92] and physical symptoms associated with pregnancy (e.g. morning sickness, cravings, and aversions to certain foods) are also known to influence women's nutritional choices [46, 63, 66, 68, 77, 79, 88, 179, 180].

Identifying which factors are most influential is key to determining which factors should be targeted in intervention strategies. Notably, while the reviewed studies helped to highlight the range of factors influencing dietary choices in pregnancy, few studies went beyond the identification of influencing factors and quantitatively assessed the contribution that factors made to explaining variance in dietary behaviour. Furthermore, none of these studies examined the factors influencing pregnant women's healthy eating intentions, consumption of a healthy diet in line with the pregnancy guidelines, or selection of dietary supplements during pregnancy.

While it is useful knowing the range of factors that influence dietary choices in pregnancy, for the purpose of developing effective intervention strategies, it is vital to understand which factors have a considerable and significant impact on dietary behaviour during pregnancy, and how these factors are related. Therefore, the present research aimed to address these gaps in the literature by using the TPB as a framework to understand the factors influencing women's intention to consume and consumption of a healthy balanced diet during pregnancy; as well as using a DCE to examine preferences for dietary supplements in the context of pregnancy.

The limitations of the reviewed qualitative studies made it necessary to collect contemporary qualitative data on factors influencing nutrition knowledge, attitudes and practices during pregnancy from an Australian sample of pregnant or recently pregnant women, to ensure no important information was missed in the previous studies. This information was then used, along with current nutrition recommendations and findings from previous research, to inform the content of the online survey used to address the objectives of the present study. The next chapter describes the development of the online survey as well as the study samples.

Chapter 3: Survey development and study sample

Survey development was a two stage process. The first stage involved focus group discussions to inform the content of the online survey questionnaire (section 0) and the second stage involved the construction of the questionnaire (section 0).

Focus group discussions with pregnant and post-partum women to inform content of online survey

Below is a brief overview of focus group methodology and the purpose of focus group discussions in this study. This is followed by a description of the focus group participants, their recruitment, and data collection. Lastly, a description of how the data were analysed and used in the construction of the questionnaire is provided.

What are focus groups?

Focus groups are a qualitative research method. They are facilitated group discussions where a moderator asks open-ended questions and encourages participants to discuss the topic of interest freely and to interact with each other [97, 181]. In-depth data are generated through group discussion and rather than being an aggregate of individual views, findings reflect the collective views of the participants [99, 182]. Focus groups are different to other types of group interaction as defined by the following characteristics: they involve groups of people who are relatively similar and often unfamiliar with each other; qualitative data are produced which provides insights into people's attitudes, opinions and perceptions; and the discussion is focused on pre-determined topics [97]. Most importantly, focus group discussions provide researchers an opportunity to listen to participants and learn from them about topics of interest to the researcher [183].

Purpose of focus group discussions and rationale for choosing focus group methodology

The aim of the present focus group discussions was to gain a comprehensive understanding of women's knowledge, attitudes and practices regarding nutrition during pregnancy. The key objective being to gather the full range of responses to the questions asked and then use this data to inform the content of an online survey which would address the research objectives on a larger and more national scale.

Focus groups were considered a more efficient method of obtaining this data than individual in-depth interviews as focus group discussions allow more to be learnt about the range of views and experiences of participants, while individual interview generate a larger volume of in-depth data relating to specific participants [99]. Specifically, focus group discussions allow identification of a diverse range of themes in an interactive social environment where individual comments can trigger responses from other participants; focus group participants may feel less 'on the spot' as others are also responding; and there is a sense of 'safety in numbers', which is particularly important when discussing sensitive topics and may also encourage participation from people who may not feel comfortable being interviewed alone or who feel anxious about communicating [98, 184, 185]. It has also been noted that compared to individual interviews, focus groups can facilitate the expression and sharing of more critical views [186].

Also, due to the group interaction and resulting conversations between participants, focus groups allow the researcher to both direct the discussion towards predetermined topics of interest and also to pursue new and emerging ideas [183]. Thus, focus group discussions facilitate the exploration of both predetermined and unexpected issues which can then be further examined in larger samples and/or validated using other research methods (e.g. quantitative surveys), making the final survey a more comprehensive data collection tool.

Several previous studies have successfully used focus group research to generate information used to guide the development of quantitative questionnaires [187-189]. Additionally, the open-ended nature of questioning allows participants to respond to questions and discuss issues in their own words. This terminology can then be used in the development and phrasing of questions to increase clarity and understanding of survey items by survey respondents from the same target group (in this case, pregnant women).

The procedures followed in conducting the focus group discussions are described in the following sections.

3.1.1 ***Participant selection***

Sampling and eligibility criteria

Purposive sampling was used to select focus group participants. This purposive selection was based on the following inclusion criteria:

- Women aged ≥18 years
- Currently pregnant, currently lactating or <12months post-partum and breastfed for at least one month.
- Able to understand and speak English
- Able to give informed consent

Composition of groups

Homogeneity among participants but with enough variation to allow for different opinions and an exploration of different insights is important in focus groups [97, 98]. According to Krueger [97], participants should be relatively similar in regards to factors which may influence sharing within the group discussion. Therefore, in this study, homogeneity was based on education level and gravidity. Previous studies that have explored dietary intake, including supplement use, among pregnant women have found that women with lower education levels are less likely to have healthier dietary patterns and take dietary supplements; and dietary intake and supplement use also differed in first and subsequent pregnancies [19, 37, 42, 46, 50-54, 92]. Therefore to ensure the focus groups were comprised of relatively similar women, they were segmented by education (‘post-secondary education’ and ‘secondary education only’) and the following pregnancy criteria: 1) women who are/were pregnant for the first time, and 2) women with subsequent pregnancies.

While it was intended that this stratification would result in four sub-groups, first and subsequently pregnant women with secondary education only were grouped together, forming one subgroup rather than two. This was due to difficulty in both recruiting sufficient numbers of women with secondary education only and getting these women to attend the focus group sessions.

Thus, discussions were conducted with three subgroups of women, outlined below.

1. Post-secondary education and pregnant for the first time.
2. Post-secondary education and subsequent pregnancy.
3. Secondary education only and first or subsequent pregnancy.

As well as ensuring that there were relatively similar women in each group, this purposive sampling method aimed to maximise participant interaction and thereby increase the range of insights and quality of the data [97, 98].

Size of groups

According to Krueger [97], the size of the group should be small enough to allow everyone to share their views and large enough to provide a range of insights. While Krueger [97] noted that focus groups can range in size from 4-12 people, Kitzinger [98] states that ideal group size is 4-8 people. Accordingly, the initial aim was a group size of 8-10 women but due to poor attendance rates (shown in Table 2) final groups ranged in size from 2-6 participants. The two groups with only two women in attendance were conducted despite the small group size, as suggested by Krueger [97]. Notably, a recent review of 220 focus group studies published in health science journals reported that the size of groups ranged from 1-20 [190]. Thus, the group sizes in the present study are within the range of published studies.

Importantly, despite relatively small group sizes, most groups still had a good level of interaction when compared with the larger groups (based on the author's personal evaluation after facilitating all discussions). Overall, greater interaction was noted in the groups of women with post-secondary education.

Table 2. Attendance at focus groups

	Post-secondary education							***Secondary education only***		
	Gravidity=1			**Gravidity>1**						
	FG1	**FG3**	**FG7**	**FG2**	**FG4**	**FG6**	**FG8**	**FG5**	**FG9**	**FG10**
Invited	8	13	10	10	10	9	7	11	6	5
Attended	2	5	6	5	3	5	3	4	3	2
Attendance rate	25%	38%	60%	50%	30%	56%	43%	36%	50%	40%
Number of pregnant women in attendance	1	2	1	2	1	2	1	1	0	1

Number of groups

In regards to the required number of focus groups, it is suggested that focus groups continue to be conducted until little new information is provided and at this stage 'saturation' of concepts is achieved [97]. Transcribing the discussions after each session allowed me to determine whether new information was being provided in subsequent groups (within each subgroup). Data saturation was achieved after three focus groups with women with post-secondary education and pregnant for the first time (first subgroup) and after four focus groups with women with post-secondary education and a subsequent pregnancy (second subgroup).

Due to difficulties with both recruitment and attendance of women with secondary education only (third subgroup), study methods were adjusted after the third focus group with this subgroup. To confirm that data saturation had been achieved in this subgroup, the focus groups were supplemented with two individual in-depth interviews conducted at the participants' homes. One interview was with a participant who had failed to attend two previous focus groups and the other was with a newly recruited participant. This change of data collection method from focus group discussion to individual interview reduced participant burden by eliminating the participant's need to travel to the Women's and Children's Hospital (WCH), and given that it was an individual interview, it was able to be conducted at a time that suited the participant.

3.1.2 *Recruitment*

Recruitment commenced in August 2011 and ended in September 2012. A screening form was developed (see Appendix 1) which was used to assess women's eligibility against the eligibility criteria. After determining eligibility and interest, the following details were recorded on the screening form: the participant's name, address, telephone number, recruitment method, gravidity, highest level of education and availability (suitable days/times for focus group attendance) . A number of recruitment methods were employed to maximise enrolment, and these are outlined below.

1. An information sheet regarding the study was provided to interested and eligible women who were participating in or being approached to participate in other Women's and Children's Health Research Institute studies involving pregnant women from the antenatal clinic or postpartum women from the post-natal ward.

2. Advertisements outlining the study purpose, participation requirements, eligibility criteria and contact number (see Appendix 2) were displayed in the WCH and GP Plus clinics around metropolitan Adelaide; and a short article was included in an e-newsletter emailed to all South Australian health clinicians.
3. Word of mouth. In particular, personal contacts of friends and colleagues.
4. In an effort to increase the recruitment of women with secondary education only, the author visited Para West Adult Campus (a senior secondary school for adults attended by students over 16 years of age who have been out of formal education for at least 6 months) and gave a brief talk to students enrolled in the 'Mums and Bubs' class. While four students initially expressed interest in participating and were provided information sheets, they changed their minds upon follow-up mostly due to lack of time and other commitments.

Recruitment methods (2) and (3) required potential participants to make initial contact by calling me. During this call, the author discussed the study, confirmed eligibility and answered any questions regarding the study. If the woman was eligible and still interested in participating, her postal (or email) address was obtained and she was sent an information sheet. Women recruited via method (1) by a researcher other than the author, had the same phone discussion with the author. Consequently, all women were given the opportunity to discuss the study and raise any questions prior to giving verbal consent.

After at least 10-12 women with the same availability, education level and gravidity (for women with post-secondary education) were recruited, a room was booked for the focus group. These women were contacted 2-3 weeks before the scheduled focus group to confirm their availability. Following this phone call, a confirmation letter with the date, time and location was posted. Also enclosed was a map of the hospital with directions to the room and a consent form which participants were asked to read and bring to the focus group. A reminder phone call was made to all participants 1-2 days before the focus group/interview and where phone contact was unsuccessful a text message reminder was sent the day before the session.

Of the 124 women who were eligible and received information about the focus group study, 40 consented and participated, 29 refused consent, and the remainder were not required as data saturation had been achieved.

3.1.3 ***Data collection***

Questioning route

A questioning route was developed to guide the discussions (see Appendix 3). This involved drafting a list of questions based on the study objectives and a review of the literature [71, 79, 97], and organising these questions under topics to be covered during each discussion. Following the questioning route ensured that all topics were covered in each discussion and that a clear and consistent order was followed across discussions [183]. This improved comparability across discussions and subgroups, and made it easier to determine at which point data saturation had been achieved.

A pilot focus group was conducted to pre-test the questioning route with ten clinical trials staff at the Women's and Children's Health Research Institute, who were either mothers or of childbearing age. Based on the feedback from this pilot, changes were made to the wording of some questions to improve clarity and brevity, and other questions were removed.

Additionally, a brief (one page) self-reported questionnaire was developed to collect information regarding dietary supplement use during preconception, pregnancy and lactation (see Appendix 4). Participants were asked to indicate which supplement(s) (if any) they took during each period from a list of products and were asked to name any products which were not listed.

Moderator

While a professional moderator is not essential for producing high quality data, the moderator does require specific skills to facilitate the discussion in such a way that will enable the researchers to learn the most about their topic from their selected sample [99]. Good moderators are comfortable and familiar with group processes, are interested in the topic and the participants, can communicate clearly and formulate easy to understand questions, have a good sense of timing and know when to move on to the next question or topic, are friendly and have a sense of humour, have a genuine and keen interest in people, are open to new ideas and are careful/good listeners [97, 99]. These qualities affect the nature of the group interaction and therefore the quality of the data. Below is an account of how the author achieved high quality moderating in this study.

Upon arrival at the session, the author greeted and introduced herself to each participant. She engaged in small talk in matters unrelated to the study in an effort to make the participants feel more comfortable and to create a warm and friendly environment. Participants were seated in a circle around a table and name cards (with first names only) were placed on the table in front of each participant to enable both the author and group members to see each other's names.

An open and permissive environment is critical to the success of focus groups and was developed in each session by introducing the group discussion in the following consistent manner (see Appendix 3) [97]. After welcoming the participants, a brief overview of the study and the topics to be discussed was provided, and ground rules were set. This included highlighting that there were no correct or incorrect answers to questions and encouraging participants to share differing points of view. This was followed by a group warmer activity which aimed to engage all participants and get them to speak at least once before asking further questions. The group warmer activity also acted to highlight to the participants that they all had something in common and each had something to contribute.

A conscious effort was made to listen to the participants, keep track of the conversations, keep silent and not share or interrupt with personal opinions, and to not cut people off. Short verbal responses such as ‘yes’ and ‘uh huh’ were used to acknowledge comments and to encourage additional responses. While an effort was made to avoid head nodding, which can be seen as a sign of approval, it was used occasionally to encourage additional responses from participants. Likewise, neutral non-verbal responses such as smiling and other facial expressions including rising of eyebrows were used to encourage participants to talk and to continue talking. Further information was also elicited from participants by pausing after participants made comments and probing when participants made vague comments that did not give enough detail.

As well, in groups where participants did not always readily volunteer information, individuals were called upon to respond, and there was more probing. Additionally, while participants were encouraged to share differing points of view at the beginning of the session, throughout the discussion participants were further prompted to share their different opinions and experiences through questions such as, ‘Does anyone have anything else to add?’, and, ‘Does anyone think differently?’.

To maintain the flow of the discussion, the questioning route was memorised and a printed list of the questions in front of the author served as a reminder of upcoming questions. While there was a relatively high level of moderator involvement, as indicated by the author following the questioning route to ensure all topics were covered in each discussion, a more flexible rather than rigid approach was taken to following the questioning route. This allowed for more open discussion, skipping of questions already covered, probing and exploration of new ideas not included in the questioning route [99].

Setting

All focus groups were conducted by the author between October 2011 and August 2012 in a meeting room at the WCH in Adelaide, South Australia. Focus group discussions with women with post-secondary education lasted between 60 and 90 minutes, and discussions with women without post-secondary education lasted between 60 and 73 minutes. The higher level of participant interaction noted in the groups with post-secondary education, contributes to the difference in discussion duration. Light refreshments including a fruit platter, biscuits, orange juice, water and tea were provided and participants received $15 cash at the end of the session as reimbursement for travel and parking expenses. A free crèche service (at the WCH) was offered to all focus group participants with children less than ten years of age to facilitate attendance at the session.

The two in-depth interviews were conducted by the author in September and October 2012. Both interviews occurred at the home of the participant and lasted between 40 to 90 minutes. Food and drinks were not provided and participants did not receive any payment.

Individual in-depth interviews

The main point of difference between the in-depth interviews and the focus group discussions was the setting (as described above). Additionally, while the questioning route remained unchanged, changes were made to the introduction to reflect the individual rather than group nature of the interview and the fact that the interview was being conducted in the participants home (see Appendix 3).

Recording of discussions

All discussions were recorded with a digital voice recorder (Olympus, WS-750M). Focus groups were also video recorded (JVC Everio S Camcorder) to facilitate contextualisation of the comments. The video recordings were viewed when it was difficult to discern which participant made which comment from the voice recording alone. This allowed comments to be linked to individual participants and in particular their education level, pregnancy status (pregnant/postpartum), gravidity and age.

Ethical considerations

Ethics approval was obtained from the Women's and Children's Health Network Human Research Ethics Committee. Before commencing the focus group discussions and individual interviews, informed written consent was obtained from all participants and they were assured of their confidentiality. Specifically, they were informed that names would not be attached to any comments included in any resulting reports or publications.

3.1.4 ***Data analysis and results***

NVivo 9.0 software was used to help transcribe and analyse the data. The author transcribed each discussion verbatim and carefully checked each resulting transcript for accuracy by simultaneously listening to the audio recording and reading the transcript. This was done to ensure that comments and their meanings were not changed. Each transcript took approximately 10 hours to prepare for data analysis.

The full range of responses obtained for each question was then collated into list form (see Appendix 5). These responses were used to inform the development of survey items in the following ways:

- Forming multiple choice options. For example, when asked about the recommended dose of folic acid and iodine supplementation in pregnancy, some women responded with number amounts, several said 'however much is in the supplement I'm taking', and others stated that they did not know. These responses formed the response options for the multiple choice questions about the recommended dosage of these nutrients.

- Aiding selection of attributes and levels for the DCE. For example, the following product characteristics were identified by women as important when choosing between supplement products and were considered for inclusion as product attributes and levels: brand (trusted/well-known brand vs. less well known), price, ingredients/nutrient content (specific nutrients, and single nutrient vs. multivitamin), nutrient levels, supply in package (e.g. three month supply), number of tablets/capsules per day (e.g. one per day vs. two or more per day as some women have trouble remembering to take supplements so easier to just take one per day), product form and size, information on label (more information regarding health benefits was preferred), and whether and by whom the product was recommended.
- Forming specific belief items used as indirect measures of theory of planned behaviour (TPB) constructs. For example, the following factors were reported as barriers to healthy eating during pregnancy:
    - Busy lifestyle (work commitments and/or caring for other children made it difficult for women to find the time needed to prepare healthy meals and/or eat regular meals and sometimes they believed it was easier to eat unhealthy but convenient foods)
    - Feeling stressed
    - Feeling tired (‘*not feeling like you want to cook at the end of the day’* made it harder for some women to prepare/eat healthy meals)
    - Not planning ahead (women generally found that eating a healthy diet during pregnancy required planning ahead and good time management skills)

These findings led to the inclusion of the following control belief items in the TPB questionnaire.

Q. For each item, please indicate <u>how often</u> the following occur DURING PREGNANCY: (Always – Never, 7-point scale)

- *Work or employment place considerable demands on my time*
- *Family duties and responsibilities place considerable demands on my time*
- *I feel stressed*
- *I feel tired*
- *Not planning ahead has an effect on what I eat*

Q. It would be MUCH MORE DIFFICULT to eat a healthy balanced diet during pregnancy if: (Strongly agree – Strongly disagree, 7-point scale)

- *Work or employment placing considerable demands on my time*
- *Family duties and responsibilities placing considerable demands on my time*
- *I felt stressed*
- *I felt tired*
- *I didn't plan ahead*

- Lastly, some responses were used as the basis of questions. For example, the following survey question was included after finding that some women increased use of iodised salt in pregnancy as they were aware that iodine was beneficial/should be increased in pregnancy: 'Do you add more salt to your food because it is iodised?' (yes/no)

Construction of the online survey

Survey questionnaires are a common method used to collect nutrition information from populations of interest. Online surveys are commonly used in consumer research as they are a convenient and effective way of reaching and collecting data from target audiences, provided there is internet access. Online surveys have previously been used to collect nutrition information from large national samples [45, 191, 192]. This has included the collection information about dietary supplement use and associations with socio-economic, lifestyle and dietary factors from pregnant women in France [45]; and perceptions regarding food, diet and health among Canadian consumers [192]. In the present study, an online survey allowed the research questions to be addressed with large samples of pregnant women, including a national sample.

The questionnaire developed for the current study was administered as a cross-sectional web based survey. It covered a range of topics relating to women's knowledge, attitudes and practices regarding nutrition and dietary supplements during preconception and pregnancy. The topics included nutrition knowledge and information sources (presented in Chapter 4); dietary practices and perceptions (Chapter 4); attitudes towards 'eating a healthy balanced diet during this pregnancy' (TPB questionnaire discussed in Chapter 5); supplement use (Chapter 4); preferences for dietary supplements (DCE discussed in Chapter 6); attitudes and practices around gestational weight gain (findings will not be presented as this is beyond the scope of this thesis); and socio-demographic and pregnancy-related variables (Chapter 3). Questions were asked in a range of formats including multiple-choice, table format (one or multiple answers per row), rating scale and ranking questions for closed-ended questions; and free-text questions using comment boxes, and numerical textboxes for open-ended questions. Image questions were also used in the supplement section of the survey, which allowed respondents to select one or more images from a list of supplement products.

3.1.5 *Socio-demographic, lifestyle and pregnancy-related variables*

Information on socio-demographic, lifestyle and pregnancy-related variables was collected to help characterise women and explore associations between participant characteristics and nutrition knowledge, attitudes and practices. This information included maternal age, educational attainment, area of residence (metropolitan vs. other), gross annual household income, household composition (number of adults and children living in household, and age categories of children), employment status, ethnicity, country of birth, country where spent most time prior to coming to Australia, and usual physical activity level prior to pregnancy (used to determine compliance with the national physical activity guidelines). Pregnancy-related questions included gestational age, gestational age upon learning of pregnancy, gravidity, parity, history of miscarriage, use of fertility treatments to assist conception, whether the pregnancy was planned, pre-pregnancy weight and height (used to calculate pre-pregnancy body mass index (BMI)), paternal age, and maternal smoking status and alcohol consumption during pregnancy. Respondents were also asked to indicate who their main healthcare provider (HCP) was during their current pregnancy.

3.1.6 *Piloting and programming the survey*

Prior to uploading the survey to the hosting site (Confirmit) several informal pilots were carried out with child-bearing aged, pregnant or previously pregnant women. The first version of the survey was piloted by 10 women in August-September 2012 (all worked in health/nutrition research). A second pilot was conducted in January-February 2013 with five women, three of whom were university educated (two worked in health/nutrition research) and two completed secondary education only. A third and final pilot was conducted in February 2013 with three women, one of who was pregnant, university educated and a psychologist. Changes were made to the wording and formatting of some of the questions based on feedback obtained from piloting to ensure all questions were unambiguous, and some questions were removed to shorten the survey.

This version of the survey was sent via email to The Centre for the Study of Choice (CenSoc) (now known as the 'Institute for Choice') which was contracted to program the survey and upload it to the online survey platform and hosting site, 'Confirmit'. In the process of programming, changes were made to the formatting of some questions to suit the online platform.

After the survey was programmed, it was piloted online with a national sample of 49 pregnant women. These women were recruited by Pureprofile, an online panel provider (www.pureprofile.com/au), and met the eligibility criteria described in section 3.1.7. Following this pilot, several questions were removed and some reformatted (e.g. asking respondents to rank three options instead of five) to reduce the length of the survey. Data from these 49 respondents were included in the final dataset.

Study sample

The survey was administered online to two separate cohorts of pregnant women who were recruited using different methods: a national cohort recruited using Pureprofile and a South Australian (SA) cohort recruited through the WCH. This section of the chapter describes the recruitment of the cohorts and the characteristics of participants. This is followed by a description of the statistical methods used to analyse the participant characteristics (section 3.1.8) which are then summarised and discussed in the results section (section 0).

3.1.7 *Participants and setting*

Women were eligible to complete the survey if they were currently pregnant, could understand English and were between 18-49 years of age, inclusive. Women who worked in the nutrition industry, in market research or in nutrition-related health research were excluded.

The national cohort was recruited using Pureprofile an online research panel provider. All women in the Pureprofile database who were aged 18-49 years and lived in Australia were invited to participate in the survey. Estimated completion time was 35 minutes and participants were paid $5.35 upon completion of the survey. Data were collected between June and August 2013.

The SA cohort was recruited through the Women's and Children's Hospital, a large public maternity hospital in Adelaide, and through word of mouth. I approached women in the waiting room of the antenatal clinic who were attending routine antenatal appointments (between Tuesday and Friday). Women were excluded if they had completed the same survey through Pureprofile. Study advertisements were also displayed in different areas of the Women's and Children's Hospital where they were likely to be seen by pregnant women. Eligible women who were interested in participating in the survey were emailed a URL (web address) to the survey. A reminder email was sent to women who did not complete the survey within two weeks of receiving the link. Participants were reimbursed $20 in the form of a digital gift card (sent via email) upon completion of the survey. Data were collected between July and November 2013.

No time limit was set for completing the survey once started. Women were able to return to the last point of entry in the survey using their unique web address. Ethics approval for the study was obtained from the University of Adelaide Human Research Ethics Committee, and the Women's and Children's Health Network Human Research Ethics Committee.

3.1.8 *Data analysis*

Data presented in this chapter were analysed using SPSS (version 20.0) and the level of significance was set at $P<0.05$. Descriptive statistics (including frequencies, means, standard deviations, medians and interquartile ranges) were calculated for all socio-demographic, lifestyle and pregnancy-related variables. The independent samples t-test was used to compare means for the normally distributed continuous variables, and the Mann-Whitney U-test was used to compare medians for not normally distributed continuous variables. Differences in categorical variables between the two cohorts were investigated using the Pearson chi-square test.

Results

The online survey was completed by 857 women in total. The final nation-wide cohort comprised 455 respondents. Completion rate was 57% (455/804) for this cohort.

The final SA cohort comprised 402 respondents. Over 60 days of recruitment, I approached 955 women in the antenatal clinic of the Women's and Children's Hospital. Of the women approached, 689 (72%) were interested in participating and received an email with a web address to the online survey. Completion rate was 55% (382/689) for the women recruited through the antenatal clinic. A further 42 women responded to poster advertisements or heard about the survey through word of mouth. Of these women, 20 (48%) completed the survey. Therefore, the overall completion rate for the SA cohort was 58% (402/689).

Socio-demographic characteristics

Socio-demographic characteristics of the total sample and each cohort are shown in Table 3, and the area of residence (Australian states and territories) of the national cohort is shown in Figure 2. There were significant differences between the two cohorts in regards to maternal age, area of residence, household income, student/employment status, number of children aged <18 years living in the household, being born in/outside of Australia, and for those born overseas, the number of years living in Australia. The national cohort had a smaller proportion of women with childless households (39% vs. 54%, P<0.001). Fewer women in the national cohort were also born overseas (21% vs. 29%, P=0.014) and for those born overseas, the median years living in Australia was significantly higher compared to women in the SA cohort (9 vs. 4.5 years, P=0.001). The country that women spent most of their time in before coming to Australia did not differ significantly between cohorts, with about half of the women born overseas spending most of their time in India or other Asian countries before coming to Australia.

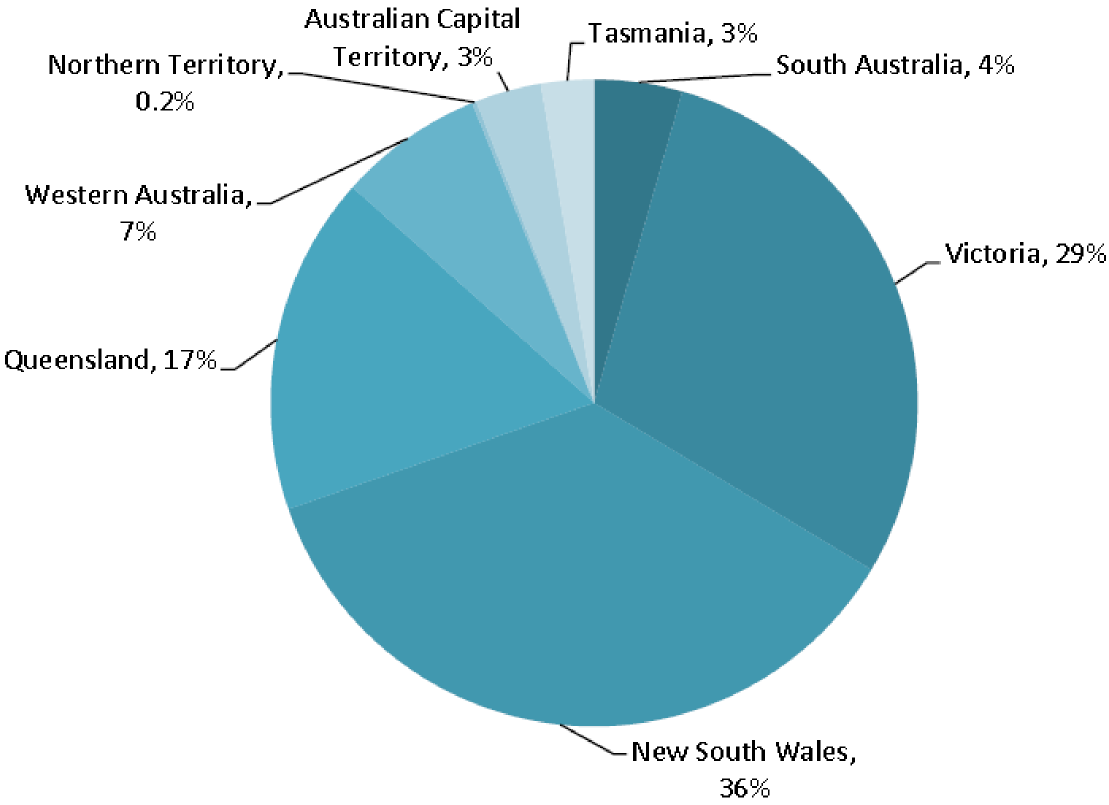
There were no significant differences between cohorts in terms of women's usual level of physical activity before pregnancy. The majority of women (61%) achieved at least 30 minutes of exercise on 1-4 days per week, and almost a third (31%) on five or more days per week. While 13% reported achieving at least 30 minutes of exercise every day of the week, 8% of the sample did not achieve this level of physical activity on any day of the week.

Table 3. Socio-demographic characteristics of participants[1]

	National cohort n=455	SA cohort n=402	Total n=857
Maternal age (years), mean ± SD (range)	31.6 ± 4.9 (18-46)	30.5 ± 5.1** (18-46)	31.1 ± 5.0 (18-46)
Living in metropolitan area	71.7	85.1***	77.9
Highest education level			
Secondary	21.1	17.4	19.4
Post-secondary but no tertiary	25.3	27.6	26.4
Tertiary	53.6	55.0	54.3
Gross household income			
≤$20,000	4.4	7.5	5.8
$20,001 - $40,000	8.4	14.7**	11.3
$40,001 - $70,000	22.6	23.6	23.1
$70,001 - $105,000	32.7	25.1**	29.2
≥$105,001	31.9	29.1	30.6
Employment status			
Employed	66.8	63.2	65.1
Unemployed student	3.1	6.5***	4.7
Employed and student	1.5	6.5***	3.9
Unemployed	28.6	23.9	26.4
Living with a partner	95.2	94.5	94.9
Born in Australia	78.7	71.1*	75.1
Ethnic background			
Oceanian (including Australian, NZ, Melanesian and Papuan, Polynesian)	52.1	46.3	49.4
North-west European	5.9	6.0	6.0
Southern and Eastern European	4.2	8.2	6.1
British/Irish	16.3	17.9	17.0
Asian	14.5	13.7	14.1
Other	7.1	7.9	7.4

*P<0.05, **P<0.01, *** P<0.0001 (for difference between national and SA cohort)
[1] Data are % unless otherwise indicated

Figure 2. Area of residence of national cohort (n=455)



Pregnancy-related variables

Pregnancy-related characteristics of the participants are shown in Table 4. There were no significant differences between cohorts, except in regards to gestational age, parity, use of fertility treatments, and main health care provider during this pregnancy. Compared to the SA cohort, a significantly higher proportion of women in the national cohort were in their first trimester (24% vs. 3%, P<0.001) and a lower proportion were in their second (35% vs. 47%, P<0.001) or third (42% vs. 50%, P<0.001) trimester. A greater proportion of women in the national cohort also used fertility treatments to assist their conception (11% vs. 7%, P=0.035). In both cohorts, the median gestational age at which women learnt of their pregnancy was 5 weeks. Overall, 21% of women were overweight (BMI 25-29.99kg/m^2) and 17% were obese (BMI ≥30kg/m^2) prior to pregnancy, with no significant differences found between cohorts.

Table 4. Pregnancy-related characteristics of participants[1]

	National cohort n=455	SA cohort n=402	Total n=857
Gestational age (weeks), median(IQR)[2]	22 (13.0-30.0)	25 (17.8-34.3)*	24 (16.0-32.0)
Nulliparous	36.9	58.0***	46.8
Planned pregnancy	76.3	72.4	74.4
History of miscarriage[3]	38.8	47.5	42.5
Pre-pregnancy BMI (kg/m^2), median (IQR)	23.6 (21.1-28.0)	23.1 (20.9-27.4)	23.4 (21.0-27.7)
Main health care provider during this pregnancy[4]			
GP	31.4	21.1***	26.6
Obstetrician	38.2	30.1***	34.4
Midwife	26.2	43.3***	34.2
None	4.2	5.5	4.8
Smoked during pregnancy	7.3	4.0	5.7
Consumed some alcohol during pregnancy	19.8	22.9	21.2

*P<0.05, *** P<0.0001 (for difference between national and SA cohort)
[1] Data are % unless otherwise indicated
[2] Gestational age at commencement of survey
[3] % calculated for multigravida women only (n=304 in national cohort and n=221 in SA cohort)
[4] Main health care provider defined as 'the health professional that you see most often for antenatal appointments'

National representativeness of study samples in terms of key socio-demographic and pregnancy-related variables

The overall study sample matched with all women giving birth in Australia in 2012 in terms of median maternal age (total sample: 31y; Australian Bureau of Statistics (ABS): 31y); the distribution of pregnant women in different age groups, with the greatest proportion of women aged 25-34 years (total sample: 65%; ABS: 60%); and the proportion of nulliparous women (total sample: 47%; ABS: 44%), though the parity data from the ABS excludes births registered in in Victoria, Queensland and Tasmania [193]. While women living in metropolitan areas were slightly over-represented (total sample: 78%; ABS: 70%) [193], women born overseas were slightly under-represented (total sample: 25%; ABS: 32%) [194].

Based on the 2013 ABS data for individuals aged 20-49 years in Australia, the study sample over-represented women with post-secondary education (total sample: 81%; ABS: 65%) and in particular those with tertiary education (total sample: 54%; ABS: 30%) [195, 196]. These statistics should however be interpreted with caution as they are based on the general Australian population, not specifically mothers (i.e. pregnant women or women with children). When compared with the ABS data collected from women with a child under the age of two years in 2011, the study sample also over-represented women in the two highest household income quintiles and under-represented women in the lowest income quintile. The proportion of the study sample in the remaining quintiles was within 10% of the ABS data [197, 198]. The study sample was, however, nationally representative in terms of employment during pregnancy with 68% of mothers in Australia with a child aged less than two in 2011 having a job during pregnancy, compared to the 69% of employed women in the study [199].

While the ABS does not collect data on whether women live with/without a partner, weight status, history of miscarriage or smoking during pregnancy, this data was available in the 2011 SA pregnancy outcomes report [200]. The study sample was fairly representative of married women or those in a de facto relationship (total sample: 95%; all women giving birth in SA in 2011: 90%), as well as overweight (total sample: 21%; SA in 2011: 27%) and obese (total sample: 17%; SA in 2011: 24%) women [193, 200]. The BMI data must however be interpreted with caution as pre-pregnancy weight and height were self-reported in the present study and the BMI data reported for SA women giving birth in 2011 was calculated based on height and weight at the first antenatal visit where gestational age was <20wks, and was only available for 75% of all women who gave birth in SA in 2011 [200]. Further, while the study sample over-represented women with a history of miscarriage (total: 43%; SA in 2011: 34%), it under-represented women who smoked during pregnancy (total sample: 6%; SA in 2011:

13%). Also over-represented in the study sample were women who planned their pregnancy (total sample: 74%; vs. an estimated 50% in Australia) [201].

While both cohorts were comparable to mothers nationally or in SA in terms of maternal age, employment status, living arrangements and pre-pregnancy weight status, compared to the SA cohort, the national cohort was more representative in terms of parity and area of residence. The national cohort was also fairly representative in terms of the relative distribution of births across Australian states and territories [193]. Overall, both cohorts over-represented women with higher education levels and higher household incomes, and under-represented low-income women, those without post-secondary education, who smoked during pregnancy, and who did not plan their pregnancy.

Healthier dietary intakes as well as a greater prevalence of supplement use and compliance with supplement recommendations, are more commonly found among women with higher education levels, higher incomes, those who planned their pregnancy and do not smoke [19, 35, 37, 40, 42, 45, 46, 48-54, 92]. Therefore, with the sample over-representing women with these characteristics it is likely that the study will over-estimate Australian pregnant women's true compliance with the dietary guidelines and supplement recommendations. This over-representation of these groups of women is likely due to the non-probability sampling and also self-selection bias, with those more interested in nutrition more likely to complete the survey.

Chapter 4: Nutritional intake, knowledge and information sources during pregnancy

Introduction

Nutrition guidelines for pregnancy

To help women achieve a nutritionally adequate diet during pregnancy, there are dietary guidelines that recommend the number of daily servings that should be consumed from each of the food groups. In Australia, the dietary guidelines recently underwent a review and were updated in February 2013 [2]. Table 5 shows the number of daily servings from each of the Five Food Groups that are recommended for pregnant women, compared to non-pregnant adult women. Pregnant women can meet the requirements of most nutrients by consuming a healthy balanced diet in line with the Five Food Group recommendations for pregnancy that are part of the Eat for Health Australian Dietary Guidelines [2]. Dietary intake alone may not, however, be sufficient to meet the increased requirements of folic acid and iodine. Women in Australia are therefore recommended to take folic acid and iodine supplements. A brief overview of the importance of and the recommendations for folic acid and iodine supplementation is provided below.

Table 5. Minimum recommended number of serves per day from the Five Food Groups for adult women and additional requirements for pregnant women. Adapted from [2]

Food group	Example serves	Women (19-50y)	Pregnant women (19-50y)
Grain (cereal) foods, mostly wholegrain and/or high cereal fibre varieties	▪ 1 slice bread ▪ ½ cup cooked rice, pasta, noodles, other grains ▪ ⅔ cup wheat cereal flakes	6	+ 2.5
Vegetables and legumes/beans	▪ ½ cup cooked green or orange vegetables ▪ 1 cup green leafy or raw salad vegetables ▪ ½ cup cooked dried or canned legumes/beans	5	No change
Fruit	▪ 1 medium piece (e.g. apple, banana) *Or only occasionally:* ▪ ½ cup fruit juice (no added sugar)	2	No change
Milk, yoghurt, cheese and/or their alternatives, mostly reduced fat	▪ 1 cup (250ml) milk ▪ 40g hard cheese, such as cheddar ▪ ¾ cup (200g) yoghurt	2.5	No change
Lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans	▪ 65g cooked lean red meats or 80g lean poultry ▪ 100g cooked fish fillet or one small can of fish ▪ 2 large eggs ▪ 1 cup (150g) cooked or canned legumes/beans	2.5	+ 1

Folic acid supplementation

Folic acid is a B vitamin that is essential for DNA synthesis and is therefore crucial for the normal growth and development of body cells, including red blood cells. Adequate folate status is especially important during periods of rapid growth such as embryonic and fetal development. In 1991 and 1992, two landmark studies provided conclusive evidence that supplementation with 400µg of folic acid in the periconceptional period reduces risk of neural tube defects (NTD) by up to 72% [9, 202]. Now there exists the almost universal recommendation that all women to take 400-500µg of folic acid daily in the one month prior to and in the first three months of pregnancy.

Iodine supplementation

Iodine is an essential micronutrient required for the production of thyroid hormones which are required during pregnancy for normal fetal growth and cognitive development [203]. Iodine deficiency leads to a spectrum of iodine deficiency disorders including goitre, hypothyroidism and impaired mental and physical development; with major fetal effects including abortions, still births, congenital abnormalities, increased perinatal and infant mortality and cretinism, in severe iodine deficiency [204]. Pregnant women and young children are at particular risk of iodine deficiency due to their increased iodine requirements [205, 206]. Thus, to improve iodine status of these at-risk groups, in January 2010, the National Health and Medical Research Council (NHMRC) in Australia started recommending that all women who are planning pregnancy, pregnant or breastfeeding take a daily supplement containing 150 µg of iodine [207].

Gaps in available literature

A review of the literature regarding folate knowledge among pregnant [208], recently pregnant [209, 210] and childbearing-aged women [71, 211-220] living in Australia revealed that while the majority of women may have previously heard of folic acid, their understanding of the importance of folic acid and the recommendations in regards to timing of supplementation and required dose for prevention of NTDs is often more limited [71, 208-220]. While many of the studies in childbearing aged women surveyed state or nationally representative samples, the most recent national data were collected in 1999, and SA data in 2005, and therefore are likely to be out-dated. Additionally, no previous national surveys have assessed folate knowledge among pregnant women.

Australian studies which assessed iodine knowledge among pregnant [18, 221, 222], breastfeeding [223], and non-pregnant women aged 20-55yrs [224, 225], have shown low awareness of iodine deficiency as a public health issue in Australia and the health effects of iodine deficiency, as well as poor knowledge regarding dietary sources of iodine. These studies, three of which were conducted after the introduction of the NHMRC's iodine supplement recommendation [18, 222, 223], all surveyed relatively small samples of women (n=20-200) in either New South Wales (NSW) or Victoria, limiting the generalisability of the findings to the wider population of pregnant or childbearing aged women in Australia. The present study therefore assesses for the first time iodine knowledge among a large national sample of pregnant women as well as a large sample of SA pregnant women.

Contemporary data regarding pregnant women's compliance with the current national food group recommendations is also lacking. The few pregnancy studies which report the number of servings consumed from at least one of the five core food groups (grain foods, vegetables, fruits, dairy/alternatives and meat/alternatives), were conducted in Australia [21-25, 226, 227], New Zealand [26], UK [13], and North America [27-30]. Only five studies reported the number of servings consumed from all food groups or the proportion of pregnant women meeting the recommendations [21, 26, 28, 30, 226], two of which were Australian studies [21, 226], with the remainder reporting fruit and vegetable servings only or in addition to servings of grains [27], or dairy [22, 25].These studies were conducted between 1995 and 2011. The most recent Australian data collection occurred in 2008, prior to the introduction of the new dietary guidelines. Further, rather than reporting overall compliance, this study only reported the proportion of women meeting recommendations for each food group within each socio-economic group (low, medium and high) [226]. Thus, the present study provides the first national and SA data on pregnant women's compliance with the Five Food Group recommendations for pregnancy in the current 2013 Australian Dietary Guidelines.

Further, while several studies have also assessed supplement use during preconception and pregnancy [15, 16, 18, 30, 35-45, 228], no Australian studies have assessed compliance with the iodine supplement recommendation in a national sample. The present study therefore also provides the first national and SA data regarding pregnant women's compliance with the two supplement recommendations and the maternal characteristics associated with compliance.

Given the two recent changes made to the dietary and supplement recommendations for pregnancy, these being an update of the food group recommendations in February 2013 and the introduction of the iodine supplement recommendation in January 2010, it is timely to collect contemporary data on nutritional knowledge, nutritional practices and the most influential and preferred sources of nutrition information during pregnancy. Furthermore, examining whether pregnant women make dietary changes, their reasons for not making dietary changes, and their perceptions regarding the healthiness of their dietary intake will provide a better understanding of women's dietary behaviour in pregnancy.

Aim and objectives

This chapter aims to increase understanding of pregnant women's nutritional knowledge and practise by addressing the following research questions:

1. How does dietary intake in pregnancy compare with the national dietary guidelines and do women make dietary changes specifically for pregnancy?
2. How does perceived diet quality compare to actual diet quality during pregnancy?
3. Are pregnant women aware of the current supplement recommendations in pregnancy, and are they able to identify dietary sources of folate and iodine?
4. How prevalent is supplement use in preconception and pregnancy, and what proportion of women comply with the folic acid and iodine supplement recommendations? What maternal characteristics are associated with adherence to supplement recommendations?
5. What are the most influential and preferred sources of pregnancy-related nutrition information?

Methods

Details of the study design and participants are provided in Chapter 3. Questionnaire items regarding nutrition knowledge and practice were based on the range of responses provided to questions asked in the focus group discussions (described in section 0), the 2013 Australian

Dietary Guidelines [2], Food Standards Australia New Zealand (FSANZ) mercury in fish and listeria guidelines [5, 6], NHMRC recommendations regarding folate and iodine supplementation [207, 229], established health benefits of selected nutrients and a review of the literature on potential pregnancy and/or early-childhood related health impacts of these nutrients [230-234]. A review of the literature also identified additional information sources not identified in the focus groups, which were included to provide a more comprehensive list of items for survey respondents to consider [54, 70, 235]. The questionnaire included eight questions regarding nutrition knowledge, four questions regarding nutrition information and sources of information, twelve questions regarding dietary intake during pregnancy, and twelve questions regarding supplement use.

Dietary intake: questions assessed whether deliberate changes were made to dietary intake specifically for pregnancy, number of daily servings consumed from each of the Five Food Groups (during an average week of pregnancy), use of iodised salt, and food avoidance. Information was also collected on women's perceptions of the healthiness of their dietary intake during pregnancy.

A brief six-item questionnaire was developed based on the Australian Dietary Guidelines Five Food Group system to assess women's average daily intake from each food group to allow comparison of actual intake during pregnancy to the recommended intake for pregnancy from each food group in the new Australian Dietary Guidelines. Women were required to indicate the estimated number of servings consumed from each of the five core food groups and from the 'discretionary choices' during an average week of their pregnancy. Examples of the amounts and types of foods equivalent to one serving from each food group were provided. For each food group, responses could be recorded as number of serves 'per day' or 'per week'. Average number of daily serves was calculated for each food group prior to data analysis.

To provide an indication of women's dietary quality during pregnancy, a dietary quality score was developed. Similar to existing and validated dietary quality scores (namely the Healthy Eating Index (HEI) [236] and Dietary Quality Index- Pregnancy (DQI-P) [27]), dietary quality scores in this study were calculated as the sum of a number of dietary components. In this case, components represent the Five Food Groups defined in the Australian Dietary Guidelines. A similar scoring method was also adapted to that used in the HEI and DQI-P, such that each of the dietary components were weighted equally and scores for each component were proportional to the number of recommended servings consumed. For each component, the maximum score of 10 was assigned if the recommended daily servings of that food group were met; a score of zero was assigned if no servings from that food group were consumed; and if, for example, the recommended intake from a food group was five serves per day, a score of four out of ten would be assigned to women consuming two serves per day. Considering the fruit group as another example, women consuming only one of the two recommended servings would receive a score of five out of ten for that component.

Supplementation: questions collected information on supplement use before and during pregnancy, and whether women were advised to take specific supplements in preconception/pregnancy and by whom. Women who reported taking supplements in the one month prior to pregnancy and/or during pregnancy were presented with a table containing images and names of 36 different supplement products including folic acid, pregnancy multivitamins and general nutrient supplements (the included products were identified in focus group discussions and observed in the current marketplace). Women were asked to select all the products they used, and to list any other products not shown in the table. If women selected products which contained iodine and/or folic acid, or if they listed any products in free-text form, additional information was collected on when women began and ceased supplementation, their frequency of use, and usual dosage to assess compliance with recommendations for iodine and folic acid supplementation.

Nutrition knowledge: questions assessed women's knowledge of the health benefits of selected nutrients, current supplement recommendations for preconception and pregnancy, and dietary sources of iodine and folate.

Nutrition information and information sources: questions asked whether women's main HCP during pregnancy provided nutrition information and for which nutrition related topics. Women were also asked to identify their most influential and preferred sources of pregnancy-related nutrition information (up to three options could be selected for these questions).

For further details regarding the questions asked, refer to Appendix 6.

Data analysis

Data presented in this chapter were analysed using SPSS (version 20.0) and the level of significance was set at $P<0.05$. Descriptive statistics (including frequencies, means, standard deviations, medians and interquartile ranges) were calculated for all variables outlined in this chapter. The independent samples t-test was used to compare means for the normally distributed continuous variables and the Mann-Whitney U-test was the non-parametric alternative. Differences in categorical variables between the two study samples were investigated using the Pearson chi-square test. Free text responses were either recoded into the appropriate predetermined categories or new categories were created for common responses which did not fit into existing categories.

To assess whether women were complying with national food group serving recommendations for pregnancy, average daily servings from each food group were compared with the number of servings recommended by the Australian Dietary Guidelines

[2]. The Kolmogorov-Smirnov statistic for the distribution of the dietary quality scores was significant indicating violation of the normality assumption. Therefore, the non-parametric Kruskal Wallis test was used to examine the differences in dietary quality scores between groups of women with different perceptions about the healthiness of their diet during pregnancy ('healthy', 'unhealthy', and 'neither healthy nor unhealthy'). Mann-Whitney U Tests were then used to determine whether there were significant differences in the median dietary quality scores of women who perceived their diet during pregnancy as healthy, and those who perceived it as unhealthy.

A sample size of 384 was required to detect a prevalence of 50%, based on 80% power and 5% precision. Smaller sample sizes were required to determine all other prevalence rates with the same precision with the same power.

Results

Participant characteristics are shown in Table 3 and Table 4. In the following sections, the results reported in the text are for the overall study sample, with key differences between cohorts highlighted.

Dietary intake and changes made for pregnancy

Overall, almost two thirds (63%) of the women surveyed reported making some changes to their usual pre-pregnancy diet specifically for pregnancy (excluding changes made due to morning sickness). Dietary changes were significantly more common among women in the SA cohort compared to the national cohort (73% vs. 54%) [χ^2 (1, n=857) = 32.58, P<0.001], and among nulliparous women compared to multiparous women (73% vs. 55%) [χ^2 (1, n=857) = 30.41, P<0.001]. Table 6 shows the reasons for not making dietary changes. Among those who did not make dietary changes, the main reason was believing their diet was already healthy and balanced (61%). A third also did not think they needed to make any changes, and there were also some women (less than one in ten) who thought diet change was too difficult or did not know what changes they should be making. Reasons for not making dietary changes did not differ significantly between cohorts.

Table 6. Reasons for not making dietary changes for pregnancy[1]

	National cohort (n=208)	SA cohort (n=108)	Total (n=316)
Too difficult	10.1	4.6	8.2
Diet was already healthy and balanced	59.1	64.8	61.1
I didn't think I needed to make any changes	34.6	29.6	32.9
I didn't know what changes I should be making	7.2	7.4	7.3
Other	3.4	2.8	3.2

*** P<0.001 (for difference between national and SA cohort)
[1] Data are %

Of the women who made changes to their diet, about half started making changes as soon as they found out they were pregnant. Nine out of ten women who started making dietary changes when already pregnant, started making changes in their first trimester. There were no significant differences between cohorts in regards to the timing of dietary changes.

Overall, women who planned their pregnancy were significantly more likely to make dietary changes than women who did not plan their pregnancy (66% vs. 55%; χ^2 (1, n=857) = 7.84, P=0.005). Forty percent of the women who planned their pregnancy and made dietary changes started making dietary changes as soon as they started planning; for the majority, this was either one to three months or more than three months prior to conception.

Compliance with the Five Food Group recommendations for pregnancy

Median daily serves consumed from each food group during an average week of pregnancy and the proportion of women not meeting the serving recommendations are reported in Table 7. While median servings from the ‘grain (cereal) foods’, ‘vegetables and legumes/beans’, ‘fruit’ and the ‘milk, yoghurt, cheese and/or alternatives’ groups did not differ significantly between cohorts, median serves from the meat group (national=1.0 (IQR 1.0 – 2.0) vs. SA=1 (0.7 – 2.0), P=0.010) and the discretionary foods group (national = 1.0 (IQR 0.6 – 2.0) vs. SA = 1 (0.4 – 1.6), P=0.001) were higher in the national cohort. Of the Five Food Groups, the greatest adherence was to the recommendations for the fruit and dairy groups, with 56% and 29% of the total sample meeting the minimum recommended serves for pregnancy, respectively. Less than 10% of women met the minimum recommendations for each of the other food groups. There were no significant differences in compliance rates between cohorts.

Overall, 37% of the pregnant women did not meet any of the Five Food Group serving recommendations for pregnancy, 35% met one, 21% met two, 6% met three and 1% met four and none of the women met all five recommendations. No significant differences were found between cohorts (P=0.359) or between nulli- and multiparous women (P=0.402).

Table 7. Median (IQR) daily servings from food groups during pregnancy[1]

	Total sample (n=857)	% Not meeting recommended daily serves	Recommended daily serves for pregnancy[1]
Grain (cereal) foods	4.00(2.00-6.00)	96.1	8.5
Vegetables and legumes/beans	2.00 (1.00-3.00)	90.5	5
Fruit	2.00 (1.00-2.00)	43.8	2
Milk, yoghurt, cheese and/or alternatives	2.00 (1.00-3.00)	71.3	2.5
Lean meat and poultry, fish, eggs, nuts and seeds, and legumes/beans	1.00 (1.00-2.00)	98.5	3.5
Discretionary foods	1.00 (0.50-2.00)	10.4	0-2.5

[1] Recommended by the Eat for Health Australian Dietary Guidelines [2]

Specific dietary changes and food choices

Table 8 compares women's intake of selected high listeria risk (HLR), allergenic and mercury-containing foods during pregnancy to their usual intake before pregnancy/before planning pregnancy. Over half of the women surveyed reported avoiding or eating less pre-prepared or pre-packaged salads (55%), soft cheeses (77%), processed meat (76%), raw or semi-cooked eggs (65%), and raw fish and seafood (57%). Additionally, almost one in five now avoided or ate less cooked eggs (18%). Further, while a quarter avoided or ate less cooked fish and seafood in pregnancy, slightly more reported specifically avoiding or eating less oily fish such as mackerel, herring, sardines, tuna and salmon (29%). Around half of the women also reported avoiding or drinking less caffeinated tea and coffee during pregnancy.

Significant differences between cohorts included fewer women in the national cohort, compared to the SA cohort, now avoiding pre-prepared or pre-packaged salads, raw or semi-cooked eggs, soft cheeses, processed meat, and raw fish and seafood; although a higher proportion in the national cohort reported reduced consumption of soft cheeses and raw fish and seafood. Additionally, while a third of women in the SA cohort reported reducing consumption of caffeinated tea and coffee during pregnancy, only a quarter of women in the national cohort reported doing so.

Compared to women in the SA cohort, a greater proportion of women in the national cohort reported not changing the amount of pre-prepared or pre-packaged salads, raw or semi-cooked eggs, soft cheeses, processed meat, raw fish and seafood, and caffeinated tea and coffee they consumed. A greater proportion of women in the national cohort also reported eating more pre-prepared or pre-packaged salads, raw or semi-cooked eggs, soft cheeses, processed meat, raw fish and seafood, and coffee during pregnancy than they would usually.

Table 8. Current intake of selected foods compared to usual intake before pregnancy and before planning pregnancy for total sample (n=857)[1]

	Consume more	No change	Consume less	Avoid now	Never consume	P-value for difference between cohorts
Pre-prepared or pre-packaged salads	6.3*	18.1*	13.9	40.8*	20.9	0.001
Eggs (cooked)	27.3	50.3	14.4	3.4	4.7	0.288
Eggs (raw or semi-cooked)	1.2*	8.6*	7.9	56.7*	25.6	0.001
Soft cheeses *(brie, camembert, ricotta, feta, blue-vein)*	2.0*	6.5*	7.8*	68.8*	13.7	<0.001
Processed meat *(cold meat/deli meat, ham, salami, luncheon meat, smoked meat, paté)*	2.3*	10.7*	19.8	56.6*	10.5	<0.001
Nuts	24.3	55.9	10.7	2.6	6.5	0.138
Oily fish (e.g. mackerel, herring, sardines, tuna, salmon)	14.8	24.3	21.7	6.8	18.2	0.408
***Cooked* fish and seafood**	17.4	43.5	19.5	5.0	14.6	0.111
***Raw* fish and seafood**	1.6*	5.5*	5.4*	51.6*	35.9	<0.001
Coffee *(excluding decaffeinated)*	1.9*	17.0*	28.5*	28.1	24.5	0.001
Tea *(excluding herbal tea)*	7.8	31.3*	28.9*	14.2	17.7	0.028

*Indicates where significant cohort differences are located.
[1]All data are %

Of the women surveyed, about half of those who consume milk and yogurt usually choose reduced-fat varieties (51% and 49%, respectively), while only a third of those who eat cheese, usually choose reduced-fat cheese (33%). More women who report eating bread choose high-fibre bread over white-bread (70% vs. 30%) while fewer women who consume soft drinks choose the diet varieties over regular soft drink (43% vs. 57%). No significant differences were found between cohorts.

Overall, approximately half of the women reported using iodised salt at home, either in cooking or at the table (added to meals) (51%); a third did not know if they were using iodised-salt (35%); and almost one in ten reported adding more salt to their food because the salt is iodised (8%). There were no significant differences between cohorts.

Dietary perceptions

Table 9 shows women's perceptions regarding the healthiness of their diet during pregnancy, and their change in level of concern about healthy eating as pregnancy progresses. Almost two thirds of the women surveyed believed their diet during this pregnancy had been healthy, and only one in ten believed their diet had been unhealthy. Significant positive associations were found between women's perceptions regarding the healthiness of their pregnancy diet and perceptions of how this compares to their usual pre-pregnancy diet, $\chi2(4, n=857)=164.78$, $P<0.001$. Women who believed their diet during pregnancy was healthier than their usual diet before pregnancy, were significantly more likely to perceive their diet during pregnancy as healthy (74% healthy vs. 18% unhealthy). Whereas women who believed their diet during pregnancy was less healthy than their usual diet, were significantly more likely to perceive their diet during pregnancy as unhealthy (43% unhealthy vs. 22% healthy).

Table 9. Women's perceptions regarding healthiness of diet during pregnancy[1]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Diet during this pregnancy has been:			
Unhealthy	11.2	10.2	10.7
Neither	32.5	24.1*	28.6
Healthy	56.3	65.7*	60.7
Current diet compared to usual pre-pregnancy diet			
Less healthy	11.0	9.2	10.1
More healthy	50.1	50.5	50.3
No change in healthiness	38.9	40.3	39.6
Level of concern about healthy eating as pregnancy has progressed			
Less concerned	11.6	5.0**	8.5
More concerned	49.9	51.5	50.6
No change (same level of concern)	38.5	43.5	40.8

*P<0.05, **P<0.01
[1]Data are %

Dietary quality scores differed significantly across the three groups of women with different perceptions about the healthiness of their diet during pregnancy (‘healthy’, ‘unhealthy’, ‘neither healthy nor unhealthy’) in the total sample [χ^2 (2) = 14.65, P=0.001] and in the national cohort [χ^2 (2) = 10.59, P=0.005] but not the SA cohort [χ^2 (2) = 5.20, P=0.074]. In the overall study sample, women who perceived their diet during pregnancy as healthy had significantly higher dietary quality scores (Median = 29.6) than women who perceived their diet as unhealthy (Median = 25.2) [U=20182, z=-2.39, p=0.017, r=0.10]. The same association was seen in the national cohort (Median=29.9 vs. 24.6; U=5218, z=-2.26, p=0.024, r=0.13]. However, despite reaching statistical significance, the actual difference between groups was small in both cases, with an effect size of 0.10 and 0.13.

In the overall study sample, perceived healthiness of diet was significantly associated with meeting the recommended serves of fruit [$\chi2$ (1, n=857) = 19.77, P<0.001, *Phi*=0.15] and dairy [$\chi2$ (1, n=857) = 3.88, P=0.049, *Phi*=0.07] (this association with dairy was not found in the SA cohort). Women who consumed the recommended daily serves from these food groups were more likely to perceive their diet as healthy. Despite reaching statistical significance, the association with fruit servings was weak, and with dairy servings negligible, as indicated by the *Phi* coefficients [237].

Supplement use

Table 10 shows the prevalence of supplement use before and during pregnancy. When asked about their usual pre-pregnancy use of nutritional and herbal supplements, 44% of the women surveyed reported using some nutritional and/or herbal supplements prior to pregnancy. Almost two thirds of women reported taking dietary supplements in the one month leading up to pregnancy. During pregnancy, supplement use increased to 93%, with a higher rate of supplement use reported in the SA cohort compared to the national cohort (97% vs. 90%, P<0.001). In both preconception and pregnancy, the majority of women were taking supplements containing folic acid and iodine. Overall, 63% of multigravida women took supplements in their last pregnancy, with this proportion not differing significantly between cohorts (61% in the national cohort vs. 64% in the SA cohort, P=0.504).

Table 10. Supplement use in the one month before pregnancy and during pregnancy, and usual pre-pregnancy intake of nutritional and herbal supplements[1]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Usual pre-pregnancy intake			
Vitamin/mineral supplements only	32.1	28.6	30.5
Herbal supplements only	4.4	2.0**	3.3
Both vitamins/minerals and herbs	12.1	7.7**	10.0
No vitamins/minerals or herbs	51.4	61.7**	56.2
One-month prior to pregnancy			
Any dietary supplements	67.0 (305/455)	61.2 (246/402)	64.3 (551/857)
Folic acid containing supplements	62.7 (281/448)	58.5 (235/402)	60.7 (516/850)
Iodine containing supplements	53.1 (238/448)	46.6 (187/401)	50.1 (425/849)
During pregnancy			
Any dietary supplements	89.5 (407/455)	96.8***(389/402)	92.9 (796/857)
Folic acid containing supplements	83.7 (379/453)	94.0*** (378/402)	88.5 (757/855)
Iodine containing supplements	75.3 (341/453)	86.3***(347/402)	80.5 (688/855)

**P<0.01, ***P<0.001
[1]Data are % (n)

Compliance with supplement recommendations

Overall, 38% of the women surveyed complied with the recommendation to take ≥400µg of folic acid daily at least one month preconception and 35% took at least 150µg of iodine daily before conception (no significant difference between cohorts, P=0.103 and P=0.806, respectively). Of those who planned their pregnancy, 47% were complying with the folic acid recommendation preconception (52% in SA cohort vs. 44% in national cohort, P=0.047) and 43% were supplementing with the recommended amount of iodine prior to conception (no significant difference between cohorts, P=0.699).

Overall, only 27% of women fully complied with the periconceptional folic acid supplement recommendation (≥400µg daily at least one month preconception and in the first trimester) (no significant difference between cohorts, P=0.154) and an additional 19% of women took ≥400µg daily in the first trimester, starting within five weeks of conception which was the median gestational age at which women learnt of their pregnancy (13% national cohort vs. 25% SA cohort, P<0.001). Only 23% of women complied with the recommendation to take a daily supplement containing 150µg of iodine during pregnancy and prior to pregnancy, with no significant differences between cohorts. Forty percent of women (45% in SA cohort vs. 35% in national cohort, P=0.007), however, were taking a daily 150µg iodine supplement during pregnancy and started supplementing prior to pregnancy or within 5 weeks of conceiving.

Personal recommendations regarding supplement use and sources of recommendations

Of the women who planned their pregnancy, 65% were directly recommended to take a nutritional supplement prior to conception. The majority of women were advised to take a supplement containing folic acid (84%) and about half were recommended to take a multivitamin. Iodine (40%), vitamin D (36%) and iron supplements (34%) were also recommended to over a third of women. These findings did not differ significantly between cohorts.

During pregnancy, 80% of women were directly recommended to take a nutritional supplement, and this proportion was significantly higher in the SA cohort compared to the national cohort (86% vs. 75%, P<0.001). Again, folic acid was the most commonly recommended supplement (72%), followed by multivitamins (54%). At least two in five women were recommended to take vitamin D (47%), iron (44%) and iodine (40%), with a greater proportion of women in the SA cohort compared to the national cohort being advised to take vitamin D (51% vs. 42%, P=0.015) and iodine (44% vs. 36%, P=0.034). Only a quarter of women were advised to take omega-3 fatty acid supplements, both when planning and during pregnancy.

GPs were the most common source recommending folic acid, iodine and multivitamin supplements both when planning pregnancy and during pregnancy (see Table 11). Obstetricians, family/friends and midwives were the next most common sources of these recommendations when planning pregnancy, and during pregnancy, midwives became more common sources of this advice than family/friends. Compared to the national cohort, a significantly higher proportion of women in the SA cohort reported being advised by family/friends to supplement with folic acid and multivitamins both when planning and during pregnancy. Women in the SA cohort also more commonly reported midwives as a source recommending folic acid (43% vs. 23%, P<0.001) and iodine (34% vs. 19%, P=0.005) supplements during pregnancy which is likely due to the significantly higher proportion of women in this cohort with a midwife as their main HCP (43% vs. 26%, P<0.001).

Table 11. Sources of folic acid, iodine and multivitamin recommendations (total sample)[1,2]

	When Planning Pregnancy			*During Pregnancy*		
	Folic acid N=348	**Iodine N=167**	**Multi-vitamin N=200**	**Folic acid N=496**	**Iodine N=275**	**Multi-vitamin N=369**
GP	73.0	64.7	67.0	76.2	69.1	30.0
Obstetrician	23.6	31.7	21.0	30.2	28.7	22.5
Midwife	20.7	15.0	19.0	33.3***	27.3**	27.6*
Nurse	4.3	4.8	1.0	3.4	3.6	2.7
Pharmacist	8.0	9.0	11.0	6.9*	6.9	6.8
Naturopath	4.6	4.2	7.0	3.2	2.2	3.3
Dietitian/nutritionist	2.3	2.4	2.0	2.2	2.9	1.6
Family/friends	24.1	14.4	31.5	19.4***	13.8	25.7**
Other	4.0	3.6	2.5	2.4	1.8	1.4

*P<0.05, **P<0.01, ***P<0.001 (for difference between national and SA cohort)
[1] Data are %, based on women who were recommended to take each respective nutrient/supplement.
[2] More than one source could be selected.

Associations between supplement use and dietary quality

Dietary quality scores were higher among women who took dietary supplements during pregnancy (Median=28.9) than for women who did not take any dietary supplements (Median=23.2), U=17828.5, P=0.001, r=0.12. Likewise, women who complied with the periconceptional folic acid supplement recommendation had significantly higher dietary quality scores (Median=30.6) than non-compliant women (Median=27.5) [U=59992.0, P=0.001, r=0.12], and women who complied with the iodine supplement recommendation also had significantly higher dietary quality scores (Median=29.7) than non-compliers (Median=27.6) [U=77158.5, P=0.004, r=0.10]. The same associations were found in both cohorts, with the only exception being a non-significant association between dietary quality and compliance with iodine supplementation in the SA cohort.

Associations between supplement use and participant characteristics

Associations between dietary supplement use in pregnancy including compliance with folic acid and iodine supplement recommendations varied between cohorts and are shown in Appendix 7. Overall, despite reaching statistical significance, the majority of the observed associations were weak. In the overall sample, women with higher household incomes were significantly more likely to be taking dietary supplements during pregnancy and complying with the folic acid and iodine supplement recommendations. While supplement use was also significantly more likely among women with tertiary education and less likely among women with secondary-education only, no significant associations were found between educational attainment and compliance with supplement recommendations. Women who planned their pregnancy were, however, more likely to comply with the folic acid and iodine supplement recommendations.

Additionally, use of dietary supplements during pregnancy as well as compliance with the folic acid recommendation was significantly more likely among women with an obstetrician or midwife as their main HCP and less likely among women with a GP as their main HCP. Supplement use and compliance with iodine supplementation was also more likely among nulliparous women, women living with a partner, and women who received information about iodine and folate, respectively, from their main HCP; the strength of this last association, however, was negligible.

Lastly, women who complied with the periconceptional folic acid supplement recommendation were, on average, 1.1 years older than non-compliant women (95% CI for mean difference: 0.4-1.8; P=0.002) [Cohen's d = 0.23, small effect size]. There were no significant differences in age of supplement users vs. non-users or women complying with the iodine recommendation vs. those not complying.

Nutrition knowledge

Knowledge regarding nutrient benefits

Table 12 shows women's awareness of health benefits associated with iodine, folic acid, vitamin D and omega-3 fatty acids. Three quarters of the women surveyed were aware that folic acid prevents neural tube defects and almost half were aware that iodine is important for baby's brain development. While just over half of the women believed that omega-3 fatty acids are important for baby's brain development, only one in ten believed they play a role in lowering risk of premature birth and childhood allergy.

Table 12. Knowledge of health benefits associated with selected nutrients[1]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Iodine			
Important for baby's brain development	42.2	53.0	44.5
Folic acid			
Prevents neural tube defects such as spina bifida	68.8	81.3***	74.7
Important for baby's brain development	34.1	24.4**	29.5
Vitamin D			
Strengthens baby's bones	53.0	63.4**	57.9
Omega-3 Fatty Acids			
Important for baby's brain development	57.4	55.5	56.5
Lowers risk of premature birth	10.3	4.7**	7.7
Lowers risk of childhood allergy	11.9	8.2	10.2

**P<0.01, *** P<0.001 (for difference between national and SA cohort)
[1] Data are %
[2] Women could select more than one option/health benefit for each nutrient

Knowledge regarding supplement recommendations

Table 13 shows women's knowledge of supplement recommendations for preconception and pregnancy. While almost all women believed folic acid supplements are recommended in preconception and during pregnancy, fewer women were aware of recommendations for iodine supplementation. Just over half of women believed iodine supplementation is recommended in preconception and more than two thirds believing it is recommended during pregnancy.

Furthermore, while 40-59% of women incorrectly believed that omega-3 fatty acid, vitamin D, iron and calcium supplements are recommended in preconception, this increased to 55-77% in pregnancy. Notably, while there were no significant differences between cohorts in the proportion of women believing folic acid and iodine supplements are recommended when planning pregnancy, a significantly greater proportion of women in the national cohort believed each of the other nutrients were recommended. The same pattern was not seen with knowledge of supplement recommendations for pregnancy.

Table 13. Proportion of participants who believe health authorities recommend all women take supplements containing the listed nutrients in preconception and pregnancy (%)

	Preconception/when planning pregnancy			*During pregnancy*		
	National cohort (n=455)	**SA cohort (n=402)**	**Total (n=857)**	**National cohort (n=455)**	**SA cohort (n=402)**	**Total (n=857)**
Folate	89.7	93.8	91.6	90.8	96.8**	93.6
Iodine	57.1	55.2	56.2	66.2	71.9	68.8
Omega-3 fatty acids	46.6	34.3**	40.1	58.7	51.0*	55.1
Vitamin D	54.7	44.0**	49.7	66.6	65.9	66.3
Iron	64.4	52.5**	58.8	76.5	76.6*	76.6
Calcium	58	43.8***	51.3	72.5	69.4	71.1

*P<0.05, **P<0.01, *** P<0.001

Women's knowledge regarding the folic acid and iodine supplement recommendations is shown in Table 14 and Table 15, respectively. Of the women who indicated that supplementation is recommended for all women in preconception and/or pregnancy, over three quarters were aware that folic acid helps in the prevention of NTDs and just over half were aware that iodine plays an important role in baby's brain development. A third knew the recommended daily dose of folic acid and only one in ten knew the recommended daily dose of iodine; and for folic acid, about one in ten correctly identified the recommended duration.

While greater awareness of the importance and recommended dosage of folic acid supplementation was found in the SA cohort, there were no significant differences between cohorts in awareness of the importance and recommended dose of iodine supplementation. Overall, 25% of women reported that the recommended dose of folic acid is 'However much is in the supplement I am taking', and 30% gave the same response when asked about the recommended dose of iodine.

Table 14. Knowledge regarding the benefit of folic acid and recommended dose and timing of supplementation among women reporting that folic acid is recommended in preconception and/or pregnancy[1]

	National cohort (n=424)	SA cohort (n=393)	Total (n=817)
Aware folic acid 'prevents neural tube defects such as spina bifida'	72.9	83.0**	77.7
Recommended daily dose			
400 or 500µg	29.5	36.6***	32.9
'However much is in the supplement I am taking'	22.2	27.0***	24.5
'I don't know' or incorrect amount	48.3	36.4***	42.6
Recommended duration			
At least 3 months before conception and the first 3 months of pregnancy	40.8	31.3***	36.2
At least 1 month before conception and the first 3 months of pregnancy	9.4	13.0	11.1
At least 1 month before conception and throughout pregnancy	8.5	11.9***	10.3
At least 3 months before conception and throughout pregnancy	33.3	38.6***	36.2
During pregnancy only	2.8	0.8***	1.8
'I don't know'	5.2	3.3***	4.3

**P<0.01, *** P<0.001 (for difference between national and SA cohort)
[1]Data are %

Table 15. Knowledge regarding the benefits of iodine and the recommended supplement dose among women reporting that iodine supplementation is recommended in preconception and/or pregnancy[1]

	National cohort (n=312)	SA cohort (299)	Total (n=611)
Aware iodine is 'Important for baby's brain development'	50.6	56.5	53.5
Recommended daily dose			
150µg	10.6	8.7	9.7
'However much is in the supplement I am taking'	26.9	32.8	29.8
'I don't know' or incorrect response	62.5	58.5	60.6

[1] Data are %

Associations between participant characteristics and knowledge regarding folic acid and iodine supplement recommendations

Associations between participant characteristics and knowledge regarding the recommendation for periconceptional folic acid supplementation and iodine supplementation are shown in Appendix 8 and Appendix 9, respectively. Despite reaching statistical significance, the strength of the associations ranged from negligible to moderate, with the majority being classified as weak [237]. Both awareness that supplementation with folic acid is recommended in preconception and pregnancy and that it plays a role in the prevention of NTDs was more likely among older women [mean difference: 2.0y (95% CI: 0.6-3.4) and 1.9y (95% CI: 1.1-2.7), respectively], women in the highest income quintile, and those who received information about folic acid from their main HCP; and was less likely among women who were in the lowest income quintile, and had a GP as their main HCP. Additionally, awareness of the link between folic acid and prevention of NTDs was more likely among women who were born in Australia, lived with a partner, had planned their pregnancy, and had an obstetrician as their main HCP. In the SA cohort alone, awareness of the folic acid and NTD link was also more likely among women who completed post-secondary education.

Overall, women who were aware that supplementation with iodine is recommended in both preconception and pregnancy were more likely to have received information about iodine from their main HCP, and to have an obstetrician as their main HCP. Additionally, women in the national cohort were more likely to be aware of the recommendations if they were nulliparous and if they planned their pregnancy, and those in the SA cohort were more likely to be aware if they were overweight or obese. Women who knew that iodine is important for the baby's brain development were on average one year older (95% CI for mean difference: 0.3-1.6, P=0.005) and were more likely to have completed post-graduate tertiary education, be in the highest household income quintile, planned their pregnancy, and received information about iodine from the main HCP. A statistically significant but negligible association was also found between awareness of the importance of iodine and living with a partner.

Awareness of the correct periconceptional timing of folic acid supplementation and the recommended daily dose of folic acid was more likely among women who completed post-graduate tertiary education, those with household incomes in the highest quintile, who planned their pregnancy, and those who received information about folic acid from their main HCP; and was less likely among those who did not complete any post-secondary education and with incomes in the lowest quintile. Additionally, in the total sample, significantly more women than expected who knew the recommended dose of folic acid had an obstetrician as their main HCP. Mean age of women with and without knowledge of the correct dose and duration of periconceptional folic acid supplementation did not differ significantly.

While no significant associations were found between knowledge of the recommended dose of iodine supplementation and participant characteristics in the total sample, significant positive associations were found with receiving iodine information from main HCPs in the national cohort, and with being nulliparous in the SA cohort.

Knowledge regarding dietary sources of folate and iodine

Folate sources

Dietary sources of folate identified by participants are shown in Table 16. Overall, 43% of pregnant women were unable to identify any good dietary sources of folate (either answering they 'didn't know' or listing incorrect sources) and almost a third were able to identify more than one good source. Awareness of folate sources was significantly lower among women in the national cohort, compared to the SA cohort.

Green leafy vegetables were the most commonly identified source of folate, and they were the only source of folate identified by one in five women. Breakfast cereals and bread were each identified by 10% and 8% of the total sample, respectively. This was followed by nuts, citrus fruits and yeast extract spreads, each identified by about 5% of women. Other good sources collectively identified by 11% of women included avocados, eggs, bananas, strawberries, sunflower seeds and kiwi fruit. Significantly more women in the SA cohort identified green leafy vegetables and legumes as a good source of folate.

Just over one in ten women incorrectly identified at least one food as a good source of folate. Of these women, 30% listed 'vegetables' or 'fruit' in general, and 22% listed a specific type of vegetable or fruit which is relatively low in folate and not considered a good source of folate. Nine percent also incorrectly identified meat as a good source of folate. There were no significant differences between cohorts.

Table 16. Dietary sources of folate identified by participants (unprompted responses)[1]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Green leafy vegetables (in general or specific examples)	36.0	56.0**	45.4
Bread	6.6	10.0	8.2
Cereals/breakfast cereals	8.8	12.2	10.4
Oranges/citrus fruit/orange juice	4.6	6.5	5.5
Liver	0.9	2.5	1.6
Nuts[2]	4.2	9.0	6.4
Legumes (beans, lentils, peas)	7.3	17.4**	12.0
Vegemite/marmite/yeast extract	4.2	6.0	5.0
Other good source(s)	7.9	13.9	10.7
Range of sources identified			
Green leafy vegetables only	18.5	20.6	19.5
More than one good source	21.8	38.3**	29.5
≥1 incorrect source(s)	10.8	16.2	13.3
None or incorrect source(s) only	51.6	34.1***	43.4

**P<0.01, *** P<0.001 (for difference between national and SA cohort)
[1]Data are %
[2]Peanuts were the most commonly listed nut (n= 26/55)

Iodine sources

Dietary sources of iodine identified by participants are shown in Table 17. Overall, 54% of pregnant women were unable to identify any good dietary sources of iodine (either answering they 'didn't know' or listing incorrect sources) and only 23% were able to identify more than one good source. As was the case with folate, awareness of iodine sources was significantly lower among women in the national cohort, compared to the SA cohort.

Fish and seafood were the most commonly identified sources of iodine, identified by almost a quarter of the total sample. While there were no significant differences between cohorts in the proportion of women identifying fish/seafood, seaweed and eggs as sources of iodine, a significantly higher proportion of women in the SA cohort identified dairy products and bread as good sources. Compared to the other dietary sources, relatively few women overall identified bread as a good source of iodine.

Overall, 11% of the total sample identified iodised salt as a good source of iodine and a further 11% identified 'salt' but did not specify whether it was iodised. There were no significant differences between cohorts.

About one in five women listed at least one incorrect source of iodine. Of these women, about two thirds incorrectly identified vegetables as a good source, and 14% incorrectly identified meat. Compared with the national cohort, significantly more women in the SA cohort incorrectly identified fruit as a good source of iodine (33% vs. 18%, P=0.013).

Table 17. Dietary sources of iodine identified by participants (unprompted responses)[1]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Fish and seafood	20.0	25.6	22.6
Seaweed	9.0	12.7	10.7
Bread	4.6	10.9*	7.6
Dairy	9.2	20.9***	14.7
Eggs	8.1	14.9	11.3
Iodised salt	8.8	13.7	11.1
Other source(s)	0.4	1.5	0.9
Incorrect source(s)	17.6	25.6	21.4
Range of sources identified			
Iodised salt only	2.4	3.7	3.0
Salt only ('iodised' salt not specified)	5.5	3.7	4.7
More than one good source	15.8	30.1***	22.5
Identified both good and poor sources	11.2	20.6*	15.6
≥1 incorrect source(s)	17.6	25.6	21.4
None or incorrect source(s) only	61.3	45.3***	53.8

*P<0.05, *** P<0.001 (for difference between national and SA cohort).

[1] Data are %

Associations between participant characteristics and ability to identify dietary sources of folate and iodine

Appendix 10 shows the associations between participant characteristics and knowledge regarding dietary sources of folate and iodine. While statistically significant, the majority of the associations were weak. For both folate and iodine, women who were not able to identify any good dietary sources were more likely to be older [mean difference: 0.9y (95% CI: 0.2-1.6) and 0.7y (95% CI: 0.03-1.4), respectively], to have lower education levels (no post-secondary education for folate and no tertiary education for iodine), lower household incomes, be living without a partner, be overweight or obese prior to pregnancy and were more likely to have given birth previously. Women who received some information about folic acid or iodine from their main HCP were more likely to be able to identify at least one good source of the respective nutrient. Additionally, women with unplanned pregnancies were also less likely to know any dietary sources of folate, and women born in Australia were less likely to identify iodine sources.

Nutrition information received during pregnancy and the most influential and preferred information sources

Just over two thirds of the women surveyed (69%, 565/816) reported receiving some information about nutrition from their main HCP, and this proportion did not differ significantly between cohorts (67% in the national cohort vs. 72% in the SA cohort; χ^2 (1, n=816) = 2.26, P=0.133). Overall, the most common topics women received information about were folate (62%), dietary intake/nutrition for pregnancy (54%), listeria/food safety (54%), and dietary supplements (47%) (see Table 18). Compared to the national cohort, a significantly higher proportion of women in the SA cohort received information about dietary intake/nutrition for pregnancy, listeria/food safety, dietary supplements, and vitamin D.

Table 18. Nutrition related topics women received information about from their main healthcare provider[1,2]

	National cohort (n=292)	SA cohort (n=273)	Total (n=565)
Iron	38.4	41.8	0.4
Folate	60.3	64.1	62.1
Calcium	35.6	35.5	35.6
Iodine	28.8	34.8	31.7
Vitamin D	37.7	47.3*	42.3
Omega-3 fatty acids (e.g. fish oil)	20.9	17.9	19.5
Dietary intake/nutrition for pregnancy	47.6	61.2**	54.1
Weight gain during pregnancy	33.6	32.6	33.1
Listeria/food safety	49.7	58.6*	54.0
Mercury	16.4	19.8	18.1
Dietary supplements/multivitamins	41.8	53.5**	47.4
None of the above	1.7	1.8	1.8

*P<0.05, **P<0.01 (for difference between national and SA cohort)
[1] Data are %
[2] Data shown are for women who reported having a main HCP during this pregnancy and reported receiving nutrition information from their main HCP

For the sample overall, the most influential sources of nutrition information during pregnancy were the GP (51%), midwife (46%) and obstetrician (36%). These sources were ranked by women as one of their top three most influential sources, and were followed by family/friends (26%), common-sense (24%), internet sites other than Government/hospital health websites (18%), and own previous experience (17%). Compared to the SA cohort, women in the national cohort were significantly more likely to consider GPs (56% vs. 44%, P=0.001), obstetricians (43% vs. 28%, P<0.001) and nurses (5% vs. 2%, P=0.012) as their most influential sources of nutrition information during pregnancy. Whereas women in the SA cohort were more likely to consider the following sources as influential: government/hospital health websites (15% vs. 9%, P=0.003), other websites (21% vs. 15%, P=0.018), booklets/pamphlets from the hospital or GP (18% vs. 8%, P<0.001), and antenatal classes (8% vs. 4%, P=0.007).

Significant differences were also found between nulli- and multiparous women. While multiparous women were significantly more likely to rank their own previous experience (27% vs. 4%, P<0.001) and women's or family health centres (4% vs. 1%, P=0.010) as one of their top three most influential sources of nutrition information during pregnancy, nulliparous women were more likely to consider their GP (55% vs. 47%, P=0.017), family/friends (30% vs. 22%, P=0.006), internet sites other than government/hospital health websites (23% vs. 13%, P<0.001], books (13% vs. 6%, P=0.001), antenatal classes (9% vs. 3%, P<0.001), and mobile phone applications (3% vs. 0.4%, P=0.005) as influential.

Overall, the most preferred methods of receiving new pregnancy related nutrition information were via a booklet or pamphlet received during an appointment with the main HCP (53%), or verbally during an appointment with the main HCP (53%). This was followed by the internet (31%) and via a booklet or pamphlet received in the mail (24%). While women in the SA cohort were significantly more likely to prefer to receive new information verbally during an appointment with their main HCP (58% vs. 49%, P=0.006), women in the national cohort had a greater preference for receiving new information via a booklet/pamphlet received in the mail (27% vs. 21%, P=0.041) or available at the chemist (9% vs. 3%, P<0.001). Additionally, compared to women who had given birth previously, nulliparous women were significantly more likely to prefer to receive new information via the internet (35% vs. 27%, P=0.009) . No other significant associations were identified between parity and preferred methods of receiving new pregnancy-related nutrition information.

Discussion

This study provides the first national and South Australian data regarding pregnant women's compliance with the new Five Food Group serving recommendations for pregnancy. Overall, poor compliance with the recommendations was revealed. Compliance was found to be highest with recommendations for daily fruit intake, with median intake being two serves per day and 56% of pregnant women complying with recommended two daily servings. This is consistent with findings from other Australian studies conducted prior to the introduction of the new Australian Dietary Guidelines [21, 22, 24, 25] and a large US study [27] in which mean and median intakes of fruit ranged from 2-2.2 serves per day during pregnancy; and also a recent New Zealand study among 5664 pregnant women, which found that 86% of women were consuming the recommended ≥2 daily servings of fruit [26]. Thus, while the minimum two serves of fruit per day appears to be more achievable than the four serves recommended in the previous Australian Dietary Guidelines, almost half of pregnant women still do not consume the recommended daily amount of fruit.

After the fruit group, pregnant women complied most with recommendations for the 'milk, yoghurt, cheese and/or alternatives' group. Fifty percent of the women surveyed consumed at least two serves per day and almost 30% met the recommended two and a half daily servings. These findings are also consistent with previous studies among pregnant women, including studies in Australia which reported mean and median daily dairy intake of around two serves [21, 22, 24]; the large New Zealand study which reported a compliance rate of 58% [26]; and smaller studies in the USA and Canada where mean intakes were 2.8-3 serves per day [28, 30]. Furthermore, these studies also showed women's compliance with dairy recommendations to be higher than for most other food groups in pregnancy.

Compliance with the remaining three food groups was much lower, suggesting that pregnant women struggle most to consume the recommended servings from the 'vegetables and legumes/beans', 'grain (cereal) foods' and 'lean meat and poultry, fish, eggs, nuts and seed, and legumes/beans' groups. It is worrying that 50% of women were consuming less than half of the five recommended daily servings of vegetables, and only one in ten pregnant women met the recommendation. These findings are comparable with previous Australian studies in pregnant women which consistently reported mean and median vegetable intakes of around two serves per day [21, 22, 24, 25], and strikingly low compliance rates of 3-11% [21, 22, 24, 227]. Relatively low vegetable consumption was also reported among pregnant women in New Zealand [26] and the USA [27, 28], despite the minimum recommendation being only four and three daily servings, respectively, rather than five as in Australia

Similar to the vegetables group, 50% of women consumed less than half of the recommended daily servings of grain foods, and only 4% consumed the recommended eight and a half daily servings. Again, this strikingly low compliance with the recommendations during pregnancy is consistent with previous studies in Australia [21] and the US [27-29]. Only 4% of pregnant women participating in the Australian Longitudinal Study on Women's Health (ALSWH) were meeting the minimum recommended servings of grain foods [21], and even fewer pregnant women (1.2%) in a large US study of low-middle income women were complying with the US recommendations [27].

The poorest compliance was with recommendations for the 'lean meat and poultry, fish, eggs, nuts and seed, and legumes/beans' group. Half of the study sample consumed between one and two daily servings from this group, and only 1.5% consumed the recommended 3.5 daily servings during pregnancy. This again is comparable to findings from the ALSWH which found that 50% of pregnant women were consuming one and a half daily servings from this food group, which was the recommended amount at the time of the study [21]. Moreover, 50% of the pregnant women in the ALSWH consumed between 1.1 and 2 daily servings, almost identical to the findings of the present study. In contrast, higher mean intakes of 2.1-3.0 servings have been reported in considerably smaller studies (n=52-149) from the USA and Canada [28-30]. Overall, the low compliance reported in the present study compared to that reported in the ALSWH is likely due to the increase in recommended daily servings from one and a half to three and a half. It is possible that women may not be aware of the increased requirements from this food group during pregnancy, or they may not know how to achieve this additional intake. Whether the low compliance is due to lack of knowledge of requirements or difficulty in meeting additional requirements requires further investigation.

Overall, 90% of the women surveyed complied with recommended daily servings of 'discretionary choices'[2]. This figure towers above the 15% of pregnant women reported to be complying with the recommendation for daily servings of 'extras' foods in the ALSWH [21]. The high level of compliance reported in the present study is likely due to an under-reporting of these discretionary/extras foods. In particular, women may not have been counting foods such as pizza, hamburgers or any additional discretionary/extra foods which were not listed as specific examples in the survey (see Appendix 6). A more comprehensive list of such foods may be required to adequately capture this information in the brief 6-item FFQ.

In general, the findings of this study, which are largely consistent with previous research conducted prior to the introduction of the new Australian Dietary Guidelines in 2013, suggest a need to improve compliance with the recommendations for all Five Food Groups in pregnancy. With the poorest compliance being seen with the recommended servings of meat/alternatives, grain foods and vegetables, these food groups warrant particular attention in healthy eating interventions targeting pregnant women. It was interesting that despite the study sample over-representing women with higher educational attainment, higher household incomes, who planned their pregnancy and did not smoke (factors generally associated with healthier dietary intake), overall compliance with food group recommendations was still poor. Thus, intervention strategies should not be restricted to these socio-demographic subgroups.

The finding that almost two thirds of women believed their diet was healthy during pregnancy yet the majority did not consume the recommended daily servings of the Five

Food Groups, is worrying. It is especially concerning in light of the finding that the main reason for not making dietary changes specifically for pregnancy was the belief that dietary intake was already healthy. The same belief regarding dietary adequacy was found to be a major barrier to nutrition education in a large European study, in which 70% of participants believed their diet was healthy [238].

Overall, this analysis revealed that stronger perceived healthiness of diet was positively but weakly associated with dietary quality scores and compliance with the daily serving recommendations for two of the Five Food Groups (fruit and dairy). This indicates that pregnant women were not able to accurately judge the healthiness of their diet, suggesting a strong need improve women's ability to evaluate their own dietary quality. Increasing awareness and understanding of what a healthy diet looks like in terms of quantity and quality of servings from each food group, and emphasising the importance of all food groups in a healthy diet, may make it easier for women to more accurately compare their own diet with a 'healthy balanced diet' as defined by the Australian Dietary Guidelines. Presenting this information visually as well as providing sample meal plans which show how the recommended number of daily servings from each food group can be incorporated into their diet, might be effective at increasing this awareness. Though, the effectiveness of this strategy among women who have poor dietary quality but perceive their diets to be healthy may be influenced by how willing they are to increase their nutrition knowledge and understanding of a healthy diet, as suggested by Kearney and McElhone's [238] findings.

Around two thirds of the women surveyed reported making dietary changes specifically for pregnancy. The majority of women reported avoiding or eating less high listeria risk foods during pregnancy, compared to their usual intake. While the reliability of the findings regarding how current dietary intake differs to pre-pregnancy dietary intake may be limited by recall bias, similar findings have been reported in previous studies [26, 88, 228]. Further, while half of the women reported that their diet was healthier during pregnancy compared to their usual pre-pregnancy diet, and these women were more likely to perceive their dietary intake during pregnancy as 'healthy', women were revealed to be poor judges of dietary quality. Therefore, the extent to which dietary quality changed from before to during pregnancy cannot be determined from the available data. Previous research, however, indicates that dietary changes are minimal [13, 239, 240]. In particular, findings from two large UK studies which assessed dietary intake before pregnancy as well as at 11 and 34 weeks gestation showed that overall eating patterns changed minimally and compliance with fruit/vegetable recommendations did not improve in pregnancy [13, 239]. This is also supported by findings from the 2011-12 National Nutrition and Physical Activity Survey which found that based on people's self-reported usual consumption of fruit and vegetables, 54% of the general Australian population met the recommended usual intake of fruit and only 6.8% met the recommended usual intake of vegetables [241], which is similar to the proportions reported in the present study (56% and 9%, respectively). Thus, there do not appear to be marked increases in fruit and vegetables intake in pregnancy. Furthermore, a recent Australian study among overweight and obese women showed that dietary quality decreased as pregnancy progressed [95]. This suggests that women need greater support making healthy dietary changes and maintaining healthy eating patterns throughout pregnancy.

Furthermore, one in four women in this study reported avoiding or eating less cooked fish and seafood during pregnancy, and almost one in three reported specifically avoiding or eating less oily fish such as mackerel, herring, sardines, tuna and salmon. Similar findings were reported in Martin's [18] survey, in which 19% of pregnant Victorian women reported avoiding or limiting their seafood intake due to risk of listeriosis or mercury contamination. Likewise, reduced consumption of fish during pregnancy has been documented among women in the US after well-publicised government recommendations to limit fish intake due to mercury levels [242]. Notably, through their analysis of blood samples from 4,484 pregnant women in the Avon Longitudinal Study of Parents and Children (ALSPAC), Golding et al. [243] revealed that seafood intake, which included white fish, oily fish, and shellfish, accounted for approximately 9% of the variation in whole blood total mercury levels. Thus, seafood had a relatively small influence on maternal blood mercury levels, suggesting that avoidance or limiting intake of fish and seafood during pregnancy need not be a major focus of nutrition education in pregnancy. The focus should rather be on ensuring adequate intake of fish rich in omega-3 fatty acids. This could be achieved through increased promotion of: 1) fish as a source of omega-3 fatty acids, 2) the benefits of omega-3 fatty acids, and 3) practical strategies to help women achieve adequate fish intake in pregnancy.

Overall, the high rate of supplement use during pregnancy but relatively low rates of compliance with supplement recommendations is consistent with previous research [18, 51, 52, 54, 208, 244-246]. Importantly, this is the first research to show poor compliance with the NHMRC's iodine supplement recommendation in both a national sample of Australian pregnant women and a South Australian sample. It must be noted, however, that the prevalence of supplement use may be higher in the present study than in the overall population of Australian pregnant women due to the study sample over-representing women with characteristics consistently shown to be associated with supplement use in pregnancy (higher educational attainment, higher household incomes, planned pregnancy, non-smokers). This study also found that around half of pregnant women incorrectly believed that omega-3 fatty acid, vitamin D, iron and calcium supplements are recommended in preconception, and up to three quarters believed supplementation with these nutrients is recommended in pregnancy. This indicates widespread misconceptions about the need for supplementation, which might also explain the high prevalence of supplement use, as women may be supplementing with nutrients that they believe are recommended.

The survey findings further revealed that while about three quarters of pregnant women were advised to supplement with folic acid during pregnancy and about half were advised to take a multivitamin, only 40% were recommended to take an iodine supplement. GPs were found to be the most common source recommending supplementation with folic acid, iodine and multivitamins. This is consistent with previous studies examining folic acid supplementation among pregnant women in Ireland [76] and iodine supplementations among pregnant women in Victoria, Australia [18, 247]. Other common sources recommending these supplements included obstetricians and midwives, followed by family and friends. Notably, these sources were also considered to be the most influential sources of nutrition information in pregnancy. Overall, these findings indicate that main HCPs in pregnancy are not consistently advising women to supplement with iodine, and many are also recommending multivitamins. Currently, no over the counter iodine-only supplements are available for purchase in Australia, and this might explain the higher proportion of women being recommended to take multivitamin supplements rather than iodine supplements. Further research is needed to investigate factors that influence HCP's practice in terms of recommending iodine and multivitamin supplements.

Consistent with previous research and supporting the 'inverse supplement hypothesis', the findings of this research showed that women taking dietary supplements in pregnancy were more likely to be older, have greater educational attainment, have a higher household income, live with a partner, plan their pregnancy and have higher dietary quality [19, 35, 37, 40, 42, 45-54]. Moreover, higher age, higher household income, living with a partner and planning pregnancy were also factors significantly associated with compliance with the folic acid and iodine supplement recommendations in at least one of the study cohorts. These associations have been shown for the first time with iodine compliance. Overall, these findings indicate a need to increase compliance with supplement recommendations among younger, lower income, single mothers, with possible strategies including increasing knowledge regarding the need for and importance of supplementation with folic acid and iodine in preconception and pregnancy.

Notably, nulliparous women were more likely to comply with the iodine supplement recommendation. This association, however, was only present in the SA cohort. Therefore, this finding could be due to the SA cohort over-representing nulliparous women (national cohort: 37%; SA cohort: 58%: ABS all women giving birth in 2012: 44%). Another reason may be that multiparous women are less likely to search for new nutrition-related information in subsequent pregnancies, relying instead on advice received in previous pregnancies and on their own experiences; and given the iodine supplement recommendation was introduced in 2010, it may not have been present during their previous pregnancy. This idea is somewhat supported by the findings of this research with respect to influential information sources, which showed that just over a quarter of multiparous women ranked their own previous experience as one of their top three most influential sources of nutrition information during pregnancy. Overall, these findings highlight the importance of updating nutrition knowledge with each pregnancy. In particular, main HCPs should provide nutrition information to all pregnant women, irrespective of parity, or at least make multiparous women aware of any recommendations introduced since their last pregnancy.

Overall, knowledge regarding the folic acid and iodine supplement recommendations was found to be poor and, as was expected, significant associations were found between knowledge of supplement recommendations and compliance with the recommendations. Firstly, considering findings regarding knowledge of folic acid, around three quarters of pregnant women were aware of the link between folic acid and prevention of NTDs. Similar awareness was reported in previous studies of childbearing aged [213] and pregnant women in South Australia [208], and in recently pregnant women in Western Australia [210]. Other Australian studies in childbearing aged women, all population health surveys conducted within the last decade, reported lower awareness, 28% in Western Australia [215] and less than 10% in Victoria [218] and Tasmania [220]. Overall, the greater awareness of the importance of periconceptional folic acid found in the present study and in previous studies of pregnant and post-partum women, may be due to this information being more salient and personally relevant during pregnancy. Additionally, the lower awareness reported among childbearing aged women in Victoria and Tasmania may be due to different public health promotion campaigns in the different states.

While most women in this study were aware of the importance of folic acid supplementation, only one in ten were aware of the correct periconceptional timing of supplementation. This is considerably lower than the proportions reported in previous Australian studies surveying pregnant women in SA (82%) [208] and recently pregnant women in Western Australia (73%) [210]. An additional 36% of women in the present study believed that the recommended timing was ‘at least 3 months before conception and the first three months of pregnancy’. The large discrepancy in findings could therefore be explained by the definition of correct timing used in the previous SA and Western Australian studies, which was ‘before pregnancy and in the first three months of pregnancy’. By not specifying the preconception period to be ‘at least one month before pregnancy’, these studies likely overestimated the proportion who knew the correct recommended timing.

Further, only a third of the surveyed women who were aware that folic acid supplementation is recommended in preconception and pregnancy, knew the recommended dose. These findings are consistent with those of the only other two Australian studies which have assessed women’s knowledge of the correct daily dose of folic acid for the prevention of

NTDs [208, 211]. Both studies found that less than one-third of women with knowledge of the association between folic acid and NTDs also knew the recommended daily dose of folic acid, 28% of childbearing aged women in Western Australia [211] and only 18% of pregnant women in SA [208]. Notably, one in four women in the present study admitted to relying on the supplements they were taking to provide the recommended amount of folic acid, thus putting their trust in the product manufacturer. This seemingly blind trust that some pregnant women place in supplement manufacturers suggests a need for increased awareness of the correct timing and dose of supplementation among childbearing aged and pregnant women, to allow them to make more informed decisions regarding supplementation. These findings also suggest a possible need for tighter regulation of supplements marketed for pregnancy. In particular, ensuring these products contain the recommended amounts of folic acid and iodine, and provide information about recommended timing of supplementation with these nutrients.

Overall, pregnant women had poorer knowledge regarding the recommendation for iodine supplementation compared to their knowledge regarding the folic acid recommendation. This greater familiarity with the folic acid recommendation is not surprising given the relative recency of the iodine recommendation, and is consistent with findings from previous studies [18, 247, 248]. Notably, twice as many pregnant women reported received information about folic acid from their main HCP compared to iodine (62% vs. 32%). This could also explain the relatively poor knowledge regarding iodine, as women who received some information about folate/iodine from their main HCP were more likely to: know that supplementation is recommended in preconception and pregnancy, know the importance of the nutrient in pregnancy, and be able to identity at least one good dietary source of the nutrient. This suggests that main HCPs play an important role in increasing women's nutritional knowledge in preconception and pregnancy.

While almost three quarters of pregnant women were aware that iodine supplementation is recommended in preconception and/or pregnancy, just over half of these women were aware that iodine plays an important role in baby's brain development, and only one in ten knew the recommended daily dose of iodine. Thus, there was relatively low awareness of the importance of iodine and the recommended dose of iodine supplementation among the surveyed women. Previous Australian studies conducted in NSW and Victoria have also reported poor awareness of the importance of iodine in pregnancy, with only 10-12% of pregnant women in previous studies found to recognise mental retardation as a health problem associated with inadequate iodine intake [221-225]. Compared to Martin's [18] study, in which less than one in five pregnant women believed iodine supplements were needed in pregnancy in addition to a healthy diet, the present study found a higher proportion of women both in SA and nationally to be aware of the need for iodine supplementation in pregnancy. No other published studies could be identified which assessed women's awareness of the NHMRC's recommendation for iodine supplementation, limiting further comparison of the study findings.

Importantly, in the overall study sample, women were more likely to comply with the recommendations for folic acid and iodine supplementation if they knew the importance of the nutrients in pregnancy and were aware that supplementation is recommended in both preconception and pregnancy. For folic acid, a statistically significant but negligible association was also found between compliance and knowing the recommended dose, which was not present in either of the individual cohorts. Notably, while receiving information about folic acid and iodine from the main HCP in pregnancy was important in increasing awareness of the recommendation for supplementation in preconception and pregnancy and the importance of supplementation, it was not significantly associated with compliance with the recommendation. Thus, increasing knowledge seems to be key rather than the source of this knowledge.

The finding that compliance with the recommendation for periconceptional folic acid supplementation was associated with knowledge of the link between folic acid and the prevention of NTDs, is consistent with previous Australian [208, 210] and international studies [249]. Likewise, Martin's [18] Victorian study found that awareness of the importance of iodine during pregnancy was a predictor of iodine supplement intake in pregnancy. The present research, however, is the first to show this association with iodine *compliance* in a national sample of Australian pregnant women and also in an SA sample.

Also, consistent with previous research, this study found lower awareness of the link between folic acid and prevention of NTDs among younger women [210, 217], those with lower education levels (in the SA cohort only) [210, 215] and lower household incomes [213, 217]. The same associations were found with awareness of the link between iodine and baby's brain development, this being an original contribution to knowledge. Younger and lower income women were also less likely to know that supplementation with folic acid is recommended in preconception and pregnancy, but these associations were not found for iodine. Overall, these findings suggest that nutrition education (specifically, promotion of the need for and importance of iodine and folic acid supplementation in preconception and pregnancy) should be targeted at these socio-demographic subgroups.

Furthermore, despite finding that knowledge of the correct timing was not significantly associated with compliance with the periconceptional folic acid supplement recommendation, the overall poor awareness of the correct timing needs addressing. Knowing the correct timing of supplementation will allow women to make more informed decisions regarding commencing and ceasing supplementation in the prenatal period. Ceasing folic acid supplementation after the recommended period (first trimester) may be especially important given findings from an Australian prospective birth cohort study (n = 557) which followed children up to 5.5 years and showed increased asthma risk in children whose mothers supplemented with folic acid in late pregnancy [250].

Of concern are the findings that a third to a half of pregnant women were unable to identify any good dietary sources of folate, and about half were not able to identify any good dietary sources of iodine. Overall, green leafy vegetables and fish/seafood, the richest dietary sources of folate and iodine, respectively, were the most commonly identified sources. While green leafy vegetables were identified by almost half of the sample, just under a quarter of the pregnant women identified fish/seafood. This is consistent with findings from previous national surveys assessing knowledge of folate sources in childbearing aged women which, like the present study, elicited unprompted responses [216, 217]. Similar to findings from the present study, these studies also showed relatively low awareness of additional sources of folate such as breakfast cereals, bread and citrus fruits among pregnant women.

The findings from this study with respect to women's limited knowledge of iodine sources are also comparable with previous studies conducted in NSW and Victoria [18, 221-224]. As in this study, fish and seafood were most commonly identified by the pregnant and childbearing aged women in these studies (by 27-74% of women), followed by milk (16-26%) and eggs (23-24%). Also similar to the present study, vegetables, fruit and meat were most commonly incorrectly identified as good sources of iodine. The higher proportion of women identifying both correct and incorrect sources of iodine in these studies, compared to the present study, is likely due to responses to dietary questions being prompted rather than unprompted as in the present study. Overall, the findings of the present research show that apart from identifying the richest natural sources of folate and iodine, most women have trouble identifying additional foods which are good sources of these nutrients; and some women are not able to name a single source. Adequate knowledge of dietary sources of key nutrients in pregnancy is essential for making informed dietary decisions. There is, therefore, a need for increased education around dietary sources of key nutrients, iodine in particular.

Only 8% of the study sample identified bread as a good source of folate and the same proportion recognised it as a good source of iodine. This is in stark contrast to the 67% of childbearing aged women in Western Australia who were aware of folate fortified bread in 2006, prior to the mandatory folic acid fortification of bread flour in 2009 [215]. It was not clear, however, whether the responses in the Western Australia study [215] were prompted or unprompted which, as highlighted in previous research, can have a considerable impact on findings [217]. Direct comparison with findings from the present study is therefore limited.

The findings of the present study regarding bread as a poorly known source of iodine are more comparable to the literature. Other recent Australian studies in pregnant women reported that between 18-24% of pregnant women identified bread as a good source of iodine when prompted [221, 222], and 4-16% were aware of the mandatory iodine fortification of bread [18, 222]. Thus, less than one in four pregnant women were able to identify bread as a good source of iodine when prompted in other studies and less than one in ten when unprompted in the present study. Overall, findings from the present research show that four years after the introduction of mandatory fortification of bread with folic acid and iodine, few women recognise bread as a good source of these nutrients. This suggests a need for increased public health promotion of bread as a good source of both folate and iodine.

Consistent with previous Australian studies among childbearing aged and pregnant women, the present study found significant associations between lower awareness of dietary sources of folate and lower household incomes [213, 217] and being nulliparous [215, 217]. Previous studies have also found lower awareness of folate sources among women living outside of capital cities [213, 217], an association not found in the present study despite the study sample being representative in terms of proportion of births in metropolitan and outside of metropolitan areas. While there is no published data with which to compare this study's findings regarding iodine knowledge and associations with participant characteristics, the findings are comparable with studies examining associations with folate knowledge.

An association found in this study, which is consistent with previous research examining nutrition knowledge in pregnancy [76] and in the general population [251-253], is the positive association between ability to identify at least one dietary source of folate and iodine, and completion of tertiary education. Possible explanations for this finding include women with lower education levels not being exposed to this information during their schooling or elsewhere, not being interested in this information, not seeking this information out or not knowing where to find this information. Notably, Charlton's [248] review of iodine nutrition knowledge among pregnant and lactating women in Victoria provides some insight, revealing that most pregnant women felt that they did not receive adequate information about iodine to make informed dietary decisions relating to iodine. While the underlying reasons for poor nutrition knowledge among less-educated pregnant women requires further investigation, the finding suggests a need to increase ability to identify good dietary sources of key nutrients in pregnancy among women with lower education levels. However, while De Vriendt et al. [251] showed that Belgian women with greater nutrition knowledge had healthier dietary intake, further research is first needed to establish whether pregnant women who are able to identify dietary sources of folate and iodine, do in fact have a higher intake of foods rich in these nutrients.

Overall, awareness of the folic acid and iodine supplement recommendations and dietary sources was greater among women in the SA cohort. This may reflect a greater knowledge among SA women compared to Australian women in general or it may be associated with the recruitment methods used. For example, women recruited in person may have taken more time to consider and complete the survey questions than women in the Pureprofile database who most likely complete surveys more frequently.

Additionally, a limitation of data collection via an online survey is the inability to verify whether the responses to the nutrition knowledge questions are a true reflection of the respondent's knowledge prior to survey completion. All respondents had access to the internet while completing the survey and therefore had the same opportunity to search for answers to the knowledge questions. Consequently, while the provided responses should reflect their current knowledge, they may not reflect knowledge prior to survey completion.

Notably, about two-thirds of women reported receiving some information about nutrition from their main HCP during their current pregnancy. Further, HCPs including GPs, obstetricians and midwives were identified as the three most influential sources of nutrition information in pregnancy. This is similar to findings from previous Australian and international studies [18, 54, 70, 76, 83, 85, 221, 228, 247, 248], with one focus group study highlighting the common view among pregnant women that GPs have an important role in both providing nutrition education and referring women on to other education [83]. Further, written or verbal information received from the main HCP was identified by the present study sample as the most preferred method of receiving new nutrition information during pregnancy. Similar preferences for receiving nutrition and general pregnancy-related information were reported in previous studies [76, 254, 255]. Thus, these findings suggest a need to review the provision of nutrition information by main HCPs in pregnancy (in terms of quantity and quality). Then, if needed, increase the necessary resources to facilitate their provision of nutrition education to pregnant women and those planning pregnancy, either verbally or in the form of printed education materials. Written information which supports information received verbally from the main HCP may, however, be most effective as indicated in Stapleton's [256] qualitative study of evidence-based leaflets for pregnant women where pregnant women's choices were more influenced by the perceived views and preferences of healthcare providers than the information provided in leaflets [256].

A potentially concerning finding was that almost half of the women surveyed (46%) considered midwives an influential source of nutrition information during pregnancy. This is concerning in light of a recent review of studies which explored knowledge, education, and attitudes of midwives towards nutrition during pregnancy finding that 'midwives lacked a basic knowledge of nutrition requirements during pregnancy' [257]. Thus, ensuring that HCP's and midwives, in particular, have adequate resources to provide reliable up-to-date nutrition information may be key to increasing pregnancy-related nutrition knowledge.

Family and friends were also among the most influential sources of nutrition information sources in pregnancy in this study. This is consistent with previous research in which family, in particular the woman's mother, and currently or recently pregnant friends, colleagues and neighbours were cited as common sources of health/nutrition information during pregnancy [18, 54, 70, 71, 235, 258]. In-depth interviews with pregnant women in the Netherlands revealed that discussions with the social environment allow women to exchange experiences 'for comparison, reassurance and advice' [235]. With family and friends considered influential sources of nutrition information by pregnant women, community education and awareness campaigns may be important in increasing the likelihood that pregnant women receive reliable and up-to-date information about nutrition from their family and/or friends.

The internet was identified as the second most preferred method of receiving new pregnancy-related nutrition information, preferred by a third of the study sample. Only 12% of women, however, identified government/hospital health websites as influential sources of nutrition information during their pregnancy, and 18% considered other websites such as blogs, forums and commercial pregnancy sites as influential. Nulliparous women, in particular, were more likely to consider these other types of websites as influential during pregnancy. Previous research has also identified the internet as a common source of pregnancy-related nutrition information [71, 235, 259]. Research has shown that the ability to remain anonymous makes the internet an appealing and popular source of information for pregnant women [235]. Pregnant women also consider the internet an up-to-date information source, and some women prefer using the internet as it means that they do not have to ‘bother’ their social environment with their pregnancy [235]. Additionally, a small focus group study of childbearing aged women in Victoria, Australia, found that the most commonly named internet sites that women reported using for preconception related information were commercial websites run by for-profit companies [71]. These included media companies, companies producing nappies and those producing preconception supplements. Unfortunately, there was no mention or further discussion in this paper as to why women used those sites over others and no information about how women judge the credibility of the information provided on websites. Although the internet has been identified as an important or preferred source of nutrition information in pregnancy, relatively few women in the present study considered internet websites to be influential sources of nutrition information during their current pregnancy. Further research is needed to investigate what types of websites pregnant women would most prefer to access for reliable nutrition information and what factors impact the influence that online information has on women’s nutritional decisions.

A limitation of this study is the use of an unvalidated measure of dietary quality with no established cut-offs for optimal or suboptimal dietary quality. Calculation of a dietary quality score using existing indexes which have previously been used to measure dietary quality in pregnancy (including the HEI [236], DQI-P [27], Australian Recommended Food Score [260] and Dietary Score [261]) would have required the collection of specific dietary information in the survey. This was not feasible in the present study due to the many topics covered by the survey. Thus, rather than including a relatively lengthy FFQ which would have enabled measurement of dietary quality using existing validated methods, this study assessed dietary intake using a brief 6-item FFQ, developed for the purpose of this study. The 6-item FFQ was based on the Five Food Group recommendations and use of this short FFQ reduced the length of the survey, thereby reducing respondent burden.

Notably, despite not using a validated FFQ, the obtained dietary intake data was consistent with that reported in previous studies in pregnancy. Nonetheless, validation of the brief 6-item FFQ is required, as is the further development and validation of the dietary quality score. Moreover, designation of cut-off scores to classify dietary quality scores as optimal and suboptimal, will allow the 6-item FFQ and resulting dietary quality score to be used simultaneously to efficiently categorise women in terms of dietary quality. This could be used in both community and clinical settings, and could potentially be developed into an online or mobile phone application which could be used for self-monitoring.

Conclusion

This study provides timely data regarding knowledge of and compliance with the current dietary and supplement recommendations for pregnancy, all of which were shown to be poor. In particular, this study is the first to obtain national and South Australian data regarding compliance with the NHMRC's iodine supplement recommendation and the updated Five Food Group recommendations for pregnancy, part of the 2013 Eat for Health Australian Dietary Guidelines. New insight is also provided into women's perceptions regarding the healthiness of their diet during pregnancy and how this compares with their actual intake. Pregnant women were shown to be poor judges of dietary quality, highlighting a need to increase women's ability to evaluate their diet against the Australian Dietary Guidelines.

The revealed associations between adherence to supplement recommendations and maternal characteristics will help target nutrition intervention strategies to women most at risk of poor compliance with the nutrition recommendations. In particular, the finding that knowledge of the importance of iodine and folic acid supplementation and the need for supplementation in both preconception and pregnancy were associated with greater compliance with the recommendations, suggests a need to increase this knowledge among childbearing aged and pregnant women. Importantly, main HCPs in pregnancy were revealed to be the most influential and preferred sources of nutrition information. Main HCPs may, therefore, be most effective at increasing nutritional knowledge and adoption of dietary and supplement recommendations in pregnancy.

Chapter 5: Using the theory of planned behaviour to examine the psychosocial factors influencing dietary quality and healthy eating intention in pregnancy

Introduction

In this chapter, the theory of planned behaviour (TPB) is used to examine the factors influencing healthy eating intention and consumption of a healthy diet during pregnancy. Having described the TPB framework in section 2.1.1, this chapter starts with a review of the literature regarding the use of the TPB to explain dietary and other health-related behaviours and intentions in pregnancy. Rationale is then provided for examining the role of additional variables alongside the TPB constructs. Next, the aims and objectives of the present TPB study are provided. This is followed by a description of the development, content and scoring of the TPB questionnaire; and the statistical methods used for data analysis. After analysing the data for the total sample and for each of the cohorts, the differences in findings between the total sample and the national and SA cohorts will be described and discussed. The findings from this study will be compared to previous research and finally, the implications of the findings will be discussed.

Literature review

Using the theory of planned behaviour to understand dietary behaviours

Over the last 20 years, the TPB has been applied to the study of a wide range of health-related behaviours, including various dietary behaviours in diverse populations. The range of different dietary behaviours and contexts which have been examined using the TPB include change in diet quality among health promotion clinic attendees [62]; fruit and vegetable consumption in young adolescents [262] and older adults [263]; soft drink consumption among female [128] and male [264] adolescents; reduction in fat intakes among UK adults [130]; dietary sodium restriction in patients with heart failure [124]; diet motivation in overweight women enrolled in a weight-loss program [127]; gluten free diet adherence in adult coeliac disease [135]; and dietary supplement use in women [125, 132, 133]. Overall, previous reviews have shown the TPB to be a successful model for predicting dietary behaviours and intentions [153, 154].

In an effort to explain additional variance in behaviour and intention not accounted for by the three TPB constructs (attitude, subjective norm and PBC), numerous studies have investigated the role of additional variables in the TPB model [156]. The effects of stress, health value and self-identity on dietary intentions and/or dietary behaviours have previously been examined in TPB studies, with mixed findings. In regards to perceived stress, it has been well-established that both chronic and perceived stress can influence eating behaviour of individuals [265, 266]. Specifically, stress has previously been found to have a significant effect on dietary intake during pregnancy [32, 87]. In the single diet-related TPB study which included stress as an additional variable in the prediction model, stress was not found to make a significant independent contribution to explaining variance in healthy or unhealthy eating intention [267]. Interactions between stress and TPB constructs did however account for significant additional variance in unhealthy eating intention [267].

The health value construct measures the value placed on one’s personal health. One previous TPB study using the health value construct could be identified [125]. This study explored supplement use in women and found higher health value to be a significant predictor of stronger intention to use dietary supplements, however the health value construct only accounted for 0.5% of the variance in intention scores [125].

The self-identity construct measures how individuals perceive themselves in relation to a particular behaviour within the wider societal context [268]. A recent review of 40 TPB data sets reported an average correlation of 0.47 between self-identity and intention for a range of behaviours including nine dietary behaviours for which correlation with self-identity ranged from 0.37 to 0.70 [269]. Overall, self-identity was found to explain an additional 6% of variance in intention after accounting for TPB constructs [269]. The authors described this level of additional variance as 'substantial', and concluded that self-identity is an important additional predictor in the TPB model [269]. As no previous TPB studies which included stress, health value or self-identity as additional variables were conducted in pregnant samples, the present study provides new insight into the role of these variables in predicting dietary intentions and dietary behaviour in pregnancy.

Using the theory of planned behaviour to understand dietary behaviours in pregnancy

While the TPB has been widely used to increase understanding of various health-related behaviours in a range of contexts, only seven health-related TPB studies have been conducted in pregnancy. The majority of the studies investigated smoking [270], alcohol use [271] and exercise [272-275], and few investigated dietary behaviour [72, 96, 276].

Of the three studies investigating dietary behaviour, two used the earlier version of the TPB, the 'Theory of Reasoned Action', which did not include the PBC construct. These studies were both conducted over 20 years ago in the UK and examined the intention of pregnant and postpartum women to try healthier eating [96, 276]. However in both studies, the behaviour under investigation was 'trying healthier eating' in general not specifically during pregnancy.

The only identified study which used the TPB to explain dietary intake during pregnancy examined factors influencing milk consumption in low-income pregnant women in the US

[72]. While this study reported the underlying behavioural, normative and control beliefs significantly influencing milk consumption during pregnancy, the proportion of variance in intention or consumption explained by the TPB constructs was not reported. Thus, the independent contribution each construct made to explaining milk consumption among the low-income pregnant women was not clear. No other studies could be identified which used the fully specified TPB model to understand the psychosocial determinants of dietary behaviour during pregnancy. Thus, this is the first application of the TPB to explain healthy eating intention in pregnancy.

Aim and objectives

The aim of this chapter is to increase understanding of the psychosocial factors influencing women's dietary behaviour during pregnancy. Specific objectives include:

1. To determine whether TPB variables and additional variables (self-identity as a healthy eater, health value and perceived stress) explain significant variance in women's dietary quality and intention to eat a healthy balanced diet during pregnancy.
2. To determine which specific beliefs have the greatest influence on attitude, subjective norm and perceived behavioural control with respect to eating a healthy balanced diet during pregnancy.

Methods

The TPB questionnaire was part of the large online survey of Australian pregnant women described in Chapter 3. Construction of the TPB questionnaire was guided by the methods outlined in Ajzen [277], Fishbein and Ajzen [104], and Francis et al. [278]. The behaviour under investigation was 'eating a healthy balanced diet during pregnancy'. Participants were provided with the following definition of a 'healthy balanced diet': *a diet which includes a* *variety of foods from all of the food groups and provides you with all the nutrients you need for pregnancy, in the recommended amounts*. All items (e.g. items measuring perceived stress, health value and self-identity) in the questionnaire directly referred to or could be applied to this specific behaviour. Before proceeding to the TPB questions, participants were provided with instructions and an example of how to complete rating scale questions; and were reassured that there were no correct or incorrect responses, that only personal opinions were of interest.

The included behavioural, normative and control belief items, which formed the indirect measures of the TPB constructs, were based on a review of the literature regarding barriers and enablers of healthy eating in pregnancy [82, 83] as well as responses provided to questions asked in the focus group discussions and in-depth interview (described in section 0). In particular, belief items were based on common responses to questions regarding perceived advantages and disadvantages of healthy eating during pregnancy, the most important people or groups of people who would approve or disapprove of healthy eating during pregnancy, and the perceived barriers to and enablers of healthy eating during pregnancy.

After piloting the survey with 49 pregnant women nationwide (refer to section 3.1.6), some items were removed to shorten the length of the TPB questionnaire (to reduce respondent burden), or to improve the internal consistency of multi-item scales used to directly measure TPB constructs, health value and self-identity as a healthy eater. The final TPB questionnaire included both direct and indirect measures of TPB constructs. Estimated completion time was five to ten minutes.

Unipolar or bipolar seven-point scales were used to rate items measuring TPB components. Below is a description of the items included in the scales used to measure the TPB constructs and each of the additional variables, and the scoring applied.

Behavioural Intention

Intention to eat a healthy balanced diet during pregnancy was assessed as the mean of the following three items: 1) *I intend to eat a healthy balanced diet during pregnancy*, 2) *I want to eat a healthy balanced diet during pregnancy*, and 3) *I expect to eat a healthy balanced diet during pregnancy*. All items were rated on a scale where 1 = *strongly disagree* and 7 = *strongly agree*. These items had high internal consistency; Cronbach's alpha was 0.84 for the total sample, 0.86 for the national cohort and 0.77 for the SA cohort.

Attitude

Direct measurement of attitude

Direct measurement of attitude involved the use of four bipolar adjectives: 1) *harmful for me-beneficial for me*, 2) *worthless-useful*, 3) *harmful for baby-beneficial for baby, and* 4) *bad-good.* These items were scored from 1 to 7, with higher scores indicating a more favourable attitude towards healthy eating during pregnancy. An overall attitude score was obtained by calculating the mean of the four items. These items had high internal consistency; Cronbach's alpha was 0.92 for the total sample, 0.94 for the national cohort and 0.84 for the SA cohort.

Indirect measurement of attitude (behavioural beliefs)

Eight underlying behavioural beliefs regarding the outcomes (advantages and disadvantages) of eating a healthy balanced diet during pregnancy were assessed. Indirect measurement of attitude was a two-step process. First, behavioural belief strength was measured using respondents' perceived likelihood of the behavioural outcome, rated on a scale where 1 =

extremely unlikely and 7 = *extremely likely*. Second, respondents evaluated outcomes using either a scale where -3 = *extremely undesirable* and +3 = *extremely desirable*, or one where -3 = *not at all important* and +3 = *extremely important*.

Each 'behavioural belief strength' score was multiplied by its respective 'outcome evaluation' score to understand the influence of behavioural beliefs on attitude. An overall attitude score was calculated by summing the products across all behavioural belief items.

Subjective norm

Direct measurement of subjective norm

Subjective norm was assessed as the mean of the following two items about the opinions of key influencers of respondent's: 1) *Most people who are important to me think that I should eat a healthy balanced diet during pregnancy*, and 2) *It is expected of me that I eat a healthy balanced diet during pregnancy*. Both items were rated on a scale where 1 = *strongly disagree* and 7 = *strongly agree*, with higher scores indicating stronger perceived social pressure to consume a healthy balanced diet during pregnancy. These items had good internal consistency; Cronbach's alpha was 0.69 for the total sample, 0.77 for the national cohort and 0.55 for the SA cohort.

Indirect measurement of subjective norm (normative beliefs)

Seven different sources of social pressure (key influencers) were identified with respect to eating a healthy balanced diet during pregnancy. These sources were used to generate either injunctive norm items representing what key influencers think a person should do, or descriptive norm items representing what key influencers do themselves.

Indirect measurement of subjective norm was a two-step process. First, injunctive normative belief strength was measured using respondent's perceived likelihood of key influencers being in favour of them consuming a heathy balanced diet during pregnancy, rated on a scale where -3 = *extremely unlikely* and +3 = *extremely likely*; and descriptive normative belief strength was measured using respondent's beliefs about key influencers consumed a heathy balanced diet during their own pregnancy, rated on a scale where -3 = *strongly disagree* and +3 = *strongly agree*. Second, respondents evaluated their motivation to comply with key influencers (for injunctive norms) or their identification with key influencers (for descriptive norms), using a scale where 1 = *not at all* and 7 = *very much.*

Each 'normative belief strength' score was multiplied by its respective 'motivation to comply' or 'identification with referent' score, to understand the influence of normative beliefs on subjective norm. An overall subjective norm score was calculated by summing the products across all normative belief items.

Perceived behavioural control

Direct measurement of PBC

Perceived behavioural control was assessed as the mean of three items for analyses involving the total sample and SA cohort, and two items for analyses involving the national cohort. The types and numbers of items used in the PBC scale differed across analyses due to selection of items being based on the internal consistency of the scale (assessed separately for the total sample and for each cohort); only those items that maximised the internal consistency of the PBC scale were included (the same procedure was followed when selecting items for the attitude and subjective norm scales).

The PBC scale items that measured respondent's self-efficacy included: 1) *I am confident that I could eat a healthy balanced diet during pregnancy if I wanted to* (used for both cohorts and the total sample), and 2) *eating a healthy balanced diet during pregnancy is very difficult for me - very easy for me* (SA cohort and total sample). The items that measured respondent's beliefs about the control they have over their behaviour included: 1) *whether I eat a healthy balanced diet during pregnancy is entirely up to me* (national cohort and total sample), and 2) *there are factors outside of my control that could prevent me from eating a healthy balanced diet during pregnancy* (SA cohort). These items were rated on a scale where 1 = *strongly agree* and 7 = *strongly disagree*, with higher scores indicating greater perceived of behavioural control. These items had acceptable internal consistency; Cronbach's α was 0.57 for the total sample, 0.68 for the national cohort and 0.58 for the SA cohort.

Indirect measurement of PBC (control beliefs)

Ten control beliefs representing factors which might influence respondents' ability to eat a healthy balanced diet during pregnancy were identified in the focus group discussions and individual interviews (described in Chapter 3). Each of these factors were included in the questionnaire. Indirect measurement of PBC was a two-step process. First, control belief strength was measured using respondents' perceived frequency of occurrence of the inhibiting or enabling factor, rated on a scale where 1 = *never* and 7 = *always*. Second, respondents evaluated the power of the control factor, which referred to whether the control factor would make it *more difficult* to eat a healthy balanced diet during pregnancy; using a scale where -3 = strongly agree and +3 = *strongly disagree*.

Each 'control belief strength' score was multiplied by its respective 'power of control factor' score to understand the influence of control beliefs on PBC. An overall PBC score was calculated by summing the products across all control belief items.

Health value

The importance respondents placed on good health was measured using the following two statements adapted from Lau, Hartman and Ware [279]: 1) *If you don't have your health you* *don't have anything,* and 2) *There is nothing more important than good health*. Both items were rated on a scale where -3 = *strongly disagree* and +3 = *strongly agree,* with higher scores indicating greater health value. An overall health value score was obtained by calculating the mean of the two items. These items had high internal consistency; Cronbach's alpha was 0.78 for the total sample, 0.80 for the national cohort and 0.75 for the SA cohort.

Self-identity as a healthy eater

Self-identity as healthy eater was assessed as the mean of the following two items adapted from Sparks and Shepherd [280]: 1) *In general, I am someone who is concerned about the health consequences of what I eat,* and *2) I am someone who is concerned with 'healthy eating' in general*. Both items were rated on a scale where -3 = *strongly disagree* and +3 = *strongly agree,* with higher scores indicating stronger identification as a healthy eater. An overall *self-identity as healthy eater* score was obtained by calculating the mean of the two items. These items had high internal consistency; Cronbach's alpha was 0.81 for the total sample, 0.85 for the national cohort and 0.78 for the SA cohort.

Perceived stress

Perceived stress was measured using the four-item version of the perceived stress scale [281], which has previously been validated for use in pregnancy [282]. Women were asked to indicate how often in the preceding month they: 1) f*elt they were unable to control the important things in their life*, 2) fe*lt difficulties were piling up so high that they could not overcome them,* 3) *felt confident about their ability to handle their personal problems*, and 4) *felt that things were going their way*. Items (1) and (2) were rated on a scale where 0 = *never* and 4 = *very often,* and items (3) and (4) were rated on a scale where 0 = *very often* and 4 = *never*. Higher scores indicated greater perceived stress during the preceding month. An overall perceived stress score was obtained by calculating the mean of the four items. These items had good internal consistency; Cronbach's alpha was 0.73 for the total sample, 0.69 for the national sample and 0.75 for the SA cohort.

Control variables

A range of socio-demographic, pregnancy-related and behavioural variables were measured in the survey and some of these were included in the regression model as control variables. Selection of control variables was informed by a review of the literature regarding factors found to be associated with dietary intake in pregnancy and/or in women in general.

Data analysis

Data were analysed using SPSS (version 20.0) and the level of significance was set at $P<0.10$. As shown in the methods above, Cronbach's alpha values were calculated to assess the internal consistency of items included in the multi-item scales used to measure attitude, subjective norm, perceived behavioural control, perceived stress, health value and self-identity as a healthy eater. Values at or above 0.50 were considered acceptable [283]. Descriptive statistics including mean scores and bivariate correlations were calculated for the measured variables. Hierarchical multiple linear regression analysis was used to determine the effect of TPB constructs and additional variables on dietary quality score and healthy eating intention.

Selection of control variables included in the final hierarchical regression model was based on results from a preliminary regression model. For the regression model with healthy eating intention as the dependent variable, bivariate correlations were assessed between behavioural intention and a range of control variables previously found to be associated with dietary intake. These control variables included: maternal age, completion of tertiary education, household income in top two income quintiles, pre-pregnancy overweight or obesity, living in a metropolitan area, previous births, stage of pregnancy (third trimester), smoking in pregnancy, pre-pregnancy compliance with national physical activity guidelines, use of folic acid and iodine supplements in pregnancy, and nutrition knowledge. A composite nutrition knowledge score was calculated based on responses to the knowledge questions (see section 0). For most knowledge questions, correct answers were assigned a score of one and incorrect answers were scored zero. Scoring differed for questions requiring women to identify good dietary sources of iodine and folate. Women who did not identify any dietary sources or incorrect sources only received a score of zero. Those who identified one good source received a score of one, and those who identified more than one good source received a score of two. Individual scores for each knowledge question were then summed with the maximum possible score being 21.

Control variables were included in the preliminary regression model if their correlation with behavioural intention was significant at the $P \leq 0.20$ level, as recommended by Maldonado and Greenland [284]. Only those control variables that remained significant predictors of behavioural intention after accounting for other control variables, TPB variables, perceived stress, health value and self-identity as a healthy eater, were included in the final regression model. The same process was followed for selecting control variables for the hierarchical regression model with dietary quality as the dependent variable. The dietary quality score described in section 0 was used in this analysis.

To control for the effects of socio-demographic and pregnancy-related variables on intention, these variables were entered in the first step. For the regression model with healthy eating intention as the dependent variable, attitude, subjective norm and PBC were entered at the second step; behavioural, normative and control beliefs were entered in the third step; and perceived stress, health value and self-identity as a healthy eater were entered in the fourth and final step. For the regression model with dietary quality scores as the dependent variable, socio-demographic and pregnancy-related variables were entered in the first step; behavioural intention and PBC were entered in the second step; attitude and subjective norm in the third step; behavioural, normative and control beliefs were entered in the fourth step; and perceived stress, health value and self-identity as a healthy eater were entered in the fifth and final step. Significant correlations between cohort membership and the TPB constructs warranted the estimation of separate regression models for each cohort. This allowed the differences in predictors of intention and behaviour to be examined between the two cohorts. Pearson correlation between healthy eating intention and behavioural, normative and control belief components was also calculated to examine which specific beliefs were correlated with healthy eating intention.

Assumptions for multiple regressions were checked prior to conducting the hierarchical multiple regression analyses. Tabachnick and Fidell [285] recommend a ratio of 20 cases per independent variable for hierarchical regression analysis. Thus, the sample sizes were considered adequate to include at most 21 predictors. The independence of observations assumption was met as indicated by the Durbin-Watson Statistic of around two for each analysis. The assumption of no multicollinearity was also met as indicated by the collinearity statistics being within the acceptable ranges [286, 287]; Tolerance values were all >0.10 (ranged from 0.19-0.99) and VIF values were <10 (ranging from 1.01- 6.31). Extreme outliers were identified using the Mahalanobis distance residual statistic. Outliers were retained in the dataset as their exclusion did not change the conclusions significantly. Cook's Distance values also indicated that outliers were not a cause for concern. Finally, inspection of scatterplots and partial residual plots indicated that the assumptions of normality, linearity and homoscedasticity were all met [286, 287].

Results

Responses from all 857 participants were included in the data analysis. Participant characteristics are reported in Table 3 and Table 4 in Chapter 3.

Explaining healthy eating intention in pregnancy

The results shown in Table 19 are from the preliminary regression model that included only control variables which were found to be independently correlated with behavioural intention at the 20% level of significance. Control variables that remained significant predictors of healthy eating intention after accounting for all other variables were included in the final regression model. These control variables differed across analyses. For the analyses of the total sample, cohort membership and previous births were included; area of residence and previous births were used for the analyses of the national cohort; and smoking during pregnancy and nutrition knowledge were included for analyses of the SA cohort.

Table 19. Results from the preliminary regression model which included control variables correlated with behavioural intention (P<0.20)[1,2]

	National cohort (n=455)	SA cohort (n=402)	Total sample (n=857)
Cohort membership	-	-	***
Maternal age	-	-	-
Tertiary education	-	NS	NS
High income (top 2 income quintiles)	-	-	-
Living in metropolitan area	*	-	-
Born in Australia	-	NS	NS
Overweight or obese pre-pregnancy	NS	NS	NS
Third trimester	NS	-	NS
Previous birth(s)	*	NS	**
Smoked during pregnancy	NS	**	NS
Compliance with physical activity guidelines pre-pregnancy	NS	NS	NS
Folic acid and iodine supplement use during pregnancy	NS	-	NS
Nutrition knowledge score	NS	*	NS

***P<0.01, **P<0.05, *P<0.10; NS= non-significant predictor after accounting for other control variables, TPB variables, perceived stress, health value and self-identity as a healthy eater.
[1]Variables with hyphen in cell were not correlated with behavioural intention at P<0.20 level and were not included in regression model.
[2]Dependent variable: behavioural intention

Table 20. Means and standard deviations of measured variables

	National cohort (n=455)		SA cohort (n=402)		Total sample (n=857)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Dietary quality score	27.18	9.86	26.96	10.86	27.08	10.34
Behavioural intention	5.97	1.02	6.44	0.69	6.19	0.91
Attitude	6.16	1.04	6.59	0.61	6.36	0.89
Subjective norm	5.75	1.14	6.10	0.98	5.91	1.08
Perceived behavioural control	5.85	1.13	5.00	1.13	5.60	1.02
Behavioural beliefs	85.42	33.74	97.34	25.17	91.02	30.59
Normative beliefs	73.13	38.47	83.06	28.53	77.79	34.51
Control beliefs	-63.19	53.67	-55.47	56.29	-59.57	55.01
Perceived stress (out of possible 16)	6.29	2.84	5.26	3.05	5.81	2.98
Health value	2.26	1.88	2.38	1.90	2.32	1.89
Self-identity	2.10	1.76	2.35	1.73	2.21	1.75
Age	31.58	4.93	30.49	5.10	31.07	5.04
Tertiary education	0.54	0.50	0.55	0.50	0.54	0.50
High income (top 2 income quintiles)	0.65	0.48	0.54	0.50	0.60	0.49
Living in metro area	0.72	0.45	0.85	0.36	0.78	0.41
Born in Australia	0.79	0.41	0.71	0.45	0.75	0.43
Overweight or obese	0.40	0.49	0.34	0.47	0.37	0.48
Third trimester	0.42	0.49	0.50	0.50	0.46	0.50
Previous birth(s)	0.63	0.48	0.42	0.49	0.53	0.50
Smoked during pregnancy	0.07	0.26	0.04	0.20	0.06	0.23
Complied with physical activity guidelines pre-pregnancy	0.27	0.45	0.35	0.48	0.31	0.46
Folic acid and iodine supplement use during pregnancy	0.75	0.43	0.86	0.34	0.80	0.40
Nutrition knowledge score (out of possible 21)	11.00	4.82	11.32	4.43	11.15	4.64

Table 21. Pearson correlations between measured variables (national cohort, n=455)[1]

	Behavioural intention	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Age	Tertiary education	High income[1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
Diet quality score	.24***	.18***	.12***	.19***	.10**	.12**	-.01	-.06	.07	.22***	.10**	.05	.09**	-.11**	.14***	-.03	.02	-.04	-.10**	.11**	.10**	.04
Behavioural intention		.57***	.73***	.77***	.69***	.58***	-.21***	-.19***	.35***	.45***	.02	.03	.03	-.10**	-.03	-.07	-.10**	-.15***	-.14***	.09*	.16***	.19***
Attitude			.49***	.53***	.59***	.53***	-.19***	-.22***	.29***	.36***	.01	.03	.05	-.09*	.02	-.08*	-.01	-.10**	-.09*	.02	.13***	.12**
Subjective norm				.69***	.57***	.67***	-.28***	-.08*	.32***	.37***	-.04	.05	-.05	-.02	-.06	-.06	-.08	-.14***	-.15***	.08	.18***	.20***
PBC					.63***	.56***	-.16***	-.24***	.30***	.39***	.04	.03	-.01	-.09*	-.01	-.06	-.03	-.15***	-.16***	.11**	.17***	.21***
Behavioural beliefs						.62***	-.22***	-.22***	.41***	.49***	-.02	.01	.04	-.07	-.06	-.04	-.11**	-.06	-.16***	.14***	.15***	.18***
Normative beliefs							-.33***	-.14***	.36***	.38***	-.12**	.03	.01	-.07	.00	-.08*	-.06	-.12***	-.10**	.05	.16***	.18***
Control beliefs								-.22***	-.02	-.03	.09*	.14***	.01	.06	-.08	-.15***	.03	-.04	.01	.09**	-.06	-.03
Perceived stress score									-.10**	-.15***	-.13***	-.15***	-.13***	-.03	-.05	.02	-.07	.00	.14***	-.05	-.04	-.06
Health value										.65***	.06	.12**	-.01	.08*	-.15***	-.10**	-.05	-.03	-.15***	.15***	.04	.16***
Self-identity											.02	.15***	.00	.02	-.03	-.21***	-.07	-.05	-.22***	.19***	.01	.20***
Age												.16***	.17***	.13***	.02	.10**	.04	.23***	-.12**	.00	-.03	.03
Tertiary education													.31***	.20***	-.17***	-.16***	-.02	-.11**	-.18***	.05	.08*	.04
High income[1]														.21***	-.06	-.08	-.01	-.13***	-.09**	.04	.09*	.01
Metro area															-.21***	-.12**	.00	-.05	-.14***	-.01	.03	.09**
Born in Australia																-.18***	.02	-.07	-.08*	.02	.12**	.05
Overweight or obese pre-																	-.01	.01	.05	-.07	.01	-.02

	Behavioural intention	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Age	Tertiary education	High income [1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
pregnancy																						
Trimester 3																		-.04	-.05	.04	.03	-.04
Previous birth(s)																			.09*	-.01	-.12**	-.07
Smoked in pregnancy																				.00	-.01	-.03
Complying with PA guidelines																					-.01	.08*
Folic acid & iodine supplements																						.21***

Abbreviations: BI=behavioural intention, PBC=perceived behavioural control, PA=physical activity
*P<0.1, **P<0.05, P<0.01*** (two-tailed test of significance)
[1] Top 2 income quintiles, based on 2009-10 income data from general Australian population [198]

Table 22. Pearson correlations between measured variables (SA cohort, n=402)[1]

	Behavioural intention	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Age	Tertiary education	High income[1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
Diet quality score	.13***	.19***	.01	.19***	.12**	.11**	-.14***	-.12**	-.13***	.10*	.11**	.11**	.24***	.06	.24***	-.02	-.06	.00	-.14***	.16***	.05	-.06
Behavioural intention		.42***	.56***	.39***	.47***	.44***	.02	-.22***	.23***	.36***	.06	.18***	.05	.01	-.07	-.10**	-.06	-.14***	-.21***	.13***	.02	.17***
Attitude			.31***	.27***	.34***	.31***	-.09*	-.13***	.07	.28***	.10**	.09*	.13***	.03	.05	-.15***	-.10*	-.04	-.15***	.15***	-.03	.03
Subjective norm				.05	.37***	.48***	-.17***	-.05	.19***	.21***	-.03	.06	.04	.01	-.02	.00	-.06	-.12**	-.06	.10**	.03	.11**
PBC					.26***	.22***	.36***	-.34***	.10**	.27***	.12**	.12**	.06	-.02	-.05	-.17***	.01	-.07	-.10**	.07	.01	.06
Behavioural beliefs						.47***	.03	-.15***	.25***	.31***	-.02	-.01	.01	-.02	.00	-.07	-.03	-.10*	-.15***	.09*	.10**	.16***
Normative beliefs							-.14***	-.08	.19***	.27***	.00	.06	.10**	-.01	.04	-.03	.02	-.09*	-.09*	.04	.06	.18***
Control beliefs								-.21***	.09*	.16***	.11**	.10**	-.06	-.02	-.27***	-.15***	.07	-.07	-.06	.08	.03	.09**
Perceived stress score									-.06	-.07	-.23***	-.23***	-.17***	-.06	.09*	.19***	.12**	.00	.08	-.07	-.06	.02
Health value										.52***	.11**	.11**	-.05	.09*	-.20***	-.15***	.05	.01	-.13***	.04	.02	.20***
Self-identity											.16***	.19***	.07	.05	-.03	-.20***	-.03	-.04	-.16***	.21***	.00	.13**
Age												.16***	.24***	.20***	-.12**	.03	-.17***	.26***	-.13**	.04	.03	.00
Tertiary education													.25***	.01	-.33***	-.23***	-.04	-.03	-.22***	-.05	.05	-.01
High income[1]														.09*	.10**	-.04	-.14***	-.03	-.12**	.08	.08	.01
Metro area															-.07	-.04	-.01	-.01	.05	.01	.07	.02
Born in Australia																-.20***	.06	-.01	-.07	-.13**	.08	.07
Overweight or obese pre-pregnancy																	-.05	.05	.02	-.11**	.01	.05

	Behavioural intention	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Age	Tertiary education	High income[1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
Trimester 3																		-.06	-.03	-.02	.03	.05
Previous birth(s)																			-.02	-.08	-.12**	-.04
Smoked in pregnancy																				-.04	-.07	-.08
Complying with PA guidelines																					-.05	-.01
Folic acid & iodine supplements																						.34***

Abbreviations: BI=behavioural intention, PBC=perceived behavioural control, PA=physical activity

*P<0.1, **P<0.05, P<0.01*** (two-tailed test of significance)

[1] Top 2 income quintiles, based on 2009-10 income data from general Australian population [198]

Table 23. Pearson correlations between measured variables (total sample, n=857)[1]

	BI	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Cohort	Age	Tertiary education	High income [1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
Diet quality score	.18***	.17***	.07**	.15***	.11***	.11***	-.08**	-.09**	-.03	.16***	-.01	.10***	.08**	.17***	-.04	.19***	-.02	-.02	-.02	-.11***	.13***	.07**	-.01
BI		.56***	.68***	.63***	.64***	.55***	-.10***	-.23***	.30***	.42***	.25***	.01	.09**	.01	-.02	-.06*	-.10***	-.06*	-.19***	-.18***	.12***	.15***	.18***
Attitude			.45***	.47***	.54***	.49***	-.13***	-.22***	.21***	.33***	.24***	.01	.05	.05	-.01	.01	-.12***	-.02	-.12***	-.12***	.08**	.11***	.09***
Subjective norm				.45***	.52***	.61***	-.21***	-.09***	.26***	.31***	.16***	-.05	.06*	-.02	.02	-.05	-.05	-.06	-.16***	-.12***	.10***	.14***	.17***
PBC					.52***	.42***	.06*	-.32***	.25***	.38***	.15***	.08**	.09***	.01	-.02	-.02	-.12***	-.03	-.09***	-.12***	.14***	.07**	.15***
Behavioural beliefs						.59***	-.10***	-.22***	.34***	.42***	.19***	-.04	.00	.01	-.02	-.05	-.06*	-.06*	-.11***	-.17***	.13***	.15***	.17***
Normative beliefs							-.23***	-.13***	.29***	.34***	.14***	-.08**	.05	.03	-.02	.01	-.07**	-.01	-.13***	-.11***	.06*	.14***	.18***
Control beliefs								-.22***	.03	.06*	.07**	.09***	.12***	-.03	.04	-.18***	-.15***	.06*	-.07*	-.02	.09***	-.01	.03
Perceived stress score									-.08**	-.13***	-.17***	-.15***	-.19***	-.13***	-.06*	.03	.11***	.01	.04	.12***	-.08**	-.07**	-.03
Health value										.59***	.03	.08**	.11***	-.04	.09***	-.18***	-.12***	.00	-.02	-.14***	.09***	.04	.18***
Self-identity											.07**	.08**	.17***	.03	.04	-.04	-.21***	-.05	-.06*	-.20***	.20***	.01	.17***
Cohort												-.11***	.01	-.11***	.16***	-.09**	-.07*	.09**	-.21***	-.07**	.08**	.14***	.03
Age													.16***	.21***	.14***	-.05	.07**	-.07**	.26***	-.11***	.01	-.02	.01
Tertiary education														.28***	.12***	-.25***	-.19***	-.03	-.07**	-.20***	.00	.07**	.02
High income[1]															.14***	.03	-.05	-.08**	-.05	-.10***	.05	.07**	.01
Metro area																-.16***	-.10***	.01	-.06*	-.09**	.01	.07*	.07**
Born in Australia																	-.19***	.05	-.06	-.08**	-.05	.11***	.07

	BI	Attitude	Subjective norm	PBC	Behavioural beliefs	Normative beliefs	Control beliefs	Perceived stress score	Health value	Self-identity	Cohort	Age	Tertiary education	High income [1]	Metro area	Born in Australia	Overweight or obese pre-pregnancy	Trimester 3	Previous birth(s)	Smoked in pregnancy	Complying with PA guidelines	Folic acid & iodine supplements	Nutrition knowledge score
Overweight or obese pre-pregnancy																		-.03	.04	.04	-.10***	.00	.00
Trimester 3																			-.07*	-.04	.02	.04	.01
Previous birth(s)																				.06*	-.06*	-.14***	-.06*
Smoked in pregnancy																					-.02	-.04	-.05
Complying with PA guidelines																						-.02	.04
Folic acid & iodine supplements																							.26***

Abbreviations: BI=behavioural intention, PBC=perceived behavioural control, PA=physical activity
*P<0.1, **P<0.05, P<0.01*** (two-tailed test of significance)
[1] Top 2 income quintiles, based on 2009-10 income data from general Australian population [198]

Table 24. Model summary and change statistics for each step of regression model with behavioural intention as the dependent variable

Model	Adjusted R Square	F Change	df1	df2	Sig. F Change
National cohort					
Step 1[a]	0.030	8.01	2	452	0.000
Step 2	0.685	313.63	3	449	0.000
Step 3	0.715	16.92	3	446	0.000
Step 4	0.718	2.51	3	443	0.058
SA cohort					
Step 1[b]	0.065	14.98	2	399	0.000
Step 2	0.484	108.89	3	396	0.000
Step 3	0.504	6.23	3	393	0.000
Step 4	0.512	3.23	3	390	0.022
Total sample					
Step 1[c]	0.082	39.22	2	854	0.000
Step 2	0.631	424.67	3	851	0.000
Step 3	0.659	24.50	3	848	0.000
Step 4	0.663	4.20	3	845	0.006

Step 1[a] predictors: Previous birth(s), living in metro area.
Step 1[b] predictors: nutrition knowledge score, smoked during pregnancy.
Step 1[c] predictors: Cohort, previous birth(s).
Step 2 additional predictors: attitude, subjective norm, perceived behavioural control.
Step 3 additional predictors: behavioural beliefs, normative beliefs, control beliefs.
Step 4 additional predictors: perceived stress, health value, self-identity as a healthy eater.

Table 25. Linear regression of behavioural intention onto TPB constructs and additional variables

Predictors[1]	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	β	SP	β	SP	β	SP
Step 1						
Cohort	-	-	-	-	0.225***	0.220
Previous birth(s)	-0.157***	-0.157	-	-	-0.142***	-0.139
Metropolitan area	-0.105**	-0.105	-	-	-	-
Smoked during pregnancy	-	-	-0.203***	-0.202	-	-
Nutrition knowledge	-	-	0.154***	0.154	-	-
Step 2						
Cohort	-	-	-	-	0.082***	0.078
Previous birth(s)	-0.025	-.024	-	-	-0.051**	-0.049
Metropolitan area	-0.039	-.039	-	-	-	-
Smoked during pregnancy	-	-	-0.123***	-0.121	-	-
Nutrition knowledge	-	-	0.085**	0.084	-	-
Attitude	0.158***	0.131	0.173***	0.157	0.180***	0.149
Subjective norm	0.345***	0.243	0.471***	0.445	0.423***	0.358
PBC	0.439***	0.299	0.297***	0.284	0.340***	0.285
Step 3						
Cohort	-	-	-	-	0.073***	0.069
Previous birth(s)	-0.038	-0.037	-	-	-0.051**	-0.049
Metropolitan area	-0.039	-0.039	-	-	-	-
Smoked during pregnancy	-	-	-0.110***	-0.108	-	-
Nutrition knowledge	-	-	0.065*	0.063	-	-
Attitude	0.083**	0.063	0.137***	0.120	0.112***	0.087
Subjective norm	0.313***	0.197	0.405***	0.341	0.358***	0.265
PBC	0.359***	0.232	0.264***	0.225	0.283***	0.222
Behavioural beliefs	0.262***	0.177	0.157***	0.130	0.223***	0.160
Normative beliefs	-0.044	-0.029	0.045	0.035	0.010	0.007
Control beliefs	-0.007	-0.007	-0.007	-0.006	-0.008	-0.008
Step 4						
Cohort	-	-	-	-	0.073***	0.069
Previous birth(s)	-0.040	-0.039	-	-	-0.052**	-0.050
Metropolitan area	-0.044*	-0.043	-	-	-	-
Smoked during pregnancy	-	-	-0.100***	-0.097	-	-
Nutrition knowledge	-	-	0.065*	0.062	-	-
Attitude	0.075**	0.057	0.118***	0.102	0.102***	0.079
Subjective norm	0.310***	0.193	0.396***	0.331	0.356***	0.262
PBC	0.351***	0.224	0.234***	0.193	0.264***	0.202
Behavioural beliefs	0.234***	0.152	0.140***	0.114	0.205***	0.143
Normative beliefs	-0.053	-0.035	0.034	0.027	0.001	0.001
Control beliefs	-0.020	-0.018	-0.031	-0.026	-0.025	-0.022
Perceived stress	-0.013	-0.012	-0.071*	-0.065	-0.029	-0.027
Health value	0.001	0.001	-0.003	-0.002	-0.004	-0.003
Self-identity	0.078**	0.056	0.103**	0.081	0.078***	0.059

Abbreviations: β=standardised regression coefficient; SP=semi-partial correlation.

The mean scores of the variables included in the final hierarchical regression models are shown in Table 20. Pearson correlations between the variables are shown in Table 21 (national cohort), Table 22 (SA cohort) and Table 23 (total sample). In the total sample and in both cohorts, behavioural intention was significantly correlated with each of the TPB constructs, and each belief-based measure was significantly correlated with its direct measure (e.g. behaviour beliefs were correlated with attitude). The only exception was the non-significant correlation found between intention and control beliefs for the SA cohort. Significant correlations were also found between intention and perceived stress, health value and self-identity as a healthy eater in the total sample and in both cohorts. Results from Spearman's rank correlation did not differ. Thus, when assessing correlation using a method better suited to analysis of non-continuous variables, the same bivariate correlations remained significant.

Table 24 shows the model summary and change statistics for each of the four steps of the final hierarchical regression model for the total sample and each cohort, with Table 25 showing the regression coefficients for the variables in each step. The results of the regression models show that in step 1, control variables were significant predictors of healthy eating intention in pregnancy, explaining 3.0% of variance in behavioural intention scores in the national cohort and 6.5% in the SA cohort. Women in the national cohort who lived in metropolitan areas (β=-0.105, P=0.024) and who had previously given birth (β=-0.157, P=0.001) were significantly less likely to intend to eat healthily during pregnancy. Whereas women in the SA cohort with higher nutrition knowledge scores had significantly stronger intentions to eat a healthy balanced diet during pregnancy (β=0.154, P=0.002); and those who smoked during pregnancy had weaker intentions (β=-0.203, P<0.001).

The addition of the direct measures of attitude, subjective norm and PBC in the second step of the model explained an additional 66% of the variance in behavioural intention scores in the national cohort compared to 42% in the SA cohort. All three TPB constructs were significant independent predictors of behavioural intention in both cohorts. An additional 3% of variance in behavioural intention scores was explained in the national cohort and an additional 2% in the SA cohort after adding the indirect (belief-based) measures of attitude, subjective norm and PBC in step 3. In both cohorts, only behavioural beliefs, the belief-based measure of attitude, made a significant independent contribution to explaining variance in intention. This finding indicates that the effects of behavioural beliefs on intention are not fully mediated by the direct measure of attitude, as the TPB would predict.

Adding the additional variables perceived stress, health value, and self-identity as a healthy eater to the regression model in the final step explained an additional 0.3% of variance in behavioural intention in the national cohort and 0.8% in the SA cohort. Self-identity as a healthy eater had a significant independent effect on intention in both cohorts, with women who identified more strongly as healthy eaters having stronger intentions to eat a healthy balanced diet during pregnancy. Perceived stress was also found to be a significant independent predictor of intention, but only in the SA cohort (see Table 25). Women in the SA cohort, who perceived less stress in the preceding four weeks of their pregnancy, had stronger healthy eating intentions.

After accounting for the effects of the control variables, TPB components and additional variables, the final regression models were statistically significant and explained 72% of the variance in behavioural intention scores in the national cohort [$F(11, 443)=105.95$, $P<0.001$] and 51% in the SA cohort [$F(11,390)=39.22$, $P<0.001$]. The standardised regression coefficients of the predictors and the proportion of unique variance explained by each predictor in the final step of the regression model are shown in Table 25.

While PBC was the strongest predictor of healthy eating intention for the national cohort, subjective norm was the strongest predictor for the SA cohort. The behavioural beliefs measure was the next strongest predictor after PBC and subjective norm in both cohorts, followed by self-identity as a healthy eater, attitude and area of residence in the national cohort; and attitude, self-identity as a healthy eater, smoking during pregnancy, perceived stress and nutrition knowledge in the SA cohort.

The proportion of unique variance in healthy eating intention explained by each variable can be calculated by squaring the semi-partial correlation coefficient, shown in Table 25. Despite each of the above variables significantly and independently predicting healthy eating intention, the unique variance in intention explained by each predictor was relatively low. The sizeable correlations between some of the predictors explain this finding, indicating that a large proportion of the total variance explained is shared variance explained by interactions between predictors.

While the TPB variables explained 68.5% of the total variance in behavioural intention scores in the national cohort, only 11.4% was unique variance contributed by the variables. Likewise, in the SA cohort, the TPB variables explained 43.9% of the variance in behavioural intention scores, and only 17.2% was unique variance. For both cohorts, PBC and subjective norm made the greatest unique contributions, approximately 5% and 4%, respectively, in the national cohort, and 4% and 11%, respectively, in the SA cohort. In each cohort, the unique variance explained by each of the other significant predictors, which were not TPB variables, ranged between 0.2 and 0.9%.

Overall these findings indicate that for both cohorts, the effects of self-identity on healthy eating intention in pregnancy, as well as the effects of area of residence in the national cohort, and smoking during pregnancy, nutrition knowledge and perceived stress in the SA cohort, were not mediated by the components of the TPB. Therefore, even after accounting for the effects of attitude, subjective norm and PBC, these factors still have independent effects on healthy eating intentions during pregnancy.

Given that the direct and indirect measures examine the same construct, including both measures in the regression model could bias the findings. Additional regression models were therefore estimated which only included the direct measures of the TPB constructs (see Appendix 11). The same variables were found to be significant predictors and the same trends were observed with respect to the relative strength of predictors.

Interactions between stress and TPB constructs- effect on healthy eating intention

Appendix 12 shows the effects of interactions between stress and TPB constructs on healthy eating intentions. While there were no significant interactions between perceived stress and the TPB constructs in the SA cohort, perceived stress moderated the effect of PBC in the national cohort (β=-0.480, P=0.017). This indicates that the strong positive effect of greater PBC on healthy eating intention was reduced by greater perceived stress. Thus, among women who perceived more stress, greater PBC over healthy eating had a smaller positive influence on healthy eating intention. In the total sample, perceived stress moderated the effect of subjective norm (β=0.317, P=0.020) but also had independent effects on healthy eating intention (β=-0.399, P=0.069). Therefore, while greater perceived stress was independently associated with lower healthy eating intentions, it also led to stronger healthy eating intentions among women with subjective norms favouring healthy eating.

Influence of control beliefs on PBC

The correlations between healthy eating intention and control belief components are shown in Table 26. For the SA cohort, lower healthy eating intentions were significantly associated with more frequent occurrence of the following factors during pregnancy: 'Cravings for unhealthy foods', 'Family duties and responsibilities placing considerable demands on my time', 'Feeling tired', 'Not knowing which foods need to be eaten and how much of them, to meet dietary requirements', 'The cost of healthy food has an effect on what I eat', 'Feeling unwell' and 'Feeling stressed'. Whereas, the only two factors significantly associated with lower healthy eating intentions in the national cohort were: 'Not knowing which foods need to be eaten and how much of them, to meet dietary requirements' and 'Lack of support from partner'. For the SA cohort, there were no significant correlations between healthy eating intentions and believing that the control factors made healthy eating more difficult. In contrast, stronger beliefs that each of the control factors would make healthy eating more difficult were significantly associated with weaker health eating intentions in the national cohort, with the exception of the belief that 'Work or employment placing considerable demands on my time would make healthy eating more difficult during pregnancy'. Thus, in the SA cohort, healthy eating intentions were associated more with frequency of occurrence of specific control factors rather than women's perceptions regarding the effect of the control factor on healthy eating during pregnancy, with the opposite observed in the national cohort.

Table 26. Correlations between healthy eating intention and control belief components

	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	Control belief	*Power*	*Control belief*	*Power*	*Control belief*	*Power*
Cravings for unhealthy foods	-0.05	-1.00**	-0.20***	-0.01	-0.14	-0.06
Work or employment places considerable demands on my time	0.04	-0.04	-0.01	0.01	0.10	-0.02
Family duties and responsibilities place considerable demands on my time	0.01	-0.11**	-0.14***	0.02	-0.07**	-0.05
Feeling tired	0.08	-0.21***	-0.18***	0.00	-0.06	-0.09***
Not knowing which foods need to be eaten and how much of them, to meet dietary requirements	-0.10**	-0.14***	-0.13***	-0.03	-0.14***	-0.10***
The cost of healthy food	-0.05	-0.11**	-0.22***	-0.01	-0.15***	-0.06*
Lack of support from partner	0.22***	-0.12***	-0.00	-0.03	0.10***	-0.06*
Feeling unwell	-0.04	-0.18***	-0.16***	-0.06	-0.11***	-0.12***
Not planning ahead	0.08	-0.16***	-0.10*	-0.05	-0.02	-0.09***
Feeling stressed	-0.00	-0.12**	-0.14***	-0.00	-0.10***	-0.06

*P<0.1, **P<0.05, P<0.01***

Influence of normative beliefs on subjective norm

Table 27 shows the correlations between healthy eating intention and normative belief components. For all sources assessed, women's belief that the source was in favour of them consuming a healthy balanced diet during pregnancy was significantly positively associated with health eating intention. The perceived opinions of women's partner, female family members, main healthcare providers and health experts in general were most influential in both cohorts and the total sample. Significant positive correlations were also found between women's healthy eating intention and their motivation to comply with each source with respect to health related matters. Pregnant women's healthy eating intention was most strongly correlated with their motivation to comply with their partner, female family members, main healthcare providers and health experts in general. While healthy eating intention was correlated with believing that pregnant or previously pregnant friends consumed a healthy diet during their own pregnancies, there was a much weaker association between healthy eating intention and women's desire to be like their friends with respect to health related matters.

Table 27. Correlations between healthy eating intention and normative belief components

	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	Normative belief	**Motivation to comply**	**Normative belief**	**Motivation to comply**	**Normative belief**	**Motivation to comply**
Main health care provider	0.47***	0.45***	0.28***	0.28***	0.41***	0.40***
Health experts in general	0.46***	0.37***	0.23***	0.30***	0.37***	0.38***
Books/magazines	0.40***	0.24***	0.17***	0.20***	0.31***	0.20***
Internet	0.38***	0.20***	0.21***	0.19***	0.31***	0.17***
Partner	0.49***	0.43***	0.35***	0.25***	0.44***	0.36***
Female family members	0.49***	0.37***	0.35***	0.22***	0.44***	0.30***
Pregnant or previously pregnant friends[1]	0.34***	0.08*	0.30***	0.07	0.33***	0.06*

*P<0.1, **P<0.05, P<0.01***
[1]'Identification with referent' assessed instead of 'motivation to comply'

Influence of behavioural beliefs on intention

The correlations between healthy eating intention and behavioural belief components are shown in Table 28. All behavioural beliefs assessed were significantly correlated with healthy eating intention with the exception of the belief that consuming a health balanced diet during pregnancy is 'very expensive' (in the national cohort and total sample) and 'means that I can't eat or drink what I enjoy' (in both cohorts). For most belief items, favourable outcome evaluations were also significantly correlated with healthy eating intentions, with stronger correlations found in the national cohort and total sample, compared to the SA cohort.

Table 28. Correlations between healthy eating intention and behavioural belief components

	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	Behavioural belief	Outcome evaluation	Behavioural belief	Outcome evaluation	Behavioural belief	Outcome evaluation
Baby getting all the nutrients it needs	0.50***	0.47***	0.28***	0.16***	0.43***	0.39***
Have a healthy baby	0.61***	0.40***	0.45***	0.15***	0.56***	0.34***
Ensure I get all the nutrients I need for my own health	0.57***	0.55***	0.46***	0.25***	0.54***	0.44***
Make me feel better	0.52***	0.50***	0.44***	0.21***	0.51***	0.40***
Very expensive	0.06	0.05	-0.15***	0.09*	-0.05	0.06
Help keep up my energy levels	0.58***	0.56***	0.42***	0.40***	0.53***	0.51***
Prevent excessive weight gain during pregnancy	0.48***	0.45***	0.37***	0.20***	0.45***	0.35***
Mean that I can't eat or drink what I enjoy	-0.02	-0.04	-0.06	0.02	-0.7**	-0.02

*P<0.1, **P<0.05, P<0.01***

Explaining dietary quality in pregnancy

The correlation matrix (Table 23) revealed that while cohort membership was not significantly associated with dietary quality for the total sample (Pearson's r=-0.011, P=0.752), it was significantly associated with the TPB constructs (P<0.025 for all). Therefore separate regression models were estimated for the two cohorts. The results shown in Table 29 are from the preliminary regression model that included only control variables found to be independently correlated with dietary quality at the 20% level of significance.

The control variables that remained significant predictors of dietary quality after accounting for all other variables and were therefore included in the final regression model were: maternal age, higher household income, living in a metropolitan area, born in Australia, pre-pregnancy compliance with physical activity guidelines, and use of folic acid and iodine supplements during pregnancy for the national cohort; and tertiary education, higher household income, born in Australia, smoked during pregnancy, and pre-pregnancy compliance with physical activity guidelines for the SA cohort.

Pearson correlations between dietary quality scores and the other measured variables are shown in Table 21 (national cohort), Table 22 (SA cohort) and Table 23 (total sample). In the total sample and in both cohorts, dietary quality was significantly correlated with each of the TPB construct variables, except control beliefs in the national cohort and subjective norm in the SA cohort. Significant correlations were also found between dietary quality scores and perceived stress and self-identity as a healthy eater for the total sample and for both cohorts. While health value was only correlated with dietary quality for the two cohorts separately, it was not significant in the total sample. Results from Spearman's correlation did not differ.

Table 29. Results from the preliminary regression model which included control variables correlated with dietary quality (P<0.20)[1,2]

	National cohort (n=455)	SA cohort (n=402)	Total (n=857)
Cohort membership	-	-	-
Maternal age	*	NS	**
Tertiary education	-	**	NS
High income	*	**	***
Living in metro area	**	-	-
Born in Australia	***	***	***
Overweight or obese	-	-	-
Third trimester	-	-	-
Previous birth(s)	-	-	-
Smoked during pregnancy	NS	*	*
Complying with physical activity guidelines pre-pregnancy	*	**	***
Folic acid and iodine supplement use during pregnancy	**	-	**
Nutrition knowledge score	-	NS	-

***P<0.01, **P<0.05, *P<0.10; NS= non-significant predictor after accounting for other control variables, TPB variables, perceived stress, health value and self-identity as a healthy eater.
[1]Variables with hyphen in cell were not correlated with dietary quality scores at P<0.20 level and were not included in regression model.
[2]Dependent variable: dietary quality.

Table 30. Model summary and change statistics for each step of regression model with dietary quality as the dependent variable

	Adjusted R Square	F Change	df1	df2	Sig. F Change
National cohort					
Step 1[a]	0.071	5.898	7	445	0.000
Step 2	0.103	8.959	2	443	0.000
Step 3	0.105	1.662	2	441	0.191
Step 4	0.114	2.384	3	438	0.069
Step 5	0.133	4.208	3	435	0.006
SA cohort					
Step 1[b]	0.140	14.010	5	396	0.000
Step 2	0.162	6.418	2	394	0.002
Step 3	0.167	2.025	2	392	0.133
Step 4	0.189	4.583	3	389	0.004
Step 5	0.202	3.103	3	386	0.027
Total sample					
Step 1[c]	0.096	16.078	6	848	0.000
Step 2	0.118	11.854	2	846	0.000
Step 3	0.125	4.359	2	844	0.013
Step 4	0.127	1.561	3	841	0.197
Step 5	0.141	5.431	3	838	0.001

Step 1[a] predictors: maternal age, living in metro area, household income, smoked during pregnancy, compliance with physical activity guidelines pre-pregnancy, folic acid and iodine supplement use in pregnancy.
Step 1[b] predictors: predictors: tertiary education, household income, smoked during pregnancy, compliance with physical activity guidelines pre-pregnancy, born in Australia.
Step 1[c] maternal age, household income, smoked during pregnancy, compliance with physical activity guidelines pre-pregnancy, folic acid and iodine supplement use in pregnancy.
Step 2 additional predictors: behavioural intention, perceived behavioural control.
Step 3 additional predictors: attitude, subjective norm.
Step 4 additional predictors: behavioural beliefs, normative beliefs, control beliefs.
Step 5 additional predictors: perceived stress, health value, self-identity as a healthy eater.

Table 31. Linear regression of dietary scores onto TPB constructs and additional variables[1,2]

Predictors[1]	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	β	SP	β	SP	β	SP
Step 1						
Maternal age	.088*	.085	-	-	.078**	.076
Tertiary education	-	-	.143***	.126	-	-
High income (top 2 income quintiles)	.088*	.084	.152***	.143	.121***	.117
Living in metro area	-.131***	-.124	-	-	-	-
Smoked during pregnancy	-.107**	-.105	-.103**	-.100	-.102***	-.101
Complying with physical activity guidelines	.108**	.108	.116**	.114	.116***	.115
Born in Australia	.140***	.136	-.270***	-.248	.207***	.204
Folic acid and iodine supplement use during pregnancy	.118**	.117	-	-	.092***	.091
Step 2						
Maternal age	.084*	.082	-	-	.077**	.075
Tertiary education	-	-	.125**	.109	-	-
High income (top 2 income quintiles)	.084*	.080	.149***	.140	.124***	.120
Living in metro area	-.105**	-.098	-	-	-	-
Smoked during pregnancy	-.078*	-.075	-.086*	-.082	-.075**	-.073
Complying with physical activity guidelines	.092**	.091	.100**	.098	.094***	.093
Born in Australia	.144***	.140	-.275***	-.252	.213***	.210
Folic acid and iodine supplement use during pregnancy	.088*	.086	-	-	.071**	.070
Behavioural intention	.208***	.132	.033	.030	.140***	.106
Perceived behavioural control	-.017	-.010	.151***	.139	.031	.024
Step 3						
Maternal age	.079*	.076	-	-	.072**	.069
Tertiary education	-	-	.122	.107	-	-
High income (top 2 income quintiles)	.073	.069	.144	.135	.119***	.115
Living in metro area	-.096**	-.090	-	-	-	-
Smoked during pregnancy	-.081*	-.078	-.077	-.073	-.075**	-.073
Complying with physical activity guidelines	.094**	.094	.095	.093	.096***	.095
Born in Australia	.139***	.135	-.269	-.247	.208***	.205
Folic acid and iodine supplement use during pregnancy	.091**	.089	-	-	.073**	.072
Behavioural intention	.230***	.128	.053	.038	.175***	.106
Perceived behavioural control	-.002	-.001	.126	.112	.020	.015
Attitude	.070	.056	.086	.075	.079**	.064
Subjective norm	-.101	-.064	-.077	-.062	-.106**	-.077
Step 4						

Predictors[1]	National cohort (n=455)		SA cohort (n=402)		Total (n=857)	
	β	SP	β	SP	β	SP
Maternal age	.074	.071	-	-	.074**	.070
Tertiary education	-	-	.131**	.114	-	-
High income (top 2 income quintiles)	.075	.071	.138***	.129	.115***	.111
Living in metro area	-.098**	-.091	-	-	-	-
Smoked during pregnancy	-.090*	-.087	-.078	-.074	-.079**	-.077
Complying with physical activity guidelines	.105**	.102	.118**	.114	.105***	.103
Born in Australia	.132***	.127	-.222***	-.196	.196***	.189
Folic acid and iodine supplement use during pregnancy	.093**	.090	-	-	.076**	.074
Behavioural intention	.299***	.158	.029	.020	.192***	.113
Perceived behavioural control	.016	.010	.194***	.157	.040	.029
Attitude	.110*	.083	.050	.043	.082**	.064
Subjective norm	-.102	-.060	-.110*	-.083	-.124***	-.083
Behavioural beliefs	-.179**	-.113	.067	.054	-.066	-.046
Normative beliefs	.041	.027	-.011	-.009	.026	.018
Control beliefs	.028	.026	-.187***	-.159	-.055	-.051
Step 5						
Maternal age	0.082*	0.078	-	-	0.077**	0.072
Tertiary education	-	-	0.122**	0.103	-	-
High income (top 2 income quintiles)	0.079*	0.075	0.123**	0.114	0.106***	0.101
Living in metro area	-0.099**	-0.091	-	-	-	-
Smoked during pregnancy	-0.069	-0.065	-0.088*	-0.083	-0.071**	-0.068
Complying with physical activity guidelines	0.087*	0.084	0.112**	0.106	0.093***	0.090
Born in Australia	0.123***	0.116	0.194***	0.168	0.175***	0.166
Folic acid and iodine supplement use during pregnancy	0.104**	0.100	-	-	0.079**	0.077
Behavioural intention	0.265***	0.139	0.027	0.019	0.176***	0.103
Perceived behavioural control	0.024	0.014	0.180***	0.142	0.028	0.020
Attitude	0.104*	0.078	0.032	0.027	0.070*	0.054
Subjective norm	-0.107	-0.062	-0.098	-0.074	-0.116**	-0.077
Behavioural beliefs	-0.208***	-0.128	0.083	0.066	-0.066	-0.044
Normative beliefs	0.039	0.025	-0.005	-0.004	0.026	0.019
Control beliefs	0.027	0.024	-0.193***	-0.162	-0.066*	-0.059
Perceived stress	0.039	0.035	-0.034	-0.031	-0.011	-0.010
Health value	-0.100*	-0.073	-0.164***	-0.133	-0.140***	-0.110
Self-identity	0.218***	0.152	0.073	0.055	0.153***	0.112

Abbreviations: β=standardised regression coefficient; SP=semi-partial correlation.

Table 30 provides the model summary and change statistics for each of the hierarchical regression model steps used to identify predictors of dietary quality in pregnancy for the total sample and for each cohort. The control variables explained the highest proportion of variance in dietary quality in all regressions. The TPB variables only explained an additional 3.1% of variance in dietary quality for the total sample, 4.3% for the national cohort, and 4.9% for the SA cohort.

The final regression models, which accounted for the effects of the control variables, TPB components and additional variables were statistically significant and explained 14%, 13% and 14% of the variance in dietary quality scores for the overall sample, the national cohort and the SA cohort, respectively. The standardised regression coefficients of the predictors and the proportion of unique variance explained by each predictor in the final step of the regression model are shown in Table 31. In the national cohort, stronger behavioural intention significantly and independent predicted higher dietary quality, with no significant effects found for PBC. Inconsistent with the TPB framework, both the direct and indirect measure of attitude were found to have unmediated effects on dietary quality. When measured directly, a more favourable attitude predicted higher dietary quality. However, when measured indirectly (behavioural beliefs) a more favourable attitude predicted lower dietary quality (despite the significant positive correlation between behavioural beliefs and dietary quality (r=0.105, P=0.013). Other variables which had unmediated effects on dietary quality in the national cohort were self-identity as a healthy eater, higher maternal age, higher household income, being born in Australia, folic acid and iodine supplementation in pregnancy, and compliance with physical activity guidelines prior to pregnancy, all of which were associated with higher dietary quality; and living in a metropolitan area, and having higher health value, which were associated with lower dietary quality.

In contrast, greater PBC significantly predicted higher dietary quality in the SA cohort, with no significant independent effects on dietary quality found for behavioural intention. Control beliefs were also found to independently predict dietary quality, with stronger beliefs regarding barriers to healthy eating in pregnancy predicting lower dietary quality. This is inconsistent with the TPB framework as it shows that the effects of control beliefs were not fully mediated by the direct measure of PBC. Other variables which had unmediated effects on dietary quality in the SA cohort were compliance with physical activity guidelines prior to pregnancy, tertiary education, higher household income and being born in Australia, all of which were associated with higher dietary quality; and smoking during pregnancy, and having higher health value, which were associated with lower dietary quality.

Overall, health value, being born in Australia, smoking during pregnancy, household income, and pre-pregnancy compliance with national physical activity guidelines were the only variables found to predict dietary quality in pregnancy in both cohorts and the total sample. Additional exploratory analysis revealed a significant positive correlation between dietary quality and number of years living in Australia for the total sample (Pearson's r = 0.17, P=0.013) and SA cohort (Pearson's r = 0.17, P=0.064), but not for the national cohort (Pearson's r = 0.14, P=0.177).

Interactions between stress and TPB constructs- effect on dietary quality

Estimation of a separate regression model which included interactions between perceived stress scores and behavioural intention, attitude, subjective norm and PBC revealed no significant interaction effects.

Discussion

This study is the first to use the TPB framework to explain healthy eating intention and dietary quality in pregnancy. The results provide new insight into the psychosocial determinants of dietary intentions and behaviours during pregnancy. Subjective norm and PBC emerged as the strongest predictors of intention to eat a healthy balanced diet during pregnancy, with attitude being a significant but much less important predictor. Specifically, women who perceived stronger social pressure to consume a healthy balanced diet during pregnancy, felt greater confidence and control over healthy eating in pregnancy, and had an overall positive attitude towards healthy eating during pregnancy were more likely to intend to eat a healthy balanced diet while pregnant. Collectively, the three TPB constructs explained 58% of the variance in women's intention to consume a healthy balanced diet during pregnancy in the overall study sample, 69% in the national cohort, and 44% in the SA cohort.

Notably, while subjective norm was the strongest predictor of intention in the overall sample and the SA cohort, PBC was the strongest predictor in the national cohort, closely followed by subjective norm. While most dietary and health-related studies have found attitude to be the strongest predictor of behavioural intentions followed by PBC and subjective norm [102, 154, 155], no previous TPB studies have examined healthy eating intention during pregnancy. The findings of this research suggest that during pregnancy, the influence of perceived social pressure on healthy eating intention may be more or equally as important as the influence of overall perceptions of control and confidence over healthy eating. This finding is perhaps not surprising, as the relative importance of the TPB constructs in predicting behavioural intention is likely to change depending on the behaviour and situation under investigation [102].

Predictors of dietary quality were also examined, and findings also differed considerably between cohorts. Stronger behavioural intention to eat a healthy diet during pregnancy, but not PBC, was found to predict higher dietary quality in the overall sample and national cohort. On the other hand, for the SA cohort, greater PBC but not behavioural intention, predicted higher dietary quality. Overall, the TPB constructs explained less than 5% of the variance in dietary quality scores in all samples. Thus, the TPB model was able to predict and explain healthy eating intention in pregnancy much better than it was able to predict and explain dietary quality. This finding is not surprising as a recent meta-analysis of 30 diet-related applications of the TPB found that, on average, the TPB explained 50% of the variance in dietary intentions and only 21% of the variance in dietary behaviour [154]. Also, consistent with the results for the total sample and national cohort, this review found behavioural intention to be a stronger predictor of behaviour than PBC [154].

In addition to the TPB components, self-identity as a healthy eater was found to be a significant predictor of healthy eating intention both overall, and in each cohort. Women who identified more strongly as healthy eaters were more likely to have stronger intentions to eat a healthy balanced diet during pregnancy, independent of their PBC, subjective norm and attitude regarding healthy eating in pregnancy. This finding is consistent with other studies which found the self-identity construct to explain significant additional variance in behavioural intention after the effects of TPB constructs were accounted for [269]. Stronger self-identity as a healthy eater was also associated with better dietary quality in pregnancy for the overall sample and the national cohort.

The present study also found a direct independent effect of perceived stress on healthy eating intentions in pregnancy, though only in the SA cohort. While lower perceptions of stress were associated with stronger healthy eating intentions, perceived stress explained only 0.4% of unique variance in overall intentions. The only other diet-related TPB study to assess the effects of stress on behavioural intention found that while stress had no significant direct effects on healthy or unhealthy eating intention, stress moderated the effects of subjective norm and PBC on unhealthy eating intentions [267]. Similar interaction effects were revealed in this analysis for the total sample and the national cohort, showing that among women who perceived more stress, the strong positive influence of greater PBC on healthy eating intentions was reduced while subjective norms favouring healthy eating had a stronger positive effect on healthy eating intentions. This suggests that stress makes women more sensitive to social pressure and less sensitive to their own perceptions of control and confidence over healthy eating during pregnancy.

The findings of this study also indicate that while health value does not have an independent effect on healthy eating intention, it does have a significant negative effect on dietary quality. This suggests that women who value good health more strongly are more likely to have lower dietary quality during pregnancy. This differs to Conner's [125] finding that a higher health value was associated with a higher intention to use supplements among women, and also made supplement use more likely. The assumption of no multicollinearity was checked and was met for the regression analyses examining predictors of dietary quality. Therefore the unexpected negative effect of higher health value on dietary quality in pregnancy may be due to mediation effects, whereby other variables may be affecting dietary quality indirectly through health value.

A small number of socio-demographic and pregnancy related variables were also found to be significant predictors of healthy eating intention. This included living in or outside of metropolitan areas for the national cohort and smoking status during pregnancy for the SA cohort. In contrast, a broad range of control variables was found to predict dietary quality, with some common findings between cohorts, including household income and compliance with physical activity guidelines prior to pregnancy. These findings are in discord with the TPB's notion that the proximal determinants of behavioural intention (attitude, subjective norm and PBC) mediate the effects of more distal variables such as socio-demographic and economic factors, knowledge, values, and other factors which could be seen to shape an individual's attitude, subjective norm and PBC regarding the target behaviour.

The findings for the overall sample and national cohort, that having previously given birth was associated with weaker healthy eating intention in pregnancy, which was found to predict lower dietary quality, is consistent with findings from relatively large studies conducted in the US, UK and Finland [27, 92, 288, 289]. Previous studies, however, did not account for the effects of psychosocial factors (e.g. attitude, subjective norm and PBC), which in this study were found to mediate the independent effect of parity on healthy eating intention. Thus, future studies aiming to better understanding factors influencing dietary behaviour would be well-advised to consider the effects of psychosocial factors, not just the effects of socio-demographic factors and pregnancy-related variables.

Not smoking during pregnancy was also associated with both stronger healthy eating intention and better dietary quality. This is consistent with previous studies reporting healthier dietary intakes among women who did not smoke during pregnancy [92, 288-290]. This finding, however, must be interpreted with caution as Sudman's [291] rule of thumb of at least 50 cases being required in each socio-demographic subgroup to draw statistical conclusions was met for all variables included in the TPB analysis except for smoking during pregnancy and not living with a partner.

The significant effect of area of residence on both behavioural intention and dietary quality in the national cohort indicated that women living outside of metropolitan areas were more likely to have stronger intentions to eat a healthy balanced diet during pregnancy and were also more likely to have higher dietary quality, compared to women who lived in metropolitan areas. This finding is interesting as, in general, individuals living outside of metropolitan areas have been shown to have poorer dietary quality or to be at greater risk of poor dietary intake [292].

Consistent with previous research in pregnancy, this study also found healthier dietary intake to be associated with higher maternal age, higher household income, use of both folic acid and iodine supplements in pregnancy, and higher levels of physical activity [27, 32, 37, 92, 293, 294]. In contrast, a finding for which there is a lack of support in the literature, is that women born in Australia were more likely to have better dietary quality during pregnancy than women born overseas. This significant and independent effect on dietary quality was found for the total sample and for both cohorts. Interestingly, in all regression models this predictor uniquely explained the greatest proportion of variance in dietary quality. Notably, additional exploratory analysis revealed a significant positive correlation between dietary quality and number of years living in Australia, suggesting that women's dietary quality improves as time spent living in Australia increases. Whether this suggests a cultural influence on dietary quality or whether this is a spurious finding, requires further investigation. In particular, different dietary assessment methods may be required in future studies to more accurately assess dietary quality of overseas born women who may have different dietary patterns.

Healthier dietary intake has also previously been found to be associated with higher levels of education [27, 37, 92, 289, 293], not being overweight or obese [28, 92, 289, 293, 295] and being in the earlier stages of pregnancy [95]. In this study, these variables did not have significant independent effects on healthy eating intention. The difference in findings could be explained by the previously referenced dietary studies in pregnancy, not assessing and, therefore, not accounting for the effects of the psychosocial factors that were assessed in the present study (e.g. attitude, subjective norm and PBC, perceived stress, health value and self-identity as a healthy eater).

Despite the findings from this research not showing a strong relationship between healthy eating intention and dietary quality in pregnancy, the behaviour and intention link has been well-established in previous TPB studies including those examining dietary behaviours. Thus, it is likely that pregnant women who intend to eat a healthy balanced diet during pregnancy are more likely to do so. Additional studies which use the TPB to explain healthy eating during pregnancy are, however, needed to verify how strong the intention-behaviour link is in this context. Overall, the findings from this study provide important insight into what types of intervention strategies might be most effective at encouraging healthy eating intention in pregnancy, and therefore motivating healthier dietary choices. Potential intervention strategies are discussed in the following paragraphs.

In accordance with Fishbein and Yzer's [296] and Ajzen's [297] suggestions for designing effective health behaviour interventions and based on the findings from the present analyses, interventions that aim to increase women's intention to consume a healthy diet during pregnancy as a means of increasing their compliance with the healthy eating guidelines for pregnancy should focus on changing PBC, subjective norm and attitude [296, 297]. This can be achieved by targeting the influential control beliefs underlying PBC, normative beliefs underlying subjective norm and specific behavioural beliefs underlying attitude.

Overall, the control beliefs or barriers to healthy eating during pregnancy which were most strongly correlated with healthy eating intention were cravings for unhealthy foods, not knowing which foods need to be eaten and how much of them to meet dietary requirements, the high cost of healthy food, lack of partner support and feeling unwell. These barriers may be worth addressing in healthy eating interventions either by helping women to overcome these barriers or creating stronger beliefs about enabling factors which will make the beliefs about barriers less salient and therefore less of a perceived barrier. This is in line with Ajzen's [297] view that while behavioural interventions can provide information that can change beliefs or lead to development of new beliefs, encouraging formation of new beliefs is an easier task. Ajzen [297] suggests identifying beliefs that are less prevalent or salient among the target population and making these the target of the intervention. Therefore, rather than trying to change perceptions regarding inhibiting factors, introducing information which focuses on factors not commonly recognised as enablers of healthy eating may lead to greater perceived behavioural control over healthier choices. Therefore, the focus of future studies should be on investigating the less commonly perceived factors which make healthy eating easier during pregnancy.

The finding that perceived normative pressure from women's partners, female family members, main HCPs and health experts in general was significantly associated with healthy eating intentions during pregnancy suggests that each source could potentially be targeted in behavioural interventions to help encourage healthy eating in pregnancy. Thus, women might benefit from stronger beliefs that these sources in particular would approve of them eating a healthy balanced diet during pregnancy. As well as strengthening these beliefs, intervention strategies should aim to increase women's motivation to comply with these sources.

The influence of social sources and social expectations on dietary intake during pregnancy is confirmed by other studies (not based on the TPB) of pregnant and postpartum women which have shown that healthcare providers and other people, including friends and family, can affect dietary intake when pregnant [82, 298]. Research shows that adjusting perceptions of social norms can lead to behavioural change [299, 300]. Therefore with this study finding that subjective norms are an important predictor of healthy eating intentions and other studies finding that social sources and expectations influence dietary intake in pregnancy, behavioural interventions that target subjective norms might be effective in encouraging healthy dietary choices in pregnancy.

Potentially effective strategies for strengthening perceptions of positive normative pressure from the key influencers identified in this study include encouraging pregnant women and their partners and female family members, to have discussions about healthy eating and how to manage healthy eating during pregnancy. Another strategy which is in line with the widespread use of mobile phone technology could include use of mobile phone applications which would allow pregnant women to monitor and receive feedback on dietary intake with updates being sent via email or being visible through the application to key influencers.

Main HCPs are also in a position to positively influence healthy eating intention in pregnancy. Therefore, an effective method of motivating healthy choices may be encouraging

HCPs to discuss and promote healthy eating behaviours with their pregnant patients during consultations. HCPs could also ‘prime’ women to make healthier choices by asking about their intention to eat healthily over a given period. This priming will make healthy eating intention easier to recall and therefore more influential in the immediate decision environment. This is supported by findings which showed increased frequency of dental flossing after similar priming [301].

The finding that the belief-based measure of attitude had an unmediated effect on healthy eating intention and was a stronger predictor of intention than the direct measure of attitude, suggests that specific behavioural beliefs may also be worth targeting in healthy eating interventions. Particularly influential beliefs may be those for which both the perceived likelihood of the behavioural outcome and the outcome evaluation were most strongly associated with healthy eating intention. These include the beliefs that consuming a health balanced diet during pregnancy will ‘Help keep up my energy levels’, ‘Make me feel better’, ‘Help me have a healthy baby’ and ‘Ensure I get all the nutrients I need for my own health’. Intervention programs should focus on strengthening women’s beliefs about the likelihood of these outcomes, and their positive evaluation of these outcomes.

This study found a weak correlation between the direct measure of PBC and the indirect belief-based measure of PBC in the total sample and national cohort. Possible explanations for the weak correlation between the two measures include the concept of ‘healthy eating’ being too broad, which might cause women to have different perceptions of control over different aspects of healthy eating (i.e. finding it easier to eat some foods/food groups than others). Likewise, control beliefs underlying PBC may differ across food groups. These suppositions are consistent with findings of previous research [120, 302].

Another reason for the weak association between direct and indirect PBC measures could be that the control belief items did not adequately capture factors influencing ability to consume a healthy diet during pregnancy. However, this is unlikely because the ten included control belief items covered an extensive range of factors. Given that the TPB proposes that only salient control beliefs will predict overall PBC [102], a more likely explanation is that only a few of the included beliefs were salient for each individual, which would have made the belief-based measure a less sensitive measure of PBC, than it would have been if only the salient beliefs were included in the indirect (belief-based) measure. An alternative way of eliciting more individually salient beliefs would be to use individually-generated items, as Steadman [303] did in her study.

Further, in the national cohort and total sample, control beliefs (the indirect measure of PBC) were negatively correlated with healthy eating intention. This indicates that women who more strongly believed that certain factors made healthy eating more difficult (i.e. perceived lower control over healthy eating), had stronger healthy eating intentions. This is inconsistent with the TPB model which proposes that positive control beliefs are predictive of stronger perceived behavioural control and therefore stronger behavioural intention. While statistically significant, the correlations were only weak to moderate and could possibly be explained by other enabling factors, which were not assessed in the study, having an overall stronger influence on healthy eating intention than the assessed barriers.

Thus, limitations of this study include not examining the psychosocial factors influencing intake from individual food groups and not using individually-generated belief items. Future TPB studies examining dietary behaviour in pregnancy should therefore consider examining each food group separately to obtain more specific and consequently more useful data regarding the control beliefs underlying perceptions of control over consuming foods from the different food groups. Dietary interventions could then better target and encourage intake from the different food groups.

The low reliability of the direct PBC measure could be attributed to the scale including measures of both self-efficacy and perceived control. Measuring self-efficacy and perceived control in separate scales may have produced greater insight into whether healthy eating intentions during pregnancy are more strongly predicted by self-efficacy or perceived control. This should be considered in future TPB studies examining dietary intentions/behaviours in pregnancy.

Another limitation relates to the measurement of direct subjective norm. Only items relating to injunctive norm were included in the scale used to directly measure subjective norm. The inclusion of descriptive norm items when measure direct subjective norm has been proposed to account for the suggested lack of variability in responses to items relating to injunctive norms only [277]. While the measure of direct subjective norm used in the present research had good internal consistency, future diet-related TPB research in pregnancy should consider including both descriptive and injunctive norm items when measuring direct subjective norm.

Furthermore, due to the cross-sectional nature of the study, healthy eating intention and behaviour were assessed at the same time. It was therefore not possible in this study to truly test the TPB models ability to predict healthy eating behaviour during pregnancy, as rather than predicting future behaviour, the TPB model was used to predict past behaviour. Future TPB studies examining dietary intentions and behaviours during pregnancy might consider using a prospective design. Measuring intention at baseline and behaviour after the time period specified in the questionnaire will better show the predictive power of the TPB. Structural equation modelling (SEM) could potentially be used to further analyse the data. The interactions between variables could be explored to determine the direct and indirect effects of the measured variables on healthy eating intention and dietary quality in pregnancy. While this might help explain some of the unexpected associations found with dietary quality, further data analysis using SEM is beyond the scope of this thesis.

Conclusion

This study found PBC and subjective norm to be the most important predictors of women's intention to consume a healthy balanced diet during pregnancy. Female family members, pregnant or previously pregnant friends, main HCPs and partners have the greatest influence on pregnant women's subjective norm. Therefore, intervention strategies may also want to consider targeting these key influencers to positively influence healthy eating intentions of pregnant women and women considering pregnancy.

Importantly, more work is needed to determine which specific control beliefs have the greatest influence on women's overall perceptions of control over healthy eating during pregnancy. These influential control beliefs can then be targeted in intervention strategies. Additionally, given that healthy eating is such a broad concept, a next step towards developing effective and targeted dietary interventions for improving maternal nutrition during pregnancy may be to explore whether different control factors impact women's ability to consume foods from different food groups during pregnancy. This could be achieved by constructing and administering separate TPB questionnaires for each food group, with items in each questionnaire referring only to the food group under investigation.

Further testing of the TPB's ability to predict dietary quality in pregnancy is also required, as is further work to validate the dietary quality measure used in this TPB analysis. Lastly, there are other nutrition-related recommendations for pregnancy that are important to consider. For example, with respect to food safety there are recommendations that pregnant women should not consume high-listeria risk food products and that they should limit consumption of fish with high levels of mercury. The TPB framework could also be used to gain a better understanding of pregnant women's intentions and behaviours regarding these dietary recommendations. This would help provide a more holistic picture of factors influencing adoption of nutrition recommendations in pregnancy.

Chapter 6: Examining women's preferences for nutritionally-fortified food and beverage products and dietary supplements during pregnancy using a labelled, alternative-specific discrete choice experiment

The high prevalence of dietary supplement use but low compliance with supplement recommendations often found in pregnancy needs to be addressed. Increasing understanding of the factors that influence women's choice of dietary supplements during pregnancy will provide important insights into what strategies might be most effective for encouraging use of appropriate dietary supplement products, and increasing compliance with supplement recommendations during pregnancy.

Aim and objectives

Using a DCE, the overall aim of this chapter is to gain an understanding of what influences women's preferences for dietary supplements, including nutritionally-fortified foods and beverages and supplement tablets during pregnancy.

Specific objectives include:

1. To determine whether the type of dietary supplement product influences women's preferences. In other words, do pregnant women prefer nutritionally-fortified food products, nutritionally-fortified beverages or supplement tablets?
2. To determine the relative importance of key pregnancy-related nutrients (e.g. folate, iodine, vitamin D and omega-3 fatty acids) and nutrient levels, versus other product attributes, including: daily cost, brand, endorsement, absorption and information regarding potential health benefits.
3. To determine whether pregnant women are heterogeneous in their preferences for

dietary supplement products and product attributes? And, if so,

a. What attributes are most important to different segments and what characteristics help explain unique segments?

b. Does knowledge of and/or reinforcement of the health benefits of nutrients influence the effect of nutrients in the choice decision?

Literature review regarding the use of DCEs to elicit consumer preferences for nutritional supplements including functional or fortified foods and beverages

This part of the chapter reviews the literature regarding the use of DCEs to elicit consumer preferences for functional or fortified foods and beverages, and dietary supplements. First, an overview of the experimental design of the DCEs is provided. The product attributes which have been found to be important drivers of consumer's choice of dietary supplements and nutritionally-fortified products in both DCE studies and those using other methods are then identified and discussed. It is important to consider this literature as inclusion of all relevant product attributes is essential in a DCE for reliable assessment of the relative importance of product attributes [304]. Lastly, individual characteristics (e.g. socio-demographics, behaviours, attitudes, perceptions) which have previously been used to explain preference heterogeneity and thus can be used to characterise and better understand different consumer segments are highlighted.

Please note that in this chapter, the term 'nutritionally-fortified' is used to refer to the products in the DCE that was developed for and used in the present study. This term is used because the specified food and beverage products are not natural sources of the nutrients being added. Studies included in the below review also use the terms 'enrichment', 'enhancement' and 'functional' to describe the products under investigation. These products fall under the broader category of 'functional foods' and are therefore included in the review.

While there is no single legal or universally accepted definition of ‘functional food’, functional foods can generally be described as, ‘…*any food or food component that may provide demonstrated physiological benefits or reduce the risk of chronic diseases, above and beyond basic nutritional functions’* [305].

Available literature and experimental design of DCEs

While DCEs have been used as a preference elicitation method to explore consumer preferences for a range of food products [306-320], only a few DCE studies have specifically examined consumer preferences for functional food and drink products [137, 138, 159, 160, 321-323] and none have examined consumer preferences for supplement pills/tablets/capsules. Most importantly, DCEs have not been previously used to examine choices in the context of supplement tablets or nutritionally-fortified products during pregnancy, a critical stage of life for both the mother and the fetus.

Six papers (reporting results from five different DCEs) were identified that elicited preferences for fortified/functional foods and/or non-alcoholic beverages from different groups of consumers in developed countries. Table 32 provides an overview of each of the studies. These studies were conducted in the UK [138], USA [159], Canada [321-323] and Greece [160]. Products under investigation included bread enriched with inulin (fibre) [138]; tomato juice containing soy isoflavones [159]; omega-3 and vitamin enhanced eggs [321]; ‘anti-cancer’ tomato sauce, ‘heart healthy’ potato chips and chicken breasts [322, 323]; and children’s snacks including savoury puffs, chips and croissants enriched with calcium, vitamins, omega-3 fatty acids or fibre [160] .

The DCE studies mentioned above required respondents to complete between 4-16 choice sets. Three to five options were included in each choice set, and all but one DCE [322, 323] included an opt-out option in each choice set to avoid forced choice; one study also included a status-quo option in each choice set which had fixed levels for all attributes [138].The selection of product attributes and levels for the experimental design was mostly based on marketplace observations, literature reviews, and hypothetical levels necessary to address study objectives. In two studies, selection of attributes and levels was informed by findings from behavioural research including an attribute screening study requiring participants to describe important attributes for a novel functional food product [159], and means-end chain analysis in combination with laddering interviews to link product attributes with respondent's perceived consequences of product consumption [138] .

The DCE tasks were generally completed as part of a questionnaire which was either interviewer-administered or self-completed. Various product attributes were considered in the reviewed studies including fortification/functionality, health claim, method of production/source of nutrients (e.g. natural, synthetic, organic, genetic engineering), required intake/dose, and price. Findings regarding each of these attributes, with the exception of method of production (which is not relevant to the present study), are discussed below.

Influence of product attributes on choice

Functional ingredients/fortification

An attribute representing nutritional fortification (also referred to as 'enrichment' or 'functional/health property') was included in all five DCEs [138, 159, 160, 321-323]. This attribute had a significant effect on choice in all studies either in the overall sample or in at least one of the consumer segments. Three of the studies evaluated consumer preference for enrichment compared to no enrichment [138, 160, 321]. Not all enriched products were appealing to consumers. For example, while consumers derived positive utility from children's snacks enriched with fibre and other nutrients [160], bread enriched with inulin [138], and vitamin enriched eggs [321], enrichment of eggs with omega-3 was found to have disutility among consumers [321].

Possible reasons for consumers rejecting the omega-3 enriched eggs in Asselin's [321] study may be lack of knowledge regarding the benefits of omega-3 enrichment. Interestingly, 'health claim' was not included as an attribute in this study, nor were participants provided with information about the benefits of omega-3. As respondents were not specifically asked about their knowledge or perceptions regarding enrichment with omega-3, it cannot be determined whether there was any association between lack of perceived benefit and the disutility derived from enrichment. These findings suggest that it may be important to assess knowledge and/or perceptions of health benefits associated with the specific nutrient enrichment/fortification under investigation to allow examination of associations between knowledge/perceptions and preferences, and therefore increase understanding of factors influencing choice.

Two DCEs were used to examine consumer preferences and willingness-to-pay for fortification of a variety of food products with different nutrients [160, 322, 323]. The relative utilities for fortification varied across nutrients and food products. For example, fortification with fibre was most valued in potato chips and croissants, and calcium fortification was most valued in savoury puffs when examining parents' preferences for children's snacks [160]. Likewise, the majority (72-86%) of Canadian consumers surveyed were willing to pay a premium for 'anti-cancer' tomato sauce and 'heart healthy' potato chips and chicken breasts [322, 323]. However, the price premium was lowest for the functional chicken breasts [322, 323]. These findings suggest that certain nutrients or functional ingredients may be more appealing in some food products than in others.

Health claims/health benefits

Three of the reviewed DCEs included health claims or health-related benefits as product attributes [138, 159, 323]. Health claim attributes had a significant influence on choices for the overall sample and/or for one or more of the consumer segments identified. In general, consumers preferred products with health claims to products without health claims, and they were willing to pay a price premium for health benefits [138, 159].

Interestingly, consumers were willing to pay more for a soy-enriched tomato juice product with a single health claim versus one with multiple health claims (\$0.93±1.85 vs. \$0.28±3.30 per pack of six cans) [159]. The authors suggested that consumers might be sceptical about claims suggesting that a single enhanced food product could have multiple health benefits. Alternatively consumers may perceive that each additional health claim reduces the relative benefit of the others [159]. The large standard deviations and ranges of the willingness to pay (WTP) estimates indicate considerable heterogeneity between individuals in terms of what they are WTP for single and multiple health claims, therefore it is likely that for various reasons, some consumers may heavily discount certain claims while others highly value claims.

Functional ingredients/fortification vs. health claims as attributes

Bitzios [138] examined the joint impact or interaction of the presence of a functional ingredient, inulin, and a health claim indicating whether the product promotes health on consumers' willingness-to-pay and choice of bread. While some consumers valued and were willing to pay a price premium for the presence of inulin, they were willing to pay more for the presence of both inulin and the promise of a health benefit, and were willing to pay the most for bread which claimed to promote health but did not contain inulin. Overall, these findings indicate a greater preference, among some consumers, for a clearly expressed health benefit compared to just a functional ingredient which may or may not be associated with a health benefit.

Price/cost of consumption

All five DCEs included price as an attribute in order to estimate the value and relative economic importance that consumers place on specific attributes. The number of price levels varied (three to six) and the levels were generally presented similar to how specific products are priced by retailers (e.g. price per kilogram of chicken, dozen eggs, loaf of bread, pack of six cans etc.). Not surprisingly, the coefficient on the price variable was significant and had a negative impact on choice in all DCE studies. Therefore, consumers derived negative utility from all price levels and tended to choose the least expensive products (holding all else constant).

Interestingly, when exploring parents' preferences for three functional children's snacks, Krystallis [160] found that price only significantly (at the 10% level) influenced purchase of chips (P=0.008) and savoury puffs (P=0.057), but not croissants (P=0.690). This highlights the importance of examining *product-specific* price effects on choice.

Additional relevant literature regarding influential product attributes

In addition to the above reviewed studies, other research examining supplement/functional food choices that did not use DCEs also provides insight into product attributes that may be important to consider when investigating choice of food products. For example, in-store shopping interviews with 51 female supplement users aged 25-45 years in the United States, identified ten key decision-making criteria used to select supplements [324]. These criteria include: price, quantity, dose, product information, dose instruction/frequency, inactive ingredient, active ingredient, product formulation (single nutrient or multi-nutrient), supplement delivery (e.g. tablet or capsule) and brand.

Further, several studies used conjoint analysis (CA) methods (discussed in section 0), to examine consumer preferences for functional foods and supplement tablets [145-147]. These studies included product attributes not assessed in any of the DCE studies reviewed above, namely product type or mode of delivery (food, drink, tablet /capsule) and information source or certification. On average, mode of delivery/product type was the most important attribute considered by consumers when making product choices [145-147]. Yogurt and ice-cream were preferred as a source of probiotics over supplement pills [147]; supplements were preferred over milk as a source of long chain omega-3 fatty acids, but bread was most preferred [146]; and supplements were preferred over milk and bread but farm-raised fish was most desirable as a source of long chain omega-3 fatty acids [145]. The findings of these CA studies support the findings of the DCE studies, which suggest that preferences for fortification differ by type of food products.

Several CA studies examined the impact that the source of health claim information [145-147, 325] or the source of certification [326] had on food product choices. The relative importance of this attribute varied between studies. Source of information/certification ranged from being the most important of four attributes in Saba and Rosati's [326] study of Canadian consumers' preferences for probiotic or nutrient fortified yogurt, to the least important of four attributes in Hailu's [147] study of Canadian consumers' preferences for probiotic enriched yogurt, ice-cream and supplement pills. In the remaining CA studies, information source was the third or fourth most important attribute out of the five or six attributes considered in the choice decision. The different sources of information/certification examined in these studies included government agencies (e.g. Ministry Of Health, Commonwealth Scientific and Industrial Research Organisation (CSIRO), 'government agency') [145, 147, 326]; national food regulators (e.g. FDA, FSANZ) [145, 146]; non-Government organisations (e.g. National Heart Foundation, American Heart Association, Association of consumers) [145, 146, 326]; product manufacturers/ private corporations [145-147, 325]; and industry groups, medical sources (e.g. surgeon general) and popular health magazines [325].

Effects of demographic and individual characteristics on choice

Characterising the different consumer segments in terms of socio-demographic and other individual characteristics provides a better understanding of groups of consumers with unique preferences and allows products and recommendations to be better tailored to target groups.

Socio-demographic characteristics

While all studies included in this review assessed participant socio-demographics, not all studies reported the effect of socio-demographic factors on consumer choice or preferences. The three studies which did either performed latent class analysis to segment the sample in terms of preferences [138], estimated choice models for different socio-demographic subgroups [159] or included socio-demographic variables as interaction terms in the systematic component of the utility function when estimating the choice model [321].

Overall, the DCE studies reported mixed findings in regards to the influence of socio-demographics on choice. Firstly, while gender and age did not significantly impact choice of vitamin or omega-3 enriched eggs [321], these variables did affect consumer preferences for a new soy-enriched tomato juice [159]. Notably, compared to males, females had a greater range of WTP estimates indicating greater heterogeneity in preferences for soy in tomato juice [159]. This suggests that when examining functional food preferences of female samples, it may be important to explore preference heterogeneity. Higher education and income were also found to have a significant positive effect on preferences for soy-enriched tomato juice [159], and higher income also had a significant positive effect on preferences for bread enriched with inulin [138].

Other individual characteristics

The same three studies also examined associations between other individual characteristics (such as behaviour related to health and consumption of functional foods, attitudes and perceptions) and preferences for functional products [138, 159, 321]. Health consciousness, health behaviours (index score based on health behaviours such as smoking, alcohol consumption, sleeping and eating habits, level of physical activity, and comparison of health to one year ago) and views regarding engineered foods significantly influenced preferences for eggs enriched with vitamins and omega-3 [321]. While respondents with higher health consciousness and health behaviour scores were willing to pay a price premium for the enhanced eggs, those who believed there were benefits from engineered foods were willing to pay a lower premium compared to those with neutral views or who did not perceive any extra benefits [321].

Health consciousness was also found to influence some consumers' preferences for functional bread [138]. These consumer segments were also influenced by emotional, external and restrained eating behaviours, all of which are associated with overeating [138, 327]. Additionally, having a family history of heart disease had a negative influence on consumer's valuation of soy-enriched tomato juice; and occasional or frequent purchase of functional, organic and natural foods had a positive impact on consumer valuation of the soy-containing tomato juice [159]. This latter finding suggests that purchase history/previous consumption of similar products may influence preferences for new but related products.

Other factors which were assessed but were not found to be significant include: number of children in the household and reading labels in relation to preferences for omega-3 enriched eggs [321]; exercise in relation to preferences for bread fortified with inulin [138]; and a family history of cancer in relation to preferences for soy-containing tomato juice [159].

Table 32. Key characteristics of reviewed discrete choice experiment studies

Reference	Country	Study design	n	Experimental design and analysis	Comments
Bitzios, 2011 [138]	UK	SAQ posted to stratified sample of UK households, purchased from commercial list broker (Marketing File). Investigated consumer preferences for purchasing bread with added inulin.	404 (64% F) Average age 53y 15% RR	24 choice sets blocked into groups of 6 (4 versions of survey). 5 alternatives per choice set. Included opt-out option and status quo option (fixed levels: white lower value sliced bread). <u>7 attributes with 2-6 levels each:</u> 1. Type of bread (white, wholemeal, brown, 50:50, rye) 2. Method of production (conventionally, organically) 3. Functional ingredient (yes, no) 4. Sliced/unsliced (medium sliced, thick sliced, unsliced) 5. Texture (soft, firm, crunchy, springy) 6. Health benefit (yes, no) 7. Price- cost (in £) for buying a standard 800gr loaf (0.7, 1, 1.3, 1.6, 1.9, 2.2) <u>Individual characteristics included in analysis:</u> Income, health consciousness when buying food, exercise (y/n), restrained eating, emotional eating, external eating. <u>Data analysis:</u> Latent class analysis. Reported regression coefficients and WTP estimates.	Not completely representative of UK population but is comparable. Sample has higher average age, higher proportion of households with children, lower average income. Latent class analysis allows for heterogeneity among respondents Selection of attributes and levels informed by means-end chain analysis in combination with laddering interviews to link product attributes with respondent's perceived consequences of product consumption.
Teratanavat & Hooker 2006 [159]	USA	SAQ posted to randomly selected households, stratified by area (rural/urban). Sample list generated by private vendor (Experian Direct Tech). Examined consumer preferences and valuations for a novel functional food	1704 (51% F) 19% <35y, 54% 35-60y, 27% >60 52% RR	8 choice sets randomly blocked into groups of 4 (2 versions of survey). 4 choice sets per respondent. 3 product alternatives plus 'opt-out' option included in each choice set. <u>4 attributes with 2-4 levels each:</u> 1. Health benefits (no health benefit, single health benefit ('rich in nutrients that may reduce the risk of prostate cancer'), multiple health benefits ('rich in nutrients that may reduce the risk of prostate cancer and heart disease') 2. Organic (conventional ingredients, organic ingredients) 3. Source of nutrients (natural, fortified nutrients) 4. Price ($3.00, $3.50, $4.00, $4.50)	Respondents similar to Ohio and U.S. populations in terms of gender, marital status, education, and household income. Sample is older and smaller proportion of African-American respondents compared to state-wide population and less Hispanic/Latino and Asian respondents compared to U.S. population. Larger proportion of respondents living in owner-occupied housing compared to more general populations.

Reference	Country	Study design	n	Experimental design and analysis	Comments
		product-a tomato juice containing added soy and/or lycopene.		Individual characteristics included in analysis: Gender, age, education, income, health-diet awareness/interest, family disease history (cancer and heart disease), and frequency of purchase of organic, natural and functional foods. Data analysis: Conditional logit model and mixed logit model. Reported WTP estimates.	Attribute screening study conducted to identify attributes for inclusion in DCE. Structured questionnaire complete by 326 undergrad business majors; described attributes important to them for this new product. Conditional logit model does not allow for heterogeneity among respondents.
Asselin, 2005 [321]	Canada	SAQ completed by shoppers from a major shopping centre (West Edmonton Mall) and other local business employees Estimated consumers' WTP pay for omega-3 eggs, when compared to generic eggs (produced using traditional methods) and vitamin enhanced eggs (↑vit E, B6, B12 and folate).	128 (60% F) Average age 36y RR not reported	28 choice sets blocked into groups of 7 (4 versions of survey). 7 choice sets per respondent. 3 options per choice set (2 presented different egg types and prices and 1 was 'opt out' option) 2 attributes with 3 levels each: 1. Egg type (generic, vitamin enriched, omega-3) 2. Price ($1.79, $2.78, $3.12) Individual characteristics included in analysis: Gender, age, propensity to read labels, number of minors in the household, perceptions of engineered foods, health consciousness, and health behaviour scores. Data analysis: Conditional logit model. Reported WTP.	Convenience sample. Conditional logit model does not allow for heterogeneity among respondents. Egg prices chosen based on (Edmonton) supermarket egg prices at time of survey.
Krystallis 2005 [160]	Greece	SAQ completed by parents with children at a snack-consuming age who had purchased a children's snack at least once during the month prior to survey. Investigated parents' preferences for 3 new	120 (70% F) Average age 39y RR not reported	16 choice sets for savoury puffs, 16 for croissants and 32 for chips-blocked into groups of 4, 4 and 8, respectively. 4 choice sets with savoury puffs, 4 with croissants and 8 with chips per respondent. 2 alternatives (of same snack) in each choice set (one was functional product and the other was status quo option- currently available product with no functionality). Each pair of alternatives presented on card with coloured pictures of the alternatives.	Convenience sample. Multinomial logit model does not allow for heterogeneity among respondents. Price based on real prices in Athens area. 3 price levels for functional products were hypothetical prices calculated as % premium added to price of conventional snacks (+50% for savoury puffs, +30%

Reference	Country	Study design	n	Experimental design and analysis	Comments
		functional children's snacks marketed in Greece: Savoury puffs, chips and croissants enriched with calcium, vitamins, omega-3 fatty acids or fibre.		<u>4 attributes with 2-5 levels each:</u> 1. Price (3 levels each for conventional and functional snacks) 2. Type of oil used (usual, olive oil) [chips and savoury puffs only] 3. Functionality (none, enriched with calcium, enriched with vitamins, enriched with omega-3 fatty acids, enriched with fibres) 4. Flavour (classic, oregano, barbeque) [chips only] and (chocolate, cream, marmalade) [croissants only] <u>Individual characteristics included in choice analysis:</u> None <u>Data analysis:</u> Multinomial logit model. Reported regression coefficients and WTP.	chips, and +60% chips on average) Flavours selected represent existing product alternatives and use of olive oil for manufacturing of salty snacks.
West et al. 2002 [323] & Larue et al 2004 [322]	Canada	CATI of household food shoppers. Market research company (SOM inc.) recruited respondents and administered survey. *West (2002):* Assessed consumer valuation of the functional properties in foods [tomato sauce (398ml can), potato chips (180g bag) and chicken breasts (1kg)] *Larue (2004):* Assessed consumer valuation of functional health properties in conventional, organic, and GM foods.	1008 (% F not reported) Estimated RR 33% Average age not reported.	12 choice sets per respondent. 4 choice sets completed for each product (3 alternatives in each choice set plus opt-out option). <u>3 attributes:</u> 1. Food property (conventional, organic, GM) 2. Functional property ('anti-cancer' for tomato sauce and 'heart healthy' for potato chips and chicken breasts) 3. Prices-set according to what observed in marketplace for organic and conventional products at time of survey (number of price levels not reported). <u>Data analysis:</u> Random parameters logit model. Reported regression coefficients, WTP and probabilities of purchase.	Representative sample of Canadian consumers. Random parameters logit model allows for heterogeneity among respondents. Telephone survey- no visual cues. These specific foods selected as: 1. Almost all Canadian households commonly purchase these foods 2. They avoid potential bias caused by ideological objections 3. They represent food products of both plant and animal origin. Prices set according to what was observed in the marketplace for organic and conventional products at the time of the survey.

Abbreviations: SAQ = self-administered questionnaire; CATI = Computer-assisted telephone interview; F = female; RR = response rate; WTP = willingness to pay; GM = genetically modified.

Methods

The DCE was part of the large online survey described in Chapter 3.

Choice task

Prior to completing the DCE, respondents answered a number of socio-demographic, pregnancy-related and nutrition knowledge questions. To avoid biasing responses to the DCE, questions regarding dietary intake and supplement use were asked after the DCE.

For the DCE, women were presented with the following scenario: '*imagine that you have just found out you are pregnant and you are shopping for a product to enhance your dietary intake during pregnancy'.* This choice scenario was specified to ensure that all of the respondents were making their choices in the same context. Brief definitions of 'fortified' products and each of the attributes used to describe the products in the choice experiment were also provided, followed by images of the different products and different types of brands considered for each alternative.

The DCE included three alternatives per choice set, which were labelled as a 'fortified food', 'fortified drink', and 'supplement tablet'. In each choice set respondents indicated 1) their most preferred product, 2) their least preferred product, and 3) if they would realistically purchase their most preferred product.

Experimental design

The DCE used an orthogonal main effects plan (OMEP) from a widely acknowledged orthogonal array library maintained by Sloane (http://neilsloane.com/oadir/). This design is the oa.162.19.9.2 design. This design has enough independent main effects for an alternative-specific design, which allowed similar attributes for each labelled alternative to be treated differently and estimated separately. The resulting 162 unique choice sets were allocated to nine blocks, each containing 18 of the choice sets. To avoid respondent fatigue, respondents were randomly allocated to one of nine different versions of the DCE.

A labelled alternative-specific DCE was chosen as the method to address the study objectives as labelling of the options as a fortified food, fortified drink and a supplement tablet rather than options A, B, and C (as would be the case in an unlabelled experiment), conveyed additional meaning to respondents beyond presentation order. Further, a design with three alternatives per choice set was chosen as this allowed one product representing each of the three types of products to be presented in each choice set. Allowing women to make trade-offs between each of the three product forms in each choice set, made it possible to determine whether there is an overall preference for the type of product delivering the nutrients. Inclusion of three alternatives in a best-worst choice task also allows the full-ranking order to be established, resulting in greater statistical efficiency [328].

Attribute and level selection

Table 33. Attributes and levels included in the discrete choice experiment

<table>
<tr><th></th><th colspan="4">Fortified food</th><th colspan="4">Fortified drink</th><th colspan="4">Supplement tablet</th></tr>
<tr><td>Specific product[1]</td><td colspan="4">1. Yogurt (1 tub/200g)
2. Bread (2 slices)
3. Cereal (1 cup)</td><td colspan="4">1. Juice (1 cup/250mL)
2. Milk (1 cup/250mL)
3. Water (1 cup/250mL)</td><td colspan="4">1. Multivitamin tablet 1/d
2. Multivitamin tablet 2/d
3. Vitamin tablet 1/d</td></tr>
<tr><td>Folate</td><td colspan="12">0, 400, 800 μg</td></tr>
<tr><td>Iodine</td><td colspan="12">0, 150, 250 μg</td></tr>
<tr><td>Omega-3</td><td colspan="12">0, 115, 500 mg</td></tr>
<tr><td>Vitamin D</td><td colspan="12">0, 200, 400 IU</td></tr>
<tr><td>Endorsement</td><td colspan="12">1. Endorsed by the National Health and Medical Research Council (NHMRC)
2. Endorsed by the Dietitians Association of Australia (DAA)
3. Endorsed by the National Heart Foundation
4. Endorsed by the CSIRO
5. Scientifically proven
6. No endorsement</td></tr>
<tr><td>Absorption</td><td colspan="12">1. Easy to digest and absorb
2. No claim</td></tr>
<tr><td>Brand</td><td colspan="12">1. A specific brand
2. No specific brand or a generic brand</td></tr>
<tr><td rowspan="3">Daily cost ($)[2]</td><td>Yogurt</td><td>0.90</td><td>2.45</td><td>4.00</td><td>Juice</td><td>0.30</td><td>1.20</td><td>2.20</td><td>MV (1/d)</td><td>0.25</td><td>0.65</td><td>1.10</td></tr>
<tr><td>Cereal</td><td>0.25</td><td>0.70</td><td>1.20</td><td>Milk</td><td>0.25</td><td>0.90</td><td>1.50</td><td>MV (2/d)</td><td>0.25</td><td>0.65</td><td>1.10</td></tr>
<tr><td>Bread</td><td>0.25</td><td>0.75</td><td>1.25</td><td>Water</td><td>0.15</td><td>1.20</td><td>2.20</td><td>Vitamin (1/d)</td><td>0.15</td><td>0.35</td><td>0.65</td></tr>
</table>

Abbreviation: MV = Multivitamin tablet

[1] Alternative-specific attribute

[2] Product-specific attribute

The attributes and levels included in the DCE are shown in Table 33, and were chosen after conducting a substantial review of the relevant literature, observing the marketplace to understand the variety of nutritionally-fortified food and beverage products and dietary supplements available, and conducting the focus group discussions and in-depth interviews described in section 0. Below is a description of all attributes and levels included in the DCE and the rationale for their inclusion.

1. *Specific product*

While the labelled alternatives represented three different types of base product (fortified food, fortified beverage and supplement tablet) a ‘specific product’ attribute was also included to determine preferences for specific food, beverage and tablet products. This attribute was alternative-specific, with three different products chosen to represent each type of base product.

Selection of the different food and beverage products was based on direct market place observation, in particular, identification of food and beverage products that are commonly fortified in the current market, and consideration of products which are considered appropriate for consumption during pregnancy. A wide variety of fortified food products such as bread, yoghurt and breakfast cereals, as well as fortified beverages, including dairy, fruit juice and bottled water products are currently available in Australia, but at the time the study was designed none were targeted at pregnant women.

Selection of different types of supplements was based on direct market place observation and focus group findings suggesting that some women prefer supplements which contain a single nutrient or a select few nutrients rather than a multivitamin.

2. Nutrients: Folate, iodine, omega-3 fatty acids and vitamin D

Four nutrients, which could be used to 'fortify' food and beverage products, or could be included in a vitamin tablet, were included as attributes in the DCE. These included: folate, iodine, omega-3 and vitamin D. Folate and iodine were selected as they are the two nutrients for which health authorities recommend supplementation during pregnancy [207, 229]. Vitamin D and omega-3 fatty acids were selected based on their established importance during pregnancy and their potential pregnancy/early-childhood related health impacts [230-234], as well as their presence in many pregnancy supplements in the current market.

The nutrient levels specified the amount of the nutrient in the product and were based on the supplement recommendations for iodine and folate [207, 229], the amount considered as 'adequate intake' for omega-3 fatty acids and vitamin D [206], as well as levels observed on nutrition information panels on products during market place observation. Each nutrient had three levels, which were identical across all three alternatives. The first level was zero (signifying absence of the nutrient), the second level was the amount recommended by the NHMRC during pregnancy, and the third level was an amount greater than that recommended but generally also found in supplement products in the current market.

3. Endorsement

Endorsement, defined as a 'third-party who approves the nutrition or health claims made regarding the fortified product', was selected as an attribute based on previous research that suggested that certifications and endorsements influence some consumers' preferences for fortified products and dietary supplements [145, 146, 325, 326]. Thus, endorsement levels chosen for this study were based on literature reviews, marketplace observation of endorsements and certifications found on relevant food products and dietary supplements, as well as expert opinions.

The endorsement ‘levels’ included i) no endorsement; ii) a national health authority (NHMRC), iii) a professional association (Dietitians Association of Australia), iv) a non-profit non-government health organisation (National Heart Foundation*)*, v) a government science agency (CSIRO*)*, and vi) a general claim often seen on supplement labels (‘scientifically proven’).

The experimental design required nine levels for each attribute. However, because only six endorsement levels were defined, three of the six ‘levels’ (‘endorsed by the Heart Foundation’, ‘endorsed by the CSIRO’ and ‘scientifically proven’) appeared twice as often in the choice experiment. As these attributes appeared more frequently relative to the other endorsement levels, more precise relative utility estimates (with lower standard errors) were estimated for these three levels.

4. Absorption

Absorption, which describes whether the product is easily digested and absorbed by the body, was included as an attribute based on findings from focus groups that some women changed supplement products due to problems with digesting the product. Two absorption levels were defined: i) ‘easy to digest and absorb’ and ii) ‘no claim’. To fulfil the requirements of a nine-level attribute, ‘easy to digest and absorb’ was assigned to four of the nine levels and ‘no claim’ was assigned to the remaining five levels.

5. Brand

A ‘brand’ attribute was included based on focus group findings that some women trusted more ‘well-known’ brands. Rather than including specific names of brands currently on the market, two brand levels were defined: i) a specific brand (assigned to five of the nine levels) and ii) a generic brand (assigned to four levels). Before completing the choice tasks, examples (images) of ‘specific’ brands and ‘generic brands’ were provided for each of the different food and beverage products, as well as the supplement tablets (see Appendix 6). A ‘specific brand’ appeared more often in the experimental design, reflecting market conditions where branded supplements outnumber generic or store-branded products.

6. *Daily cost ($)*

A ‘daily cost’ attribute was included based on previous research that suggested that product cost had a significant impact on choice of functional food/beverage products [138, 159, 160, 321-323]. Additionally, women in the focus group discussions frequently mentioned that ‘cost’ or ‘price’ influenced their consumption decisions. This attribute was ‘product-specific’ meaning that each of the three different food, beverage and tablet products had three price levels, which were specific to that product. Price levels represented the daily cost of consuming the product in the specified quantity, which was based on the recommended serving size of the product.

The selection of price levels was based on the wide range of prices observed in the market for conventional and differentiated food and beverage products and the different brands of supplement tablets. Food and beverage products were considered differentiated (from the conventional product) if they included health claims, endorsements or certifications, were fortified with specific nutrients, were differentiated according to production methods (e.g. organic) or had other points of difference warranting a price premium (e.g. gluten-free).

Visits were undertaken to supermarkets and health food shops and prices were recorded for between 17-23 food and beverage products representing both conventional and differentiated alternatives of each of the six base products. Prices were also checked online using the major food retailing websites. Cost per loaf and number of slices per loaf was recorded for each bread product, and cost per 100 grams was recorded for all other products. Daily cost (per specified serve size) was derived from these values and the selected price levels were based on the observed price range for each specific product. For each product, the lowest price level represented the lowest observed price of conventional/undifferentiated products, the highest represented the highest observed price of differentiated products, and the middle-price level reflected a mid-point between the lowest and highest observed prices.

To establish price levels of supplement tablet products, visits were undertaken to three major pharmacies, one department store, and one health/beauty retailer, and prices were recorded for different types (including multivitamins as well as products containing one or two types of nutrients only) and brands of supplement tablets. Product cost (per package), number of capsules/tablets per package and daily dose were recorded and used to calculate daily cost of consumption. Again, the price levels selected were based on the observed price ranges for the different types of supplement tablet products.

7. Information conditions

The ‘information conditions’ or health claims regarding health benefits, which are supported by scientific evidence for each of the nutrients included in the choice experiment, are shown in Table 34. A between-subject (2^J) design ensured each respondent saw a specific combination of nutrients and health claims. For each nutrient, respondents were randomly shown or not shown one of 16 different information conditions based on their nutrient-related knowledge gathered in an earlier section of the online survey. Table 35 shows the steps followed in randomly allocating women to information conditions. Using folate as an example, there were four different ways of allocating information regarding the benefits of folate when it was included as a nutrient in the choice set: 1) if the respondent *was aware* of the benefits of folate then they *were shown* the folate-related health claim; 2) if the respondent *was aware* of the benefits of folate then they were *not shown* the folate-related health claim; 3) if the respondent was *not aware* of the benefits of folate then they *were* *shown* the folate-related health claim; and 4) if the respondent was *not aware* of the benefits of folate then they were *not shown* the folate-related health claim.

Thus, while a within-subject choice experiment design ensured each participant completed 18 different choice sets, a between-subject (2^J) design for the information conditions, ensured that each participant saw the same combination of health claims in all 18 choice sets. The aim of varying the information conditions between respondents according to knowledge was to ensure that we could determine whether knowledge and/or being shown health benefits of specific nutrients influenced product choice.

Table 34. Health claims relating to each of the nutrients included in the choice experiment

Folate	Adequate folate helps prevent neural tube defects such as spina bifida.
Iodine	Iodine plays an important role in the normal development of the baby's brain.
Omega-3	Omega- 3 fatty acids play an important role in the normal development of the baby's brain and may help prevent premature birth and childhood allergy.
Vitamin D	Vitamin D plays an essential role in strengthening baby's bones.

Table 35. Method of allocating women to information conditions

	Knowledge of benefit (from knowledge section)	Shown benefit information (random allocation)
Folate	Y	Y or N
	N	Y or N
Iodine	Y	Y or N
	N	Y or N
Omega-3	Y	Y or N
	N	Y or N
Vitamin D	Y	Y or N
	N	Y or N

Empirical model and data analysis

A conditional logit model (also known as a 'multinomial logit model') was used to model pregnant women's product choice among nutritionally-fortified foods and beverages, and supplement tablets. The choice model assumes that women will choose the product that maximises their utility (see section 2.1.2 for a discussion of utility). As shown below, the choice model describes pregnant women's utility as a function of both product attributes [$\boldsymbol{\beta_{ij}}$ $\boldsymbol{X_{ij}}$] and individual characteristics [$\boldsymbol{(z_i * X_{ij})\alpha}$]:

$$U_{ij} = \boldsymbol{\beta_{ij} X_{ij} + (z_i * X_{ij})\alpha} + \varepsilon_{ij} \qquad (1)$$

In the above formula, U_{in} is the utility that individual *i* derives from choosing product *j*, $\boldsymbol{X}$ represents the different attribute levels of product *j*, $\boldsymbol{\beta}$ is the parameter to be estimated (representing the effect of the attribute level on utility/choice), **z** represents the characteristics of individual *i* which are interacted with specific attribute levels ($\boldsymbol{X}$) of product *j*, and $\boldsymbol{\alpha}$ is the parameter to be estimated (representing the effect of the individual characteristics on choice of products with given attributes).

The specific empirical formulas used to model choice in this study, were:

Model 1

$$\begin{aligned} U_{ij} = {} & [\beta_1 \mathit{Alternative}_{ij} + \beta_2 \mathit{Brand}_{ij} + \beta_3 \mathit{Endorsement\_alt1}_{ij} + \beta_4 \mathit{Endorsement\_alt2}_{ij} + \beta_5 \\ & \mathit{Endorsement\_alt3}_{ij} + \beta_6 \mathit{Absorption\_alt1}_{ij} + \beta_7 \mathit{Absorption\_alt2}_{ij} + \beta_8 \mathit{Absorption\_alt3} \\ & {}_{ij} + \beta_9 \mathit{Folate}_{ij} + \beta_{10} \mathit{Iodine}_{ij} + \beta_{11} \mathit{Omega\text{-}3}_{ij} + \beta_{12} \mathit{Vitamij\ D}_{ij} + \beta_{13} \mathit{Folate*Iodije}_{ij} + \beta_{14} \\ & \mathit{SpecificProduct\_alt1}_{ij} + \beta_{15} \mathit{SpecificProduct\_alt2}_{ij} + \beta_{16} \mathit{SpecificProduct\_alt3}_{ij} + \beta_{17} \\ & \mathit{Price\_yogurt}_{ij} + \beta_{18} \mathit{Price\_bread}_{ij} + \beta_{19} \mathit{Price\_cereal}_{ij} + \beta_{20} \mathit{Price\_juice}_{ij} + \beta_{21} \\ & \mathit{Price\_milk}_{ij} + \beta_{22} \mathit{Price\_water}_{ij} + \beta_{23} \mathit{Price\_multivit1}_{ij} + \beta_{24} \mathit{Price\_multivit2}_{ij} + \beta_{25} \\ & \mathit{Price\_vitamij1}_{ij} + \beta_{26} \mathit{Information\ condition\_folate*folate}_{ij} + \beta_{27} \mathrm{Information} \\ & \mathrm{condition\_iodine*iodine}_{ij} + \beta_{28} \mathit{Information\ condition\_omega\text{-}3*omega\text{-}3}_{ij} + \beta_{29} \\ & \mathit{Information\ condition\_vitamin\ D*vitamin\ D}_{ij}] + [\alpha_1 \mathit{Cohort*alt1}_{ij} + \alpha_2 \mathit{Cohort*alt2}_{ij} + \\ & \alpha_3 \mathit{Cohort*alt3}_{ij}] + \varepsilon_{ij} \end{aligned}$$

Model 2

U_{ij} = [β_1 *Alternative*$_{ij}$ + β_2 *Brand*$_{ij}$ + β_3 *Endorsement_alt1*$_{ij}$ + β_4 *Endorsement_alt2*$_{ij}$ + β_5 *Endorsement_alt3*$_{ij}$ + β_6 *Absorption_alt1* $_{ij}$ + β_7 *Absorption_alt2* $_{ij}$ + β_8 *Absorption_alt3* $_{ij}$ + β_9 *Folate*$_{ij}$ + β_{10} *Iodine*$_{ij}$ + β_{11} *Omega-3*$_{ij}$ + β_{12} *Vitamin D*$_{ij}$ + β_{13} *Folate*Iodine*$_{ij}$ + β_{14} *SpecificProduct_alt1*$_{ij}$ + β_{15} *SpecificProduct_alt2*$_{ij}$ + β_{16} *SpecificProduct_alt3*$_{ij}$ + β_{17} *Price_yogurt*$_{ij}$ + β_{18} *Price_bread*$_{ij}$ + β_{19} *Price_cereal*$_{ij}$ + β_{20} *Price_juice*$_{ij}$ + β_{21} *Price_milk*$_{ij}$ + β_{22} *Price_water*$_{ij}$ + β_{23} *Price_multivit1*$_{ij}$ + β_{24} *Price_multivit2*$_{ij}$ + β_{25} *Price_vitamin1*$_{ij}$ + β_{26} *Information condition_folate*folate*$_{ij}$ + β_{27} Information condition_iodine*iodine$_{ij}$ + β_{28} *Information condition_omega-3*omega-3*$_{ij}$ + β_{29} *Information condition_vitamin D*vitamin D*$_{ij}$] + [α_1 *Cohort*alt1*$_{ij}$ + α_2 *Cohort*alt2*$_{ij}$ + α_3 *Cohort*alt3*$_{ij}$ + **α_4 *Age_alt1*$_{ij}$ + α_5 *Age_alt2*$_{ij}$ + α_6 *Age_alt3*$_{ij}$ + α_7 *Education_alt1*$_{ij}$ + α_8 *Education_alt2*$_{ij}$ + α_9 *Education_alt3*$_{ij}$ + α_{10} *Income_alt1*$_{ij}$ + α_{11} *Income _alt2*$_{ij}$ + α_{12} *Income _alt3*$_{ij}$ + α_9 *Parity_alt1*$_{ij}$ + *Parity_alt2*$_{ij}$ + *Parity_alt3*$_{ij}$**] + ε_{ij}

Note that *alternative (referring to the product being a fortified food, fortified beverage or supplement tablet), brand, endorsement, nutrients (folate, iodine, omega-3 fatty acids* and *vitamin D), specific product* and *price* are all product attributes considered in the choice sets. The attribute levels shown in Table 33 and the survey responses to the choice experiment were used to estimate the above choice models.

Effects coding, which allows β parameters to be estimated for all levels of attributes, was used for the analysis of the following attributes: *alternative, brand, endorsement* and *specific product.* Linear coding was used to estimate the β parameters for the price and nutrient attributes, which were recoded into continuous variables and mean-centred to allow the model to estimate and produce meaningful parameter estimates. Additionally, the units of vitamin D were changed from IU to µg (for consistency across nutrients) to be consistent with the other nutrients; and to ease interpretation, folate, iodine and omega-3 levels were divided by 100 such that effects are estimated for every/per 100µg of folate and iodine, 100mg of omega-3 and 1µg of vitamin D.

The alternative-specific design of the choice experiment enabled estimation of alternative-specific effects of attributes. Whether attributes influenced choice differently for the three different alternatives or whether their effect was the same across the alternatives was determined by Wald tests. A Wald test is a chi-square test, which tests the significance of sets of parameters included in a choice model. Results from the Wald test were used to determine whether *generic* or *alternative-specific* effects were estimated for each attribute. Alternative-specific effects were estimated for attributes when at least one of the three alternatives had a significant Wald statistic; this was the case for specific product, endorsement, absorption, and price (for which product-specific effects were calculated). Generic effects were estimated for attributes which had non-significant Wald statistics for all three alternatives; this was the case for brand, the four nutrients and the folate and iodine interaction (described below).

As well as estimating main effects of attributes to determine the importance of attributes in the choice decision and the preferences for different levels of attributes, a small number of interaction terms were also included in the model. Of specific interest was determining whether increasing levels of both iodine and folate, the two nutrients for which supplements are recommended in pregnancy, affected pregnant women's choices. Also of interest was determining how knowledge regarding nutrients and/or being presented with information about the health benefits of a nutrient, influenced pregnant women's preferences for products with higher levels of that nutrient. This was done by adding the 16 information conditions into the model as predictors and interacting them with the nutrient referred to in the information condition (e.g. the information condition where women did not know the health benefits of folate but were shown this information, was interacted with women's preferences for every 100μg increase in folate).

As shown above in the equations for Model 1 and Model 2 the empirical formulas used to model choice also included individual characteristics as explanatory variables. To determine the impact that cohort membership had on choice, cohort membership was included as an individual characteristic in Model 1. Model 2 included four additional individual characteristics, maternal age, educational attainment, household income and parity (previous births vs. no previous births).

Table 36 provides an overview of each of the individual characteristics included in the estimation. To incorporate these variables into the choice models, they were interacted with the product alternative attribute. Thus, the interaction terms measure the effect of the individual characteristics (e.g. cohort, maternal age) on likelihood of choosing a fortified food, fortified beverage or a supplement tablet. Selection of these explanatory variables was based on findings from previous studies that found that these variables had a significant influence on dietary decisions, including use of dietary supplements during pregnancy [19, 35, 37, 40, 42, 45-54].

Table 36. Individual characteristics included in the estimation of the aggregate choice model[1]

Variable	Measured	Mean	SD	Min	Max
Cohort	0 if national; 1 if South Australian	0.47	0.50	0	1
Age	Respondent's age in years. Continuous variable	31.07	5.05	18	46
Education	Highest level of education completed. 8 levels coded 0-8: Below Year 10, Year 10, Year 11, Year 12, Certificate (III or IV), Diploma level or advanced diploma, Bachelor degree, Graduate certificate or graduate diploma, Postgraduate degree (masters or PhD)	5.19	1.75	0	8
Income	Gross annual household income. 6 levels coded 0-5: ≤ \$20,000, \$20,001 - \$40,000, \$40,001 - \$70,000, \$70,001 - \$105,000, \$105,001 - \$205,000, > \$205,00	2.72	1.24	0	5
Previous births	0 if no previous births; 1 if ≥1 previous birth	0.53	0.50	0	1

The choice data were analysed in Latent Gold Choice 5.0 syntax module with the level of statistical significance set at P<0.10. Respondents' choices were analysed using an aggregated conditional logit model which assumed preference homogeneity among respondents. Therefore, women's preferences for the three alternative products (fortified foods, fortified beverages and supplement tablets) and each of the attribute levels were estimated. As the aim of this analysis was to assess the impact of different attributes and attribute levels on choice rather than to determine demand for products with specific attributes and attribute levels, responses to the 'most preferred' question were used as the dependent variable in the model, rather than responses to the 'intention to buy' question.

After estimating the aggregated choice model, latent class analysis was used to explore preference heterogeneity by identifying distinct consumer segments with unique preferences [172]. Empirical model 1 (shown earlier) was estimated using latent class analysis. Post-hoc chi-square tests and one-way ANOVA were then used to characterise consumer segments by socio-demographics and behavioural variables in an attempt to link choice heterogeneity to observable covariates and better understand different consumer segments.

No pilot data were available on which to perform a power calculation to determine the necessary sample size. Therefore, the required sample size for the choice experiment was guided by a rule of thumb used by experts in conducting discrete choice experiment research (T. Flynn, personal communication, June 20, 2013) suggesting that 30 to 50 respondents complete each version of the choice experiment (where each version contains a specified number of unique choice sets). Thus with nine versions of 18 choice sets, a sample size of between 270 and 450 women was required for this study.

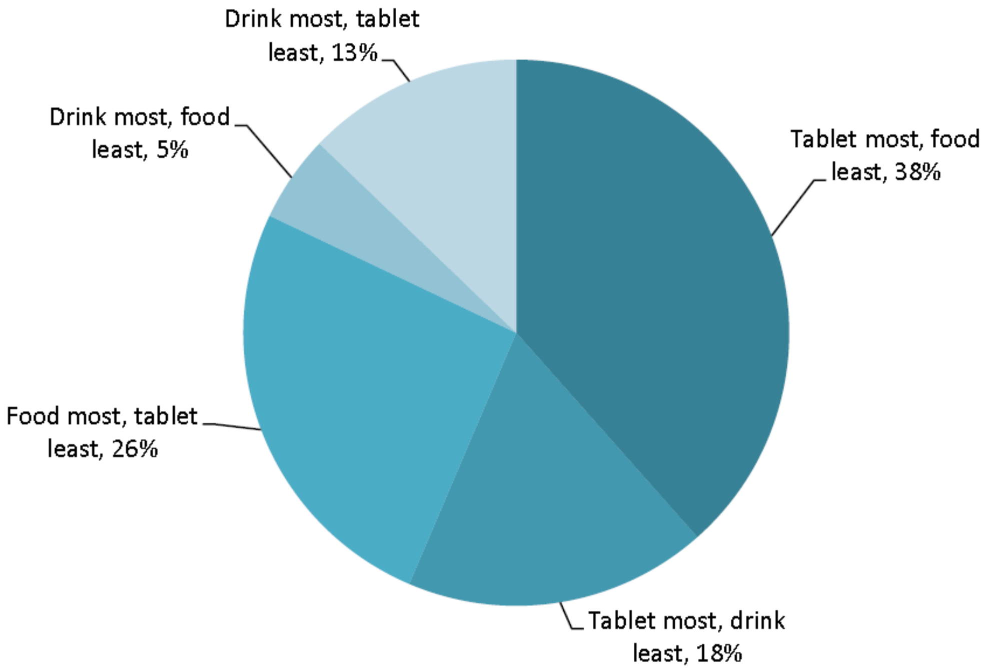
Results

In total 857 respondents completed the DCE. An overview of the socio-demographic and pregnancy-related characteristics of these respondents is provided in Table 3 and Table 4 in Chapter 3.

Deterministic respondents

Thirty-nine participants were identified as deterministic respondents (23 from the national cohort and 16 from the SA cohort). These respondents made choices based only on the type of alternative presented (fortified food, fortified beverage or supplement tablet). Figure 3 shows the preference patterns of these respondents. Supplement tablets were the most preferred product by the majority of these respondents. After excluding the deterministic respondents, the choice model was estimated using the remaining 818 respondents (432 from the national cohort and 386 from the SA cohort).

Figure 3. Preference patterns of deterministic respondents (n=39)



Aggregated DCE models

Results of Wald tests are shown in Table 37. The Wald test was used to test whether the overall effect of a variable on choice was zero (in which case the variable had no significant effect on choice) or non-zero (the variable had a significant effect on choice). Table 38 shows the relative importance of the product attributes in the choice decision. The parameter estimates (or 'preference coefficients') for the aggregated choice models, which show the effect of each attribute level on pregnant women's product choice, are presented in Table 39.

Table 37. Wald test results for product attributes and individual characteristics included in choice model estimation[1]

		Model 1		Model 2	
	Df	Wald	P-value	Wald	P-value
Cohort	2	13.02	0.002	7.46	0.024
Maternal age	2	-	-	25.80	0.000
Educational attainment	16	-	-	171.50	0.000
Income	10	-	-	17.41	0.065
Previous births	2	-	-	1.05	0.590
Alternative	2	39.35	0.000	67.78	0.000
Brand	1	0.03	0.870	0.06	0.800
Endorsement					
Fortified foods	5	110.35	0.000	112.51	0.000
Fortified beverages	5	56.28	0.000	57.34	0.000
Supplement tablets	5	84.30	0.000	84.02	0.000
Absorption					
Fortified foods	1	14.32	0.000	15.08	0.000
Fortified beverages	1	2.13	0.140	2.21	0.140
Supplement tablets	1	1.03	0.310	1.09	0.300
Specific product					
Fortified foods	2	13.66	0.001	13.83	0.001
Fortified beverages	2	2.94	0.230	3.43	0.180
Supplement tablets	2	22.84	0.000	22.58	0.000
Price					
Yogurt	1	7.46	0.006	7.58	0.006
Bread	1	14.59	0.000	15.02	0.000
Cereal	1	5.01	0.025	4.75	0.029
Juice	1	4.26	0.039	4.42	0.035
Milk	1	2.36	0.120	2.68	0.100
Water	1	35.50	0.000	33.13	0.000
Multivitamin tablet (1/day)	1	7.00	0.008	7.34	0.007
Multivitamin tablet (2/day)	1	0.02	0.880	0.08	0.770
Vitamin tablet (1/day)	1	0.64	0.420	0.99	0.320
Folate (every 100µg)	1	111.72	0.000	112.48	0.000
Iodine (every 100µg)	1	42.75	0.000	43.77	0.000
Omega-3 fatty acids (every 100mg)	1	274.94	0.000	278.74	0.000
Vitamin D (every 1µg)	1	203.38	0.000	208.40	0.000
Folate (every 100µg increase) X Iodine (every 100µg)	1	11.67	0.001	11.33	0.001
Folate information condition	3	93.15	0.000	93.28	0.000

		Model 1		Model 2	
	Df	Wald	P-value	Wald	P-value
and Folate nutrient interaction					
Iodine information condition and Iodine nutrient interaction	3	26.69	0.000	27.94	0.000
Omega-3 information condition and Omega-3 nutrient interaction	3	16.88	0.001	16.43	0.001
Vitamin D information condition and Vitamin D nutrient interaction	3	20.10	0.000	21.20	0.000

[1]Model 1: Cohort is only individual characteristic included; Model 2: cohort, age, education, income, parity included as individual characteristics

Table 38. Relative importance of attributes when making choices[1]

	Model 1	Model 2
Alternative	5.6%	28.3%
Brand	0.1%	0.1%
Endorsement: Fortified foods	8.2%	6.2%
Endorsement: Fortified beverages	4.2%	3.3%
Endorsement: supplement tablets	8.0%	6.0%
Absorption: Fortified foods	2.0%	1.6%
Absorption: Fortified beverages	0.7%	0.6%
Absorption: supplement tablets	0.6%	0.4%
Folate (every 100µg)	8.4%	6.4%
Iodine (every 100µg)	5.0%	3.8%
Omega-3 fatty acids (every 100mg)	6.6%	5.0%
Vitamin D (every 1 µg)	6.1%	4.6%
Folate X Iodine	4.5%	3.3%
Specific product: Fortified foods	4.0%	3.0%
Specific product: Fortified beverages	1.7%	1.4%
Specific product: Supplement tablets	5.6%	4.2%
Price: Yogurt	4.7%	3.6%
Price: Bread	5.5%	4.2%
Price: Cereal	3.6%	2.6%
Price: Juice	2.4%	1.9%
Price: Milk	1.5%	1.2%
Price: Water	5.5%	4.0%
Price: Multivitamin tablet (1/day)	4.3%	3.3%
Price: Multivitamin tablet (2/day)	0.2%	0.2%
Price: Vitamin tablet (1/day)	1.1%	1.0%

[1] Based on coefficients from 'relative importance' output in LatentGold. For each segment, the relative importance indicates the proportion of the Maximum Effects that are explained by each attribute (http://statisticalinnovations.com/technicalsupport/LGCtechnical.pdf)

Table 39. Parameter estimates for aggregated choice models showing effect of product attributes on product choice

	Model 1 β (SE)	Model 2 β (SE)
Alternative		
Fortified food	0.167 (0.034)***	0.243 (0.176)
Fortified drink	0.075 (0.033)**	1.272 (0.164)***
Supplement tablet	-0.242(0.040)***	-1.515 (0.219)***
Specific product: Fortified foods		
Yoghurt (1 tub, 200g)	0.069 (0.059)	0.068 (0.059)
Bread (2 slices)	0.114 (0.056)**	0.116 (0.057)**
Cereal (1 cup)	-0.183 (0.05)***	-0.184 (0.050)***
Specific product: Fortified beverages		
Juice (1 cup, 250ml)	-0.041 (0.053)	-0.044 (0.053)
Milk (1 cup, 250ml)	0.081 (0.048)*	0.088 (0.048)*
Water (1 cup, 250ml)	-0.040 (0.047)	-0.045 (0.048)
Specific product: Supplement tablets		
Multivitamin tablet (1 per day)	0.197 (0.055)***	0.200 (0.055)***
Multivitamin tablet (2 per day)	-0.213 (0.045)***	-0.213 (0.046)***
Vitamin tablet (1 per day)	0.016 (0.044)	0.013 (0.045)
Brand		
A specific brand	0.002 (0.011)	0.003 (0.011)
No specific brand or a generic brand	-0.002 (0.011)	-0.003 (0.011)
Absorption: Fortified foods		
No claim	-0.075 (0.020)***	-0.077 (0.020)***
Easy to digest and absorb	0.075 (0.020)***	0.077 (0.020)***
Absorption: Fortified beverages		
No claim	-0.027 (0.019)	-0.028 (0.019)
Easy to digest and absorb	0.027 (0.019)	0.028 (0.019)
Absorption: Supplement tablets		
No claim	-0.02 (0.02)	-0.021 (0.020)
Easy to digest and absorb	0.02 (0.02)	0.021 (0.020)
Endorsement: Fortified foods		
No endorsement	-0.258 (0.055)***	-0.264 (0.056)***
Endorsed by the DAA	0.180 (0.049)***	0.182 (0.049)***
Endorsed by the NHMRC	-0.050 (0.059)	-0.048 (0.059)
Endorsed by the National Heart Foundation	-0.121 (0.041)***	-0.126 (0.042)***
Endorsed by the CSIRO	0.346 (0.042)***	0.351 (0.042)***
Scientifically proven	-0.097 (0.037)***	-0.096 (0.037)***
Endorsement: Fortified beverages		

	Model 1 β (SE)	Model 2 β (SE)
No endorsement	-0.091 (0.056)	-0.090 (0.056)
Endorsed by the DAA	0.153 (0.047)***	0.160 (0.047)***
Endorsed by the NHMRC	-0.093 (0.063)	-0.091 (0.063)
Endorsed by the National Heart Foundation	-0.109 (0.041)***	-0.119 (0.041)***
Endorsed by the CSIRO	0.202 (0.035)***	0.205 (0.036)***
Scientifically proven	-0.061 (0.036)*	-0.065 (0.037)*
Endorsement: Supplement tablets		
No endorsement	-0.329 (0.059)***	-0.324 (0.058)***
Endorsed by the DAA	0.185 (0.050)***	0.183 (0.050)***
Endorsed by the NHMRC	0.014 (0.062)	0.017 (0.062)
Endorsed by the National Heart Foundation	-0.108 (0.044)**	-0.114 (0.044)***
Endorsed by the CSIRO	0.261 (0.036)***	0.263 (0.036)***
Scientifically proven	-0.024 (0.036)	-0.026 (0.036)
Folate (every 100µg)	0.078 (0.007)***	0.079 (0.007)***
Iodine (every 100µg)	0.148 (0.023)***	0.150 (0.023)***
Omega-3 fatty acids (every 100mg)	0.097 (0.006)***	0.098 (0.006)***
Vitamin D (every 1µg)	0.045 (0.003)***	0.046 (0.003)***
Folate (every 100µg) X Iodine (every 100µg)	0.020 (0.006)***	0.020 (0.006)***
Price: Fortified foods		
Yogurt	-0.087 (0.032)***	-0.088 (0.032)***
Bread	-0.339 (0.089)***	-0.345 (0.089)***
Cereal	0.066 (0.029)**	0.064 (0.03)**
Price: Fortified beverages		
Juice	-0.081 (0.039)**	-0.084 (0.040)**
Milk	-0.072 (0.047)	-0.078 (0.047)
Water	-0.176 (0.030)***	-0.171 (0.030)***
Price: Supplement tablets		
Multivitamin tablet (1/day)	-0.285 (0.108)***	-0.297 (0.110)***
Multivitamin tablet (2/day)	-0.011 (0.073)	-0.021 (0.073)
Vitamin tablet (1/day)	0.071 (0.088)	0.088 (0.089)

Abbreviations: DAA = Dietitians Association of Australia; NHMRC = National Health and Medical Research Council; CSIRO = Commonwealth Scientific and Industrial Research Organisation.
*P<0.10, **P<0.05, ***P<0.01
[1]Model 1: Cohort is only individual characteristic included; Model 2: cohort, age, education, income, parity included as individual characteristics

Table 40. Interaction effects of information conditions and preferences for higher nutrient levels

	Model 1 β (SE)	Model 2 β (SE)
Folate information condition X Folate (every 100μg)		
Don't know health benefits, **Shown** information	-0.023 (0.011)**	-0.023 (0.011)**
Don't know health benefits, **Not shown** information	-0.062 (0.009)***	-0.063 (0.009)***
Know health benefits, **Shown** information	0.067 (0.008)***	0.067 (0.008)***
Know health benefits, **Not shown** information	0.018 (0.008)**	0.019 (0.008)**
Iodine information condition X Iodine (every 100μg)		
Don't know health benefits, **Shown** information	0.025 (0.024)	0.028 (0.024)
Don't know health benefits, **Not shown** information	-0.094 (0.02)***	-0.098 (0.020)***
Know health benefits, **Shown** information	0.095 (0.028)***	0.095 (0.029)***
Know health benefits, **Not shown** information	-0.026 (0.025)	-0.025 (0.026)
Omega-3 information condition X Omega-3 (every 115mg)		
Don't know health benefits, **Shown** information	0.010 (0.010)	0.009 (0.010)
Don't know health benefits, **Not shown** information	-0.037 (0.010)***	-0.036 (0.010)***
Know health benefits, **Shown** information	0.027 (0.010)***	0.028 (0.010)***
Know health benefits, **Not shown** information	-0.001 (0.008)	-0.001 (0.009)
Vitamin D information condition X Vitamin D (every 1μg)		
Don't know health benefits, **Shown** information	0.012 (0.006)**	0.012 (0.006)*
Don't know health benefits, **Not shown** information	-0.0180.005)***	-0.019 (0.005)***
Know health benefits, **Shown** information	0.014 (0.005)***	0.015 (0.005)***
Know health benefits, **Not shown** information	-0.008 (0.005)*	-0.008 (0.005)*

*P<0.10, **P<0.05, ***P<0.01

Effect of product attributes on choice

The parameter estimates for the choice model which includes cohort membership as the only individual characteristic (Model 1) suggest that on average, pregnant women had the greatest preference for the fortified food alternative, followed by fortified beverages and lastly supplement tablets (see Table 39). Food and tablet product types, but not beverage products, also had a significant effect on choice. When considering fortified food products, bread products were more likely to be chosen relative to cereal products; and when considering supplement tablets there was a significant preference for once-a-day multivitamin tablets relative to twice-a-day multivitamin tablets. While the alternative and the specific product delivering the nutrients were important, nutrients and endorsement claims were generally more important drivers of choice (see Table 38).

All four nutrients had a significant effect on product choice. In general, pregnant women preferred products with higher levels of the four nutrients as indicated by significant positive parameter estimates for increased levels of each nutrient (see Table 39). Based on the relative importance values in Table 38 folate was the most important attribute considered when choosing between products. The parameter estimates indicate the effect that every 100µg of folate, 100µg of iodine, 100mg of omega-3 fatty acids and 1µg of Vitamin D has on choice. While these parameter estimates indicate that the greatest preferences were for higher levels of iodine and omega-3 fatty acids, followed by folate and vitamin D, different relative preferences were observed upon calculating the parameter estimates for every 400µg of folate, 150µg of iodine, 115mg of omega-3 fatty acids and 5µg of vitamin D; these being the amounts of folate and iodine recommended to be obtained from supplements, and the amounts of omega-3 fatty acids and vitamin D considered an adequate daily intake. These parameter estimates (shown in the brackets) reveal that the greatest preference was for products containing the recommended amount of folate (β=0.310 for every 400µg; calculated by multiplying the β for every 100µg increase in folate by four to obtain the β for every 400ug increase), followed by vitamin D (β=0.225 for every 5µg; calculated by multiplying the β for every 1µg increase in vitamin D by five), iodine (β=0.222 for every 150µg; calculated by multiplying the β for every 100µg increase in iodine by 1.5) and lastly omega-3 fatty acids (β=0.112 for every 115mg; calculated by multiplying the β for every 100mg increase in omega-3 by 1.15).

Additionally, a significant positive interaction was observed between folate and iodine whereby the presence of both iodine and folate in the product had a further positive impact on choice (see Table 39). For example, the positive effect that every 100µg of folate had on choice (β=0.078), further increased (by β=0.020) for every 100µg of iodine also in the product (total effect= main effect + interaction effect). This indicates that the combination of iodine and folate, not just the individual levels of the nutrients, had a significant effect on choice.

Endorsement claims had a significant effect on choice in all three alternatives (see Table 39). On average, pregnant women had the greatest preference for foods, beverages and tablets endorsed by the CSIRO and the Dietitians Association of Australia (DAA), and rejected those endorsed by the National Heart Foundation. While the scientifically-proven claim had a significant negative effect on choice of fortified food and beverage products, it also had a negative but non-significant effect on choice of supplement tablets. This shows that on average, women were more sensitive and averse to scientifically proven claims in food and beverage products. Lack of endorsement also had a significant negative impact on preferences for fortified foods and supplement tablets, indicating that on average, women preferred fortified foods and supplement tablets with endorsement claims over those with no claims. Overall, endorsement of fortified foods and supplements tablets was considered twice as important as endorsement of fortified beverages (see Table 38).

Price had a significant and negative effect on preferences for some but not all food, beverage and tablet products (see Table 39). Possible explanations for the non-significant price effects in some products could be the range of prices being too small for women to properly discriminate between when making their choices; the prices not being high enough to significantly and negatively impact product preference; or the other attributes in the choice experiment being more important. The findings regarding the relative importance of attributes (Table 38) support the last hypothesis, with the price of milk, twice daily multivitamins and once daily vitamin tablets being among the least important factors considered when making choice (relative importance: 0.2-1.5%). Fortified cereal was the only product in which higher price was found to have a significant positive effect on choice. A possible explanation for this might be pregnant women associating higher price with higher quality.

Brand and absorption claims were among the least important attributes (Table 38). While brand did not have a significant effect on product choice, absorption claims only affected choice of fortified foods, with the easy to digest and absorb claim being preferred to no claim in food products (Table 39). The finding that brand was not important in the choice decision may be due to the presentation of the brand attribute in the choice experiment. Showing different product brands available in the market, rather than describing brands as 'specific' or 'generic', may have produced different results as it would have more closely simulated a real-life shopping scenario.

Interactions between information conditions and nutrient levels

The effects that the interactions between information conditions and nutrients had on choice are shown in Table 40. Firstly looking at the impact of awareness, a reduction was seen in preferences for higher levels of each of the four nutrients when women did not know the health benefits associated with the nutrients and were not shown this information when making their choices. For example, the main effect of every 100µg of folate on choice was reduced to β=0.016 (0.078 - 0.062) when women did not know and were not shown the health benefits of folate. Further, previous knowledge alone, without reinforcement of health benefit information, had no significant effect on preferences for higher levels of iodine and omega-3, and had a negative effect on preferences for higher levels of vitamin D. While previous knowledge alone increased preferences for higher levels of folate, preferences increased to a lesser extent than when women both knew and were shown the health benefits of folate.

Information reinforcement was found to have the strongest positive interaction with all four nutrients. The positive effects that higher levels of folate, iodine, omega-3 and vitamin D had on choice were further increased when women who indicated they knew the health benefits of the nutrients were also provided with this information when making their choices. In contrast, providing information to women who were not previously aware of the health benefits had less of an effect on choice; it had no effect on preferences for higher levels of iodine and omega-3 fatty acids, significantly increased preferences for higher levels of vitamin D, and reduced preferences for higher levels of folate.

Effect of individual characteristics on choice

Cohort

As the sample was comprised of pregnant women who were recruited into the study using two different methods, cohort membership was included as a predictor variable to determine whether this had a significant effect on choice. The Wald statistics in Table 37 indicate that cohort membership was in fact a significant predictor of choice. The parameter estimates, shown in Table 41, revealed that compared to women in the national cohort, pregnant women in the SA cohort were significantly less likely to choose supplement tablets (β=-0.084, P=0.008) and more likely to choose fortified beverages (β=0.085, P<0.001) as their most preferred alternative, with no significant cohort effect on preference for fortified foods (β=-0.001, P=0.970).

Maternal age, educational attainment, household income and parity

To identify whether maternal age, educational attainment, household income and parity had a significant effect on pregnant women's choices of fortified foods, fortified beverages and supplement tablets, another choice model (Model 2) was run with these variables included as additional explanatory variables. The Wald test statistics (Table 37) show that while age, education and income parameters improved model fit (i.e. were significant predictors of choice), whether women had given birth previously had no significant effect on choice. These findings are consistent with the research of Teratanavat and Hooker [159] which found that higher age, education and income had a significant positive effect on preferences for soy-enriched tomato juice, as well as Bitzios's [138] finding that higher income had a significant positive effect on choice of bread enriched with inulin. The effect of parity on choice of dietary supplement or fortified foods/beverages has not been previously investigated in DCE studies, limiting direct comparison of these findings with previous research. Notably, while studies assessing supplement use during pregnancy often find supplement use to be more likely among nulliparous women [19, 35, 42, 45, 47, 48, 51, 53, 54], the results of this study suggest that whether women have given birth previously does not affect their preferences for fortified foods, fortified beverages or supplement tablets during pregnancy.

The parameter estimates showing the effects of the included individual characteristics on preferences for fortified foods, fortified beverages and supplement tablets are provided in Table 41. Older women were significantly more likely to choose products in the form of supplement tablets and less likely to choose fortified beverages. Women who completed year 10 or higher, significantly preferred supplement tablets over fortified foods and beverages, and in all education categories (≥ year 10) fortified foods and beverages had a significant negative effect on product choice. Women with educational attainment less than year 10 had the greatest preference for fortified beverages followed by fortified foods. Women in the lowest two income categories had the greatest preference for fortified beverages closely followed by fortified foods and the opposite was seen in the highest income category, where supplement tablets had the greatest appeal.

The parameter estimates for Model 2, showing the effect of product attributes on choice, are shown in Table 39 alongside the parameter estimates for Model 1. The main differences noted in this choice model were the change in size and significance of the parameter estimates for the three alternatives. After adding the additional individual characteristics in Model 2, fortified beverages replaced fortified foods as the most preferred alternative, on average. Likewise, the only considerable change seen in the relative importance of attributes was the *alternative* (fortified food, fortified drink or supplement tablet) replacing *folate levels* as the most important factor considered when making choices.

To identify which individual characteristics were responsible for this change in relative importance, the three significant predictors (age, education and income) were added one at a time to Model 1. The parameter estimates for the three alternatives as well as the relative importance of attributes in these additional choice models are shown in Table 42. Considerable changes in the relative importance of *alternative* (from 6% to up to 20%) were observed when age and education where added to the model, indicating that the importance of the alternative in the choice decision depends on age and educational attainment.

The maternal age variable also explains the different preferences for types of alternative in Model 2 vs. Model 1. After adding age as a predictor, fortified beverages replaced fortified foods as the most preferred alternative and there was no longer a significant preference for fortified foods.

Table 41. Parameter estimates showing the effect of individual characteristics on preferences for fortified foods, fortified beverages and supplement tablets (n=818)

	Fortified food β (SE)	Fortified beverage β (SE)	Supplement tablet β (SE)
MODEL 1			
Cohort			
National	0.0001 (0.025)	-0.085 (0.024)***	0.084 (0.032)***
South Australian	-0.0001 (0.025)	0.085 (0.024)***	-0.084 (0.032)***
MODEL 2			
Cohort			
National	-0.001 (0.026)	-0.065 (0.024)***	0.066 (0.032)**
South Australian	0.001 (0.026)	0.065 (0.024)***	-0.066 (0.032)**
Age (years)	0.008 (0.006)	-0.025 (0.005)***	0.017 (0.007)**
Educational attainment			
< Year 10	2.671 (0.276)***	3.127 (0.288)***	-5.798 (0.469)***
Year 10	-0.427 (0.149)***	-0.397 (0.148)***	0.824 (0.168)***
Year 11	-0.261 (0.116)**	-0.476 (0.101)***	0.737 (0.136)***
Year 12	-0.336 (0.079)***	-0.333 (0.075)***	0.669 (0.105)***
Certificate (III or IV)	-0.355 (0.077)***	-0.490 (0.075)***	0.844 (0.106)***
Diploma level or advanced diploma	-0.422 (0.084)***	-0.436 (0.078)***	0.858 (0.111)***
Bachelor degree	-0.308 (0.059)***	-0.420 (0.056) ***	0.728 (0.083) ***
Graduate certificate or graduate diploma	-0.190 (0.087)**	-0.289 (0.090)***	0.479 (0.109)***
Postgraduate degree (masters or PhD)	-0.373 (0.082)***	-0.286 (0.076)***	0.659 (0.111)***
Annual household income			
<$20,000	0.076 (0.104)	0.191 (0.103)*	-0.267 (0.141)*
$20,001-$40,000	0.077 (0.073)	0.121 (0.070)*	-0.198 (0.094)*
$40,001-$70,000	0.072 (0.052)	-0.026 (0.050)	-0.047 (0.069)
$70,001-$105,000	-0.040 (0.051)	-0.028 (0.049)	0.068 (0.065)
$105,001-$205,000	-0.021 (0.052)	-0.074 (0.047)	0.095 (0.066)
>$205,000	-0.164 (0.087)*	-0.185 (0.100)*	0.349 (0.128)***
Parity			
No previous births	-0.027 (0.026)	0.002 (0.024)	0.025 (0.033)
Previous birth(s)	0.027 (0.026)	-0.002 (0.024)	-0.025 (0.033)

*P<0.10, **P<0.05, ***P<0.01

Table 42. Parameter estimates for the alternative forms of nutritional supplements and the relative importance of attributes in models with different predictors (n=818)[1]

	Model 1	Model 1 + maternal age	Model 1 + education	Model 1 + income	Model 1 + parity
Parameter estimates, β (SE)					
Fortified food	0.167 (0.034)***	-0.037 (0.163)	0.515 (0.050)***	0.158 (0.039)***	0.165 (0.034)***
Fortified drink	0.075 (0.033)**	0.888 (0.152)***	0.502 (0.055)***	0.100 (0.041)**	0.076 (0.033)**
Supplement tablet	-0.242 (0.040)***	-0.851 (0.191)***	-1.017 (0.071)***	-0.259 (0.051)***	-0.241 (0.040)***
Relative Importance					
Alternative	5.6%	19.9%	18.0%	5.6%	5.5%
Brand	0.1%	0.0%	0.1%	0.1%	0.1%
Endorsement: Fortified foods	8.2%	7.0%	7.1%	8.2%	8.2%
Endorsement: Fortified beverages	4.2%	3.7%	3.7%	4.2%	4.2%
Endorsement: Supplement tablets	8.0%	6.8%	6.9%	8.0%	8.0%
Absorption: Fortified foods	2.0%	1.8%	1.7%	2.0%	2.1%
Absorption: Fortified beverages	0.7%	0.6%	0.7%	0.7%	0.7%
Absorption: Supplement tablets	0.6%	0.5%	0.5%	0.5%	0.6%
Folate (every 100µgµg)	8.4%	7.2%	7.3%	8.4%	8.5%
Iodine (every 100µgµg)	5.0%	4.3%	4.4%	5.0%	5.1%
Omega-3 fatty acids (every 100mg)	6.6%	5.6%	5.7%	6.6%	6.6%
Vitamin D (every 1 µgµg)	6.1%	5.2%	5.3%	6.1%	6.1%
Folate X Iodine	4.5%	3.7%	3.9%	4.5%	4.5%
Specific product: Fortified foods	4.0%	3.4%	3.5%	4.0%	4.1%
Specific product: Fortified beverages	1.7%	1.5%	1.5%	1.7%	1.7%
Specific product: Supplement tablets	5.6%	4.6%	4.8%	5.6%	5.6%
Price: Yogurt	4.7%	4.1%	4.0%	4.7%	4.7%
Price: Bread	5.5%	4.7%	4.8%	5.5%	5.6%
Price: Cereal	3.6%	3.0%	3.1%	3.5%	3.6%
Price: Juice	2.4%	2.1%	2.2%	2.5%	2.4%
Price: Milk	1.5%	1.3%	1.3%	1.6%	1.5%
Price: Water	5.5%	4.5%	4.7%	5.4%	5.4%
Price: Multivitamin tablet (1/day)	4.3%	3.5%	3.8%	4.5%	4.3%
Price: Multivitamin tablet (2/day)	0.2%	0.2%	0.2%	0.3%	0.2%
Price: Vitamin tablet (1/day)	1.1%	1.0%	1.1%	1.1%	1.1%

*P<0.10, **P<0.05, ***P<0.01

[1]Model 1: Cohort is only individual characteristic included

Latent class choice model

Latent class analysis was then used to explore the preference heterogeneity in the study sample. Specifically, latent class analysis was used to determine whether there were two or more distinct groups (latent classes) of pregnant women with unique preferences (different decision-making criteria).

Latent class models were run and model performance was checked for up to six latent classes. The minimum Bayesian Information Criterion (BIC) was used to indicate the optimal number of latent classes [329, 330]. As shown in Table 43, the BIC value decreases with each additional class up to four classes, and increases with each additional class added after the fourth. The four-class model was therefore determined to be the optimal solution.

Table 43. Model performance for models with up to six latent classes

Model	Number of parameters	BIC
LCM1	53	29477
LCM2	107	21217
LCM3	161	20244
LCM4	215	19810
LCM5	269	19815
LCM6	323	25632

Latent class analysis simultaneously estimated a separate regression model for each of the four latent classes (consumer segments). Results of Wald tests are shown in Table 44. As well as providing results of the Wald(0) test which indicates whether variables had a significant effect on choice, results for the Wald(=) test are provided which indicate whether a variable has the same effect on choice in all segments (non-significant Wald(=) value) or whether the variable affects choice differently across the segments (statistically significant Wald(=) value). Along with cohort-membership, the following attributes had the same influence on choice in all four segments: brand, absorption, specific type of supplement tablet, the interaction between folate and iodine levels, and the price of yogurt, cereal, juice, milk and of all three tablet products. All other attributes as well as the alternative/product form, influenced choice differently across the four segments. The relative importance of product attributes for each of the four segments is shown in Table 45 and the parameter estimates for the four segments are shown in Table 46.

Latent classes (consumer segments)

The four segments were named based on their unique preferences: 1) *Supplement lovers*, 2) *Information seeking healthy eaters, 3*) *Young, low-income, endorsement-sensitive juice lovers,* and 4) *Food lovers.* The results of the one-way ANOVA for differences in individual variables across the four segments are shown in Table 48 and results of the chi-square tests of the associations between consumer segments and individual variables are shown in Table 49.

A number of significant differences exist across the consumer segments. The one-way ANOVA showed statistically significant differences in maternal age, dietary quality, perceived stress and self-identification as a healthy eater across the four segments. Though, despite reaching statistical significance, the actual differences between groups were small, with effect sizes of 0.01 to 0.03 for the variables [331]. Likewise, significant associations between consumer segments and individual variables identified by chi-square tests were weak with effect sizes of 0.1-0.2 [237]. The following paragraphs describe the preferences of each segment and how the segments differed in terms of the socio-demographic, pregnancy-related, attitudinal and behavioural variables assessed.

Table 44. Wald test results for product attributes and participant characteristics included in choice model estimation (n=818)

	Wald (0)[1]	Df	P-value	Wald(=)[2]	Df	P-value
Cohort	9.4795	8	0.300	2.8107	6	0.830
Alternative	251.8427	8	0.000	239.3812	6	0.000
Brand	4.5449	4	0.340	4.3366	3	0.230
Endorsement						
Fortified foods	171.0868	20	0.000	73.3189	15	0.000
Fortified beverages	111.1152	20	0.000	51.3094	15	0.000
Supplement tablets	142.6316	20	0.000	57.0679	15	0.000
Absorption	13.7906	4	0.008	2.933	3	0.400
Specific product						
Fortified foods	30.9355	8	0.000	20.6172	6	0.002
Fortified beverages	17.9712	8	0.021	11.9522	6	0.063
Supplement tablets	18.884	8	0.015	5.0023	6	0.540
Price						
Yogurt	4.1249	4	0.390	2.8242	3	0.420
Bread	29.2765	4	0.000	13.7525	3	0.003
Cereal	4.1638	4	0.380	2.89	3	0.410
Juice	16.6992	4	0.002	5.4328	3	0.140
Milk	3.5651	4	0.470	0.4849	3	0.920
Water	26.8183	4	0.000	6.5462	3	0.088
Multivitamin tablet (1/day)	10.5526	4	0.032	5.266	3	0.150
Multivitamin tablet (2/day)	3.121	4	0.540	1.8665	3	0.600
Vitamin tablet (1/day)	5.6834	4	0.220	5.0891	3	0.170
Folate (every 100µg)	116.8551	4	0.000	96.977	3	0.000
Iodine (every 100µg)	78.1047	4	0.000	53.6032	3	0.000
Omega-3 fatty acids (every 100mg)	314.4317	4	0.000	173.5144	3	0.000
Vitamin D (every 1µg)	221.065	4	0.000	76.0322	3	0.000
Folate (every 100µg increase) X Iodine (every 100µg)	8.2489	4	0.083	0.7006	3	0.870
Folate information condition and Folate nutrient interaction	57.4713	12	0.000	26.479	9	0.002
Iodine information condition and Iodine nutrient interaction	50.8601	12	0.000	29.8756	9	0.000
Omega-3 information condition and Omega-3 nutrient interaction	45.4881	12	0.000	20.4496	9	0.015
Vitamin D information condition and Vitamin D nutrient interaction	43.788	12	0.000	18.2143	9	0.033

Table 45. Relative importance of attributes when making choices (n=818)[1,2]

	Segment 1	Segment 2	Segment 3	Segment 4
Alternative	12.5%	0.6%	21.3%	27.8%
Brand	1.4%	0.5%	0.1%	0.2%
Endorsement: Fortified foods	4.9%	8.3%	7.5%	3.8%
Endorsement: Fortified beverages	6.5%	5.8%	6.1%	4.1%
Endorsement: supplement tablets	6.9%	8.2%	8.7%	9.4%
Absorption	0.3%	1.2%	0.9%	0.6%
Folate (every 100µg)	3.0%	13.7%	0.9%	0.6%
Iodine (every 100µg)	1.8%	8.2%	1.6%	2.2%
Omega-3 fatty acids (every 100mg)	0.7%	8.2%	2.5%	1.9%
Vitamin D (every 1 µg)	4.0%	7.5%	1.7%	2.4%
Folate X Iodine	1.9%	1.8%	3.6%	5.1%
Specific product: Fortified foods	10.4%	2.7%	6.7%	5.7%
Specific product: Fortified beverages	2.2%	2.7%	9.0%	4.6%
Specific product: Supplement tablets	1.4%	3.9%	6.7%	5.3%
Price: Yogurt	7.7%	0.7%	2.6%	5.0%
Price: Bread	10.7%	6.0%	0.3%	0.3%
Price: Cereal	4.0%	1.2%	6.9%	2.2%
Price: Juice	5.4%	4.2%	4.6%	1.1%
Price: Milk	2.6%	0.7%	2.1%	1.1%
Price: Water	3.8%	4.3%	0.6%	5.0%
Price: Multivitamin tablet (1/day)	3.2%	5.5%	1.7%	3.5%
Price: Multivitamin tablet (2/day)	0.8%	1.7%	0.8%	5.6%
Price: Vitamin tablet (1/day)	4.1%	2.6%	3.2%	2.7%

[1] Based on coefficients from 'relative importance' output in LatentGold. For each segment, the relative importance indicates the proportion of the Maximum Effects that are explained by each attribute (http://statisticalinnovations.com/technicalsupport/LGCtechnical.pdf)

[2] Segment 1:'Supplement lovers'; segment 2: 'Information seeking healthy eaters'; segment 3: 'Young, low-income, endorsement-sensitive juice lovers '; segment 4: 'Food lovers'.

Table 46. Parameter estimates for the four consumer segments (n=818)[1]

	Parameter estimates, β (SE)			
	Segment 1	*Segment 2*	*Segment 3*	*Segment 4*
Alternative				
Fortified food	-0.432 (0.251)*	0.020 (0.065)	-0.018 (0.138)	1.287 (0.225)***
Fortified drink	-0.593 (0.189)***	0.031 (0.066)	0.854 (0.212)***	0.298 (0.195)
Supplement tablet	1.026 (0.209)***	-0.051 (0.077)	-0.836 (0.283)***	-1.585 (0.388)***
Brand				
A specific brand	-0.090 (0.060)	0.035 (0.023)	-0.002 (0.035)	-0.011 (0.032)
No specific brand or a generic brand	0.090 (0.060)	-0.035 (0.023)	0.002 (0.035)	0.011 (0.032)
Endorsement: fortified foods				
No endorsement	-0.273 (0.314)	-0.544 (0.133)***	-0.320 (0.175)*	-0.195 (0.144)
Endorsed by the DAA	-0.228 (0.666)	0.645 (0.096)***	0.123 (0.160)	0.028 (0.128)
Endorsed by the NHMRC	0.178 (0.480)	-0.101 (0.114)	-0.062 (0.205)	0.060 (0.156)
Endorsed by the National Heart Foundation	-0.071 (0.267)	-0.532 (0.085)***	0.091 (0.119)	0.098 (0.113)
Endorsed by the CSIRO	0.356 (0.181)**	0.662 (0.074)***	0.275 (0.12)**	0.195 (0.132)
Scientifically proven	0.037 (0.25)	-0.131 (0.086)	-0.107 (0.108)	-0.186 (0.111)*
Endorsement: fortified beverages				
No endorsement	-0.494 (0.271)*	-0.305 (0.112)***	0.067 (0.161)	-0.181 (0.163)
Endorsed by the DAA	0.350 (0.184)*	0.503 (0.112)***	-0.164 (0.116)	0.238 (0.138)*
Endorsed by the NHMRC	0.068 (0.334)	-0.339 (0.130)***	-0.086 (0.151)	0.086 (0.172)
Endorsed by the National Heart Foundation	0.179 (0.182)	-0.326 (0.086)***	-0.090 (0.101)	-0.039 (0.131)
Endorsed by the CSIRO	-0.079 (0.201)	0.504 (0.073)***	0.324 (0.099)***	0.028 (0.107)
Scientifically proven	-0.024 (0.260)	-0.036 (0.090)	-0.051 (0.097)	-0.133 (0.137)
Endorsement: supplement tablets				
No endorsement	-0.466 (0.292)	-0.580 (0.117)***	-0.110 (0.191)	-0.573 (0.623)
Endorsed by the DAA	0.186 (0.194)	0.352 (0.097)***	0.092 (0.169)	0.052 (0.346)
Endorsed by the NHMRC	-0.214 (0.270)	-0.007 (0.121)	0.286 (0.171)*	0.398 (0.317)
Endorsed by the National Heart Foundation	-0.045 (0.185)	-0.330 (0.086)***	0.169 (0.161)	0.096 (0.279)
Endorsed by the CSIRO	0.428 (0.142)***	0.616 (0.077)***	-0.407 (0.229)*	0.139 (0.182
Scientifically proven	0.110 (0.151)	-0.050 (0.084)	-0.029 (0.111)	-0.112 (0.283)
Absorption				
No claim	0.017 (0.078)	-0.085 (0.026)***	-0.034 (0.046)	-0.031 (0.035)
Easy to digest and absorb	-0.017 (0.078)	0.085 (0.026)***	0.034 (0.046)	0.031 (0.035)
Specific product: fortified foods				
Yoghurt (1 tub, 200g)	-0.003 (0.482)	-0.250 (0.115)**	0.194 (0.258)	0.278 (0.355)
Bread (2 slices)	0.672 (0.216)***	0.143 (0.111)	0.146 (0.219)	0.031 (0.250)
Cereal (1 cup)	-0.669 (0.400)*	0.106 (0.099)	-0.340 (0.169)**	-0.308 (0.202)
Specific product: fortified beverages				
Juice (1 cup, 250ml)	-0.091 (0.288)	-0.096 (0.111)	0.398 (0.237)*	-0.163 (0.229)
Milk (1 cup, 250ml)	-0.099 (0.252)	0.242 (0.111)**	-0.320 (0.215)	0.307 (0.198)
Water (1 cup, 250ml)	0.190 (0.240)	-0.146 (0.103)	-0.077 (0.149)	-0.144 (0.177)
Specific product: tablets				
Multivitamin tablet (1 per day)	-0.028 (0.310)	0.342 (0.116)***	0.137 (0.172)	0.213 (0.548)
Multivitamin tablet (2 per day)	-0.074 (0.190)	-0.221 (0.093)**	-0.333 (0.194)*	-0.338 (0.617)
Vitamin tablet (1 per day)	0.102 (0.182)	-0.121 (0.090)	0.196 (0.149)	0.125 (0.273)
Price: fortified foods				

	Parameter estimates, β (SE)			
	Segment 1	*Segment 2*	*Segment 3*	*Segment 4*
Yoghurt (1 tub, 200g)	-0.249 (0.221)	0.026 (0.062)	-0.051 (0.085)	-0.129 (0.106)
Bread (2 slices)	-1.158 (0.385)***	-0.728 (0.174)***	-0.021 (0.288)	-0.029 (0.245)
Cereal (1 cup)	0.131 (0.202)	-0.043 (0.061)	0.138 (0.154)	0.058 (0.177)
Price: fortified beverages				
Juice (1 cup, 250ml)	-0.316 (0.266)	-0.275 (0.082)***	-0.166 (0.113)	0.053 (0.131)
Milk (1 cup, 250ml)	-0.217 (0.208)	-0.064 (0.092)	-0.107 (0.132)	-0.076 (0.121)
Water (1 cup, 250ml)	-0.215 (0.192)	-0.276 (0.067)***	-0.021 (0.082)	-0.224 (0.085)***
Price: tablets				
Multivitamin tablet (1 per day)	0.378 (0.722)	-0.733 (0.232)***	-0.121 (0.327)	0.328 (0.731)
Multivitamin tablet (2 per day)	-0.091 (0.327)	-0.220 (0.151)	0.056 (0.268)	0.513 (0.664)
Vitamin tablet (1 per day)	-0.476 (0.444)	0.349 (0.168)**	-0.233 (0.350)	-0.249 (0.431)
Folate (every 100µg)	0.048 (0.039)	0.250 (0.023)***	0.009 (0.016)	-0.008 (0.018)
Iodine (every 100µg)	0.091 (0.099)	0.480 (0.057)***	0.051 (0.063)	-0.092 (0.056)
Omega-3 fatty acids (every 100mg)	0.019 (0.033)	0.239 (0.015)***	0.040 (0.017)**	0.039 (0.021)*
Vitamin D (every 1µg)	0.051 (0.014)***	0.110 (0.008)***	0.014 (0.011)	0.025 (0.008)***
Folate (every 100µg) X iodine (every 100µg)	0.015 (0.030)	0.015 (0.012)	0.017 (0.015)	0.032 (0.016)*

*P<0.10; **P<0.05; P<0.01

[1] Segment 1:'Supplement lovers'; segment 2: 'Information seeking healthy eaters'; segment 3: 'Young, low-income, endorsement-sensitive juice lovers '; segment 4: 'Food lovers'.

Table 47. Interaction effects of information conditions and preferences for nutrient levels (N=818)[1]

	Parameter estimates, β (SE)			
	Segment 1	*Segment 2*	*Segment 3*	*Segment 4*
Folate information condition X Folate (every 100μg)				
Don't know health benefits, **Shown** information	-0.040 (0.040)	0.033 (0.025)	0.007 (0.017)	-0.050 (0.023)**
Don't know health benefits, **Not shown** information	-0.023 (0.049)	-0.137 (0.033)***	-0.020 (0.021)	-0.003 (0.021)
Know health benefits, **Shown** information	0.059 (0.039)	0.096 (0.019)***	0.049 (0.022)**	0.021 (0.02)
Know health benefits, **Not shown** information	0.004 (0.034)	0.009 (0.020)	-0.036 (0.021)*	0.031 (0.017)*
Iodine information condition X Iodine (every 100μg)				
Don't know health benefits, **Shown** information	0.014 (0.083)	0.112 (0.049)**	-0.076 (0.062)	0.087 (0.091)
Don't know health benefits, **Not shown** information	-0.037 (0.066)	-0.246 (0.044)***	-0.037 (0.063)	0.026 (0.052)
Know health benefits, **Shown** information	0.071 (0.090)	0.195 (0.053)***	0.141 (0.112)	-0.116 (0.069)*
Know health benefits, **Not shown** information	-0.048 (0.073)	-0.061 (0.047)	-0.028 (0.069)	0.003 (0.089)
Omega-3 information condition X Omega-3 (every 115mg)				
Don't know health benefits, **Shown** information	0.018 (0.058)	0.023 (0.018)	-0.012 (0.035)	0.026 (0.026)
Don't know health benefits, **Not shown** information	-0.084 (0.044)*	-0.081 (0.019)***	0.014 (0.045)	-0.015 (0.061)
Know health benefits, **Shown** information	0.031 (0.036)	0.073 (0.016)***	0.018 (0.033)	-0.025 (0.052)
Know health benefits, **Not shown** information	0.036 (0.034)	-0.015 (0.018)	-0.020 (0.026)	0.013 (0.025)
Vitamin D information condition X Vitamin D (every 1μg)				
Don't know health benefits, **Shown** information	0.002 (0.026)	0.052 (0.014)***	-0.001 (0.016)	0.005 (0.017)
Don't know health benefits, **Not shown** information	-0.032 (0.017)*	-0.045 (0.013)***	-0.016 (0.021)	0.004 (0.014)
Know health benefits, **Shown** information	0.007 (0.018)	0.021 (0.012)*	0.021 (0.012)*	0.008 (0.012)
Know health benefits, **Not shown** information	0.023 (0.022)	-0.028 (0.011)***	-0.004 (0.013)	-0.018 (0.012)

*P<0.10, **P<0.05, ***P<0.01

[1] Segment 1:'Supplement lovers'; segment 2: 'Information seeking healthy eaters'; segment 3: 'Young, low-income, endorsement-sensitive juice lovers '; segment 4: 'Food lovers'.

Table 48. One-way ANOVA results for differences in individual variables across the four unique consumer segments (n=818)

	df	*F*	*p*	η^2 *(eta squared)*
Maternal age[1]	3	5.075	.002	0.020
Gestational age	3	.905	.438	-
Dietary quality score[2]	3	7.676	.000	0.028
Nutrition knowledge score[3]	3	.227	.878	-
Perceived stress score[3]	3	4.427	.004	0.016
Health value[3]	3	1.667	.173	-
Self-identity as a healthy eater[1,3]	3	3.089	.027	0.012
Intention to eat a healthy balanced diet during pregnancy[3]	3	1.480	.219	-

[1] Welch statistic (Age df2=317; Self-identity df2=310)
[2] Calculated using method described in section 4.3
[3] Calculated using method described in section 5.4

Table 49. Chi-square tests of the associations between consumer segments and individual variables (n=818)

	X^2	df	p	Cramer's V
Aged 30 years or above (y, n)	11.16	3	.011	0.12
Age (<30, 30-35, >35y)	15.072[a]	6	.020	0.12
Educational attainment (secondary education only, post-secondary but not tertiary, tertiary undergraduate, tertiary postgraduate)	8.71	9	.465	-
Household income	41.33	15	.000	0.19
Tertiary education	6.88	3	.076	0.09
Employment status	6.18	9	.722	-
Area of residence (in or outside of metropolitan area)	1.51	3	.680	-
Born in Australia (y, n)	9.19	3	.027	0.11
Complying with national physical activity guidelines (30 min exercise ≥5 days per week) prior to pregnancy (y, n)	2.41	3	.492	-
Weight status (underweight, healthy, overweight, obese)	10.81	9	.289	-
Previous birth(s) (y, n)	14.56	3	.002	0.13
Planned pregnancy (y, n)	0.86	3	.835	-
Trimester (1,2,3)	2.57	6	.860	-
Previous miscarriage(s) (y, n)	0.74	3	.864	-
Smoked during pregnancy (y, n)	3.62	3	.306	-
Consumed alcohol during pregnancy (y, n)	5.69	3	.128	-
Main health care provider during current pregnancy (GP, obstetrician, midwife, none)	23.21	9	.006	0.13
Received some information about nutrition from main healthcare provider for this pregnancy (y, n)	4.68	3	.197	-
GP, midwife and/or obstetrician as one of top three most influential sources of pregnancy-related nutrition information (y, n)	1.62	3	.655	-
Usual use of vitamin/mineral/herbal supplements outside of pregnancy (y, n)	26.88	9	.001	0.09
Took supplements in the one month leading up to this pregnancy (y, n)	2.64	3	.451	-
Took supplements during this pregnancy (y, n)	34.32	3	.000	0.21
Taking folic acid and iodine in pregnancy (y, n)	24.74	3	.000	0.17
Made dietary changes for pregnancy (y, n)	9.40	3	.024	0.11

Segment 1: Supplement lovers (13% of sample)

Preferences

This was the smallest segment, comprising just 13% of the total sample. When choosing between products, pregnant women in this segment placed the most importance on the alternative/product form (Table 45). They had the greatest preference for supplement tablets and did not discriminate as much between fortified foods and beverages (Table 46). While the specific tablet and beverage product was relatively unimportant, more importance was placed on the specific food product, with women having a significant preference for bread and rejecting cereal products. Notably, bread was also the only product in which price had a significant and negative effect on choice.

Women in this segment were also sensitive to endorsement claims. There was a significant preference for fortified foods and supplement tablets endorsed by the CSIRO; and for fortified beverage endorsed by the DAA (Table 46). There was also a rejection of fortified beverages without an endorsement claim. Further, there was a significant preference for products with higher levels of Vitamin D in this segment. Not knowing and not being shown information about health benefits associated with omega-3 fatty acids and vitamin D significantly reduced preferences for higher levels of these two nutrients.

Consumer characteristics

Relative to the other segments, significantly more pregnant women in this segment were over 30 years of age (73%) (Table 48). No other significant associations between segment membership and individual variables were identified by chi-square tests.

Segment 2: Information seeking healthy eaters (44% of sample)

Preferences

This segment had the largest share of consumers (44%). Whether the product was a fortified food, fortified beverage or a supplement tablet was not important to women in this segment (Table 45), who had approximately equal and non-significant preferences for each alternative (Table 46). There was however, a significant preference for specific types of foods, beverages and tablets. While yogurt was rejected as a fortified food, there was a significant preference for milk as a fortified drink. Additionally, there was a significant preference for the once-daily multivitamin tablet and rejection of twice-daily multivitamin tablets.

Nutrient levels were the most important factor influencing choice in this segment, with folate levels having the greatest impact on choice (Table 45). Compared to the other segments, all four nutrients had a significant impact on product preferences (Table 46); and for all nutrients, the effects that nutrient levels had on women's choices were influenced by the information conditions under which they made their choices (Table 47). For each nutrient, women's preference for products with higher levels of the nutrient significantly increased when they knew and were shown information about the health benefits of that nutrient. In contrast, there was a significant reduction in preferences for higher levels of each nutrient when women were not previously aware of the associated health benefits and were not shown this information when making their choices. Not knowing the health benefits associated with iodine but being presented with this information also increased women's preferences for higher levels of iodine. Additionally, for vitamin D, the positive effect that every 1µg had on product choice significantly reduced when women were not shown information about the health benefits of vitamin D, irrespective of whether they knew or did not know the benefits.

After nutrients, endorsement was the next most important factor influencing choice (Table 45). For all alternatives there was a significant preference for products that were endorsed by the DAA or that claimed to be ‘scientifically proven’, while those that were endorsed by the National Heart Foundation or had no endorsement claim were rejected (Table 46). Endorsement by the NHMRC also had a significant negative effect on choice of fortified beverages.

Unlike the other segments, price had a significant and negative effect on women’s choices for most products. This was also the only segment in which absorption claims had a significant effect on choice, with women preferring products that claimed to be ‘easy to digest and absorb’ over those with no absorption claim. Though similar to the other segments, absorption claims were relatively unimportant in the overall choice decision.

Consumer characteristics

Compared to women in segment 3, the women in this segment were older (31.2 vs. 29.9y, P=0.040), identified as healthy eaters more strongly (2.3 vs 1.9, P=0.096), and perceived less stress in the preceding month (5.5 vs 6.5, P=0.002) (Table 48). The mean dietary quality score in this segment was also higher than that in segments 3 and 4 (29.1 vs. 25.4 (P=0.000) and 25.6 (P=0.002), respectively), indicating that the pregnant women in this group were more likely to consume healthier diets than those in segments 3 and 4.

Relative to the other segments, significantly fewer women in this segment had a GP as their main HCP (20%) and had household incomes in lowest two quintiles (10.5%). More women in the segment, relative to the other segments, completed tertiary education (58%), had a midwife as their main HCP (38%), had not given birth previously (54%), made dietary changes specifically for pregnancy (69%), took dietary supplements during their current pregnancy (98%), and took both folate and iodine supplements (87%) (Table 49).

Segment 3: Young, low-income, endorsement-sensitive juice lovers (21% of sample)

Preferences

This was the only segment in which women had a significant preference for fortified beverages over fortified foods and supplement tablets (Table 46). While the alternative was the most important factor in the choice decision, the specific type of food, drink and tablet product and endorsement were the next most important (Table 45). Cereal and twice daily multivitamin tablets were rejected as the preferred fortified foods and supplement tablets, respectively, and juice was found to be the most desirable fortified drink product. The pregnant women in this segment had a significant preference for fortified foods and beverages endorsed by the CSIRO, but rejected supplement tablets endorsed by the CSIRO. There was however, a significant preference for supplement tablets endorsed by the NHMRC and this was the only segment in which this effect was seen. Additionally, lack of endorsement had a significant negative influence on choice of fortified foods in this segment.

While only omega-3 fatty acid levels had a significant independent effect on choice (Table 46), levels of folate and vitamin D had a significant impact on choice under certain information conditions (Table 47). Every 100µg increase in folate and 1µg increase in vitamin D significantly increased product preferences when women knew and were also shown the health benefits associated with these nutrients. In contrast, when women knew but were not shown the health benefits associated with folate, there was a significant reduction in preferences for higher levels of folate/every 100µg increase in folate. This indicates that first increasing awareness of the health benefits of folate and then presenting this information in the immediate decision environment/at the point of choice is essential for increasing preferences for folate containing products among women in this segment.

Women's choices were not significantly impacted by the brand or absorption claims made regarding the product, and there were also no significant price effects for any of the products (Table 46).

Consumer characteristics

In addition to the differences in dietary quality, perceived stress and identification as a healthy eater between women in this segment and those in segment 2 (reported earlier), women in this segment were also younger than women in segment 1 (29.9 vs. 32.3y, P=0.001), and identified as healthy eaters less strongly than women in segment 4 (1.9 vs 2.5, P=0.025) (Table 48).

Relative to the other segments, fewer women in this segment were aged 30 years or above (53%), completed tertiary education (47%), took dietary supplements during their current pregnancy (87%), and took both folate and iodine supplements (74%). More women in this segment, relative to the other segments, had household incomes in lowest two quintiles (28%) and usually took vitamin, mineral and/or herbal supplements outside of pregnancy (51%) (Table 49).

Segment 4: Food lovers (22% of sample)

Preferences

Of the four segments, this group of consumers placed the most importance on the alternative in the choice decision (Table 45). Pregnant women in this segment had the greatest preference for fortified foods, followed by fortified beverages, and lastly supplement tablets (Table 46). Notably, while the alternative was the most important factor driving choice in this segment, there were no significant preferences for specific types of food, drink or tablet products. Thus, while yogurt was the most preferred fortified food product, this preference did not have a significant effect on choice. While fortified foods were the preferred alternative, there was no significant preference for yogurt, bread or cereal as the specific food to be fortified.

Endorsement claims were next most important in the choice decision, with more importance placed on endorsement of supplement tablets than endorsement of fortified foods or beverages. While there was a general preference for supplement tablets endorsed by the NHMRC and CSIRO, none of the endorsement claims had a statistically significant effect on choice of supplement tablets. The 'scientifically proven' claim had a significant negative effect on choice of fortified foods, and endorsement by the DAA had significant positive effect on choice of fortified beverages.

While individually the nutrient levels played a relatively unimportant role in the choice decision (1-2%), more importance was placed on the interaction between folate and iodine (5%) (Table 45). Higher levels of omega-3 fatty acid and vitamin D had a significant and independent positive effect on choice, while the individual effects of folate and iodine levels were not significant (Table 46). There was however a significant positive interaction between folate and iodine such that women in this segment had a significant preference for products containing both folate and iodine. This was the only consumer segment in which the combination of folate and iodine in nutritionally-fortified products had a significant effect on choice.

Women's preferences for higher levels of folate and iodine were also influenced by the different information conditions under which choices were made (Table 47). While not previously knowing but being shown information about the health benefits associated with folate significantly reduced women's preferences for folate-containing products, previous knowledge alone, without reinforcement had a significant positive effect on preferences. Thus, previous awareness of health benefits was key to increasing preferences for folate-containing products in this segment. In contrast, there was a significant reduction in preferences for every 100µg of iodine in a product when women both knew the benefits associated with iodine and had this information reinforced when making their choices.

Consumer characteristics

As described previously, women in this segment identified as healthy eaters more strongly than women in segment 3, and the mean dietary quality score was lower in this segment compared to segment 2 (Table 48). Relative to the other segments, fewer women in this segment took dietary supplements during their current pregnancy (86%), and fewer took both folate and iodine supplements (72%). More women in this segment, relative to the other segments, had a GP as their main HCP (38%) and were born overseas (32%) (Table 49).

Discussion

This is the first study to use a DCE to explore the relative importance of product attributes in the context of choosing dietary supplements for pregnancy. Consistent with other DCE studies, including those examining preferences for functional foods and beverages, this study found evidence of preference heterogeneity, with four unique consumer segments being identified [138, 332]. Importantly, the preferences within each of the four segments were able to be meaningfully interpreted, confirming the presence of clear segments in the data.

The main finding was that most pregnant women select dietary supplements based on the type of product delivering the nutrients; whether the product was a fortified food, fortified drink or supplement tablet was the most important driver of choice in three of the four segments. While the largest consumer segment had equal preferences for fortified foods, fortified beverages and tablets, and did not consider the alternative important when making their choices, each of the other segments had clear and different preferences for the three alternatives. This is consistent with findings from other preference elicitation studies, which examined consumer preferences for a range of functional foods and beverages as well as supplement tablets [145-147]. These studies found product type to be the most important attribute considered when making choices, both in the overall sample and in most of the consumer segments identified [145-147].

Similar to the results of the aggregate model, pregnant women in the largest consumer segment (*Information seeking healthy eaters*) selected nutritionally-fortified products based largely on the nutrient levels, with folate levels being most important. This indicates that on average, and in the largest consumer segment, pregnant women consider folate to be an important nutrient to consume and they are choosing products with higher levels of this nutrient. Notably, the *Information seeking healthy eaters* segment was the only one in which all four nutrients considered in the choice experiment had significant independent effects on choice. This was also the only segment in which both folate and iodine levels had significant independent effects on choice, though no significant interaction effect was observed between the two nutrients. The interaction between folate and iodine levels was significant among the *Food lovers* only, with women in this segment having a significant positive preference for products containing both nutrients; and no significant preference for products containing the nutrients, individually.

These findings are concerning, suggesting that in about one-third of pregnant women supplement selection is not significantly influenced by the levels of folate and iodine in the product. Given these are the only two nutrients for which health authorities recommended supplementation during pregnancy, it is important that pregnant women choose products containing these nutrients. Further, only one-fifth of pregnant women in the study were found to consider the combination of folate and iodine levels when making their choices. Whether this is due to a lack of awareness that both folate and iodine are recommended in pregnancy, or whether pregnant women prefer to supplement with products containing individual nutrients, requires further exploration.

An important finding revealed in this study was that previous knowledge of nutrient's health benefits and reinforcement of these benefits when choosing between products strengthened pregnant women's preferences for higher levels of folate and iodine in the study sample overall and in the largest consumer segment. Likewise, not being aware of the health benefits of folate and iodine, and not being provided with this information when making choices had the opposite effect, leading to a reduction in preferences for products with higher levels of these nutrients. Furthermore, reinforcement of associated health benefits among *Young, low-income endorsement-sensitive juice lovers* and previous knowledge alone among *Food lovers,* led to higher folate levels having a significant positive effect on choice. These findings indicate that both increasing awareness of health benefits and reinforcement of health benefits at the point-of-purchase may be key to encouraging selection of products with recommended amounts of folate and iodine. In the same way, not providing information about the benefits of nutrients that are not recommended in pregnancy or not scientifically-proven may help reduce women purchasing products which are unnecessary.

Thus, to help women make better-informed purchase decisions and to increase their adoption of supplement recommendations, intervention strategies should aim to increase pregnant and childbearing aged women's awareness of the health benefits of folate and iodine, and the recommended amounts of these nutrients in pregnancy. Also helpful in these circumstances would be increasing awareness of products that contain the recommended amounts of nutrients that have scientifically-proven health benefits. Overall, given the important role of information reinforcement, product manufactures should be encouraged to display folate and iodine related health claims on products containing the recommended amounts of these nutrients to help women make appropriate choices in the immediate decision environment.

Based on the finding that women had a strong preference for products endorsed by the CSIRO and the DAA, the CSIRO as well as dietitians and other nutrition experts could play an important role in promoting the above information. An innovative strategy may be to develop a mobile phone application, promoted by the CSIRO and nutrition experts and targeted at pregnant and childbearing aged women. This application could provide information on folate and iodine, a list of appropriate supplement products for pregnancy, and information on how to check if a product is appropriate (contains the recommended amounts of folate and iodine).

The finding that nutritionally-fortified products endorsed by the CSIRO were appealing to pregnant women (on average and in most segments) is consistent with findings from other preference elicitation studies which examined the influence that endorsement by government agencies had on choice of fortified foods/beverages and supplement tablets [145, 147, 326]. Thus, the findings from the present study confirm that the CSIRO is a trusted source of nutrition information in the community, and in this case, among pregnant women.

Lack of significant preference for products endorsed by the NHMRC may be explained by a lack of awareness among the general public of the NHMRC and their work. In contrast, the negative effect that endorsement by the National Heart Foundation had on choice could be explained by women not associating the Heart Foundation with pregnancy and maternal health and, therefore, not considering this organisation as a credible source of information or advice around issues related to pregnancy. Both ideas are speculations, and further consumer research would be required to determine the validity of these ideas and other possible reasons for these findings.

Different to other consumer preference studies, this study found that brand was not a significant driver of product choice [320, 324]. This could in large part be due how the brand attribute was presented in the choice experiment. In real-life shopping scenarios, brand and brand-specific packaging are visual attributes and as such, have been found to affect consumer choices unconsciously [324, 333-335]. Further, according to Mueller et al. [336], visual shelf simulations are the only reliable method of measuring the relative importance of visual attributes. Thus, while relevant brand images/logos were shown to the respondents in the glossary, which was presented prior to commencing the choice tasks and was able to be accessed at any time when completing the choice tasks, the brand attribute in this study was not presented visually in each choice task. Consequently, the relative effect of brand on consumer choice is likely to have been underestimated. Future studies examining pregnant women's preferences for dietary supplements should therefore endeavour to use visual shelf simulations in DCEs.

There is also the possibility that both brand and price were seen as indicators of quality and that price was used as the primary indicator in this context. Interviewing respondents after completing the choice tasks could have provided insight into whether this was the case. This however was not feasible given the online and anonymous nature of the survey; though future studies could examine this.

A potential limitation associated with the modified experimental design used for this DCE must be highlighted. Modification of the original experimental design was required to include all attributes of interest and this led to certain combinations of attribute levels (endorsement, folate and iodine) not being tested, which may have affected choice behaviour. The recommended level of iodine (150µg) never appeared in a profile together with endorsement by NHMRC, DAA or National Heart Foundation. Likewise, the recommended amount of folate never appeared in a profile together with endorsement by NHMRC, Heart Foundation, CSIRO or the 'scientifically proven' claim. 'No folate' and '800µg folate' also never appeared with 'endorsement by the DAA' or 'scientifically proven'. Whether not seeing certain combinations of attributes levels affected choice behaviour of pregnant women, cannot be determined through post-hoc data analysis. This would therefore need to be examined in future studies.

Furthermore, while this study shows that pregnant women prefer products with higher levels of folate and iodine, whether women had a greater preference for products containing the recommended amounts of folate and/or iodine or amounts higher than that recommended was not able to be determined due to the linear coding of the nutrient attributes which was required to allow the model to converge. This could, however, be explored in future studies, and is worthy of further investigation given the concerning findings from the knowledge section of the survey which indicate that only one-third of pregnant women were aware of the recommended daily dose of folate and one in ten were aware of the recommended dose of iodine.

As well as providing new insight into supplement preferences of Australian pregnant women using a method grounded in human-behavioural theory, other important strengths of this study include the nine versions of the survey being balanced in terms of the number of respondents completing each version. This allowed more reliable estimation of the main effects and the interaction effects of interest. The completion rate was also relatively high (57%) considering the estimated completion time of the survey was 35-45 minutes. The large amount of comprehensible free-text responses provided in later sections of the survey also suggests that the respondents were generally engaged when answering the survey questions. Additionally, 89% of the sample reported taking supplements in pregnancy, indicating that preferences were elicited from the target group of women who use supplements during pregnancy. While this study examined preferences of supplement users, it would also be interesting to examine factors that would motivate supplement use among women who currently do not use supplements in pregnancy, with the view of developing intervention strategies aimed at increasing adoption of supplement recommendations for folate and iodine.

Conclusion

This study provides unique insights into pregnant women's preferences and the relative importance they place on product attributes when choosing between different nutritionally-fortified products and supplement tablets. No known previous studies have explored the relative importance of such a wide variety of attributes in the context of choosing dietary supplements for pregnancy. The four unique segments identified differed in their preferences for fortified foods, fortified beverages and supplement tablets and in three of the four segments, product form was clearly the strongest driver of choice. Furthermore, information regarding the different endorsements that pregnant women in different segments responded to and how previous knowledge of nutrient health benefits and presentation of health claims on products influenced choices, provides important insight into what types of strategies might be most effective at encouraging selection of appropriate supplement products in different groups of pregnant women.

Chapter 7: General discussion and conclusions

This online survey of 857 Australian pregnant women provides new and valuable insight into the nutritional knowledge, attitudes and practices of pregnant women. Importantly, this study is the first to use the TPB to explain healthy eating intention and consumption of a healthy diet during pregnancy. A key original contribution to the literature regarding factors influencing dietary intake during pregnancy, was the finding that perceptions of control over healthy eating during pregnancy and overall perceptions of social pressure to eat healthy when pregnant, are the two factors that explain the most variance in healthy eating intention during pregnancy. While the TPB model successfully predicted healthy eating intention in pregnancy, it was not however able to explain considerable variance in dietary quality (actual behaviour rather than intention) and thus, was a poor predictor of dietary quality. Further research is therefore needed to confirm whether the TPB model is indeed a poor predictor of dietary quality in pregnancy. If this is the case, this then raises the question of what other psychosocial or modifiable individual factors predict dietary quality in pregnancy, and what other frameworks could be used to explain healthy eating in pregnancy. Furthermore, the cross-sectional nature of the study meant that healthy eating intention and behaviour were assessed at the same time. Thus, rather than predicting future behaviour, the TPB model in this study predicted past behaviour. Future TPB studies examining dietary intentions and behaviours during pregnancy should therefore use prospective designs, to better show the predictive power of the TPB.

This study is also the first to use DCE methodology to investigate pregnant women’s preferences for dietary supplements. Four distinct consumer segments with unique preferences were found to exist. The largest consumer segment (44% of the study sample) had equal preferences for the three alternative forms of dietary supplements (fortified foods, fortified beverages, supplement tablets), and was most influenced by the nutrient levels and product endorsements. Of the included nutrients (folate, iodine, omega-3 fatty acids and vitamin D), folate levels were considered most important and had the strongest influence on choice. This group of consumers also had a significant preference for pregnancy products endorsed by the CSIRO and the DAA, and the lowest preference for those endorsed by the National Heart Foundation. At least one of the other three segments also had a significant preference for foods, beverages and tablets endorsed by the CSIRO. Thus, the majority of consumers appear to trust supplement recommendations made by the CSIRO and dietitians/nutrition experts. In contrast, the NHMRC appears to have little influence on consumer choice of dietary supplements. Whether the NHMRC's influence could be increased by a stronger public profile (resulting in greater public awareness, recognition and respect), would require further investigation.

The relatively low importance of nutrient levels in the choice decision in the remaining consumer segments suggests a need to increase the importance of folate and iodine levels in the choice decision. The finding that compliance with the folic acid and iodine supplement recommendations was more likely among women who were aware of the importance of these nutrients, may suggest that increasing awareness of the importance of these nutrients could work to increase the importance of the nutrient levels in the choice decision. However, the findings regarding the effects of different information conditions on nutrient preferences suggest that this may not be effective in all consumer segments. Thus, other strategies may need to be considered for increasing the importance of folate and iodine levels in supplement products among the remaining consumers. For example, knowing that the *Young and low-income, endorsement-sensitive juice lovers* and *Food lovers* segments, which together comprised 43% of the sample, had a strong preference for fortified beverages and fortified drinks, respectively, and for products endorsed by the CSIRO, one potential strategy (the effectiveness of which would need to be evaluated) could involve the CSIRO and/or other nutrition experts. In the absence of pregnancy-specific nutritionally-fortified foods or beverages in the current market, the CSIRO and other nutrition experts could play an important role in 1) encouraging childbearing aged and pregnant women's consumption of foods and beverages that are natural or fortified sources of folate and iodine, and 2) highlighting the importance of these nutrients and the benefits of consuming more of these foods during pregnancy.

A limitation of the DCE used in this study, which could be addressed in future work by modifying the experimental design, is the inability to determine whether women preferred products containing the recommended doses of folic acid and iodine or whether the stronger preference was for products containing the highest amounts of these nutrients. Further, future choice experiments examining women's preferences for pregnancy supplements should consider using more realistic visual shelf-simulations, thus allowing respondents to make product choices from a simulated shelf of supplement products. This will more accurately show the true influence of brand in the choice decision.

The present study also provides the first national and South Australian data regarding pregnant women's compliance with the recently updated Five Food Group recommendations for pregnancy (part of the Eat for Health Australian Dietary Guidelines) and the NHMRC's recently introduced iodine supplement recommendation. Compliance was found to be poor for both the Five Food Group and iodine supplement recommendations. The study also showed poor compliance with the periconceptional folic acid supplement recommendation; and poor knowledge regarding supplement recommendations for preconception and pregnancy, and dietary sources of folate and iodine. Questions regarding changes in intake of high listeria risk, allergenic and high mercury foods relied on women remembering their pre-pregnancy intake of these foods; the reliability of these findings may therefore be affected by recall-bias.

Another new contribution to knowledge was the finding that pregnant women are poor judges of dietary quality. This suggests a need to increase women's ability to evaluate the healthiness of their diet, especially since the most common reason for not making dietary changes in pregnancy was believing that dietary intake was already healthy and balanced. Whether this inability to accurately evaluate dietary quality is due to poor nutritional knowledge or other factors, warrants further investigation. A better understanding of the contributing factors will provide insight into what strategies might be most effective for increasing women's ability to assess the healthiness of their dietary intake.

Overall, when compared to the national cohort, the SA cohort generally had greater nutrition knowledge and was more influenced by subjective norm than PBC with respect to healthy eating intention. The significant differences in findings between cohorts could be due to a number of factors including the different recruitment methods (online via Pureprofile vs. in person at an antenatal clinic); geographical differences (living in SA vs. other parts of Australia) as different states/territories have different education and health promotion campaigns, exposing women to different information; or other factors such as differences in socio-demographic or pregnancy-related characteristics. For example, the national cohort was more representative in terms of the proportion of mothers living in metropolitan areas and nulliparous women, and may also have included considerably more private patients. If geographical differences do exist in terms of nutrition knowledge and factors influencing dietary intake of pregnant women in the different states and territories, this would have important implications for intervention strategies. In particular, this would suggest that rather than implementing nationwide healthy eating interventions, it may be more effective to target the individual states and territories.

The main advantage of using an online survey for data collection in this study was that it increased the efficiency and practicality of collecting national data. Directly exporting the online data into the software program used for data analysis also eliminated the potential for human-errors associated with manual data entry. Additional advantages included the ability to: rotate the order in which items were presented in multiple choice questions; use more complex skip logic or ‘routing’ of questions; ensure that respondents provided all necessary responses before moving on to subsequent questions; change questions based on answers to previous questions (e.g. only asking follow-up questions about folic acid/iodine containing supplement products that respondents indicated they used during pregnancy); and to confirm the consistency of responses and query any inconsistencies [337] .

While use of an online survey made survey completion more convenient for the respondents, it also limited the generalisability of the findings to pregnant women with internet-access. While the majority of households nationally (79%) and in SA (76%) had internet-access in 2010-2011, internet-access was less common in lower-income households, which were under-represented in the presented study [338].

Another limitation of the overall study is the long survey completion time, which may have led to respondent fatigue and participants taking less care when completing questions in the later sections of the survey. However, steps were taken to minimise respondent burden and fatigue by allowing participants to return to the survey at a later time if not completed in one sitting. Furthermore, a sign of good data quality was the relatively large amount of coherent free-text responses provided towards the end of the survey.

As would be the case with any traditional pen and paper survey not completed in the presence of a researcher, it was not possible to verify who actually provided the survey responses and whether information searches were performed prior to responding. Pureprofile does, however, claim to cross-reference survey responses with profile data previously provided by respondents as a means of identifying and removing unreliable respondents; and checks data for patterned responses and unreliable free-text responses to ensure collection of high quality data [339]. There is also little chance that respondents completed the same survey multiple times through different Pureprofile accounts. Pureprofile has procedures in place to detect fraudulent profiles, which include allowing individuals to only register as an account holder in the country indicated by their internet protocol (IP) address location; and verifying each account holder's bank account details, address and name when redeeming payments [339].

Apart from both cohorts over-representing women with post-secondary education, higher household incomes, and planned pregnancies, the study samples were fairly representative in terms of other key socio-demographic and pregnancy-related characteristics. In particular, the relative proportion of respondents obtained from each state/territory in the national survey was similar to the distribution of births in Australia in 2012. This does however suggest a need for future studies investigating nutrition in pregnancy, to over-sample women with lower educational attainment and from lower income households, to cover a wider range of the pregnant population.

Notably, 71% of all women who gave birth in SA in 2011 were public patients [200]. Thus, the SA cohort is representative of the majority of pregnant women in SA with respect to receiving antenatal care from a public hospital. While it is known that most women in the SA cohort were public patients, as they were recruited from the antenatal clinic of a public hospital, the proportion of public vs. private patients in the national cohort is not known. Future studies regarding nutrition knowledge, attitudes and practices of pregnant women might consider collecting and comparing data from public and private patients. This may help develop more targeted and relevant intervention strategies for increasing knowledge of and compliance with nutrition recommendations.

Overall, this body of work indicates that there is a need in Australia to increase pregnant women's low compliance with the Five Food Group recommendations and the iodine and folic acid supplement recommendations. The work further indicates potential strategies for increasing this low compliance. Firstly, about a third of women reported receiving no nutrition-related information from their main HCP during their current pregnancy. This is unacceptable; especially as pregnant women considered main HCPs the most influential and preferred sources of nutrition information during pregnancy. A standard resource needs to be made available to women, which not only covers the most important aspects of nutrition in pregnancy but also clearly shows how to achieve a healthy balanced diet, with information presented visually and in text form (e.g. sample meal plans, quantity of different types of foods/food groups needed to meet nutrient requirements). This has the potential to improve women's ability to evaluate the healthiness of their dietary intake, allowing them to more accurately gauge whether dietary changes are needed during pregnancy. Information should also be provided on how to make healthy eating easier and how to overcome barriers to healthy eating during pregnancy. This will strengthen pregnant women's perceptions of control over healthy eating, which were shown to increase healthy eating intention. Healthy eating during pregnancy is a likely consequence as, despite the behaviour and intention relationship not being strong in this analysis, it has been well-established in previous TPB studies including those examining dietary behaviours. Moreover, the above information targeted at pregnant women (and those planning pregnancy) should be available via different methods. The most preferred methods of receiving new pregnancy-related nutrition information were either verbally or via a booklet or pamphlet received during an appointment with the main HCP, on the internet and via a booklet or pamphlet received in the mail.

Further, there is a need to target information to both the individual (pregnant women and those planning pregnancy) and key influencers, as perceptions of social pressure to consume a healthy diet were, together with PBC, shown to have the strongest influence on healthy eating intention during pregnancy. For this reason, a resource should also be developed and made available to the partner and female family members and friends of pregnant women and those planning pregnancy. This resource should provide strategies for encouraging healthy eating and should emphasise the positive impact that their encouragement and favourable view of healthy eating in pregnancy has on pregnant women's healthy eating intention. Likewise, health professionals involved in the care of pregnant women should be targeted with similar information, and should be encouraged to discuss healthy eating during consultations with pregnant women to show their support and approval of women eating a healthy diet when pregnant.

Overall, the task of influencing dietary behaviour is both challenging and complex. Thus, a collaborative, multidisciplinary approach is required to further develop, test and implement the suggested strategies. If successful, intervention strategies will guide women towards making decisions which can lead to improved maternal and child nutrition beyond the prenatal period. This effectively benefits the entire family unit, particularly if decisions become routine and positively influence the household's consumption behaviour in the long-term.

Finally, below is a summary of the future work that is needed to further improve understanding of dietary choices in pregnancy and increase compliance with nutritional recommendations. It is clear from this research that the psychosocial factors contributing to differences in dietary quality during pregnancy need further investigation, either using the TPB framework with a more nationally representative sample and with a validated measure of dietary quality, or perhaps using a different behavioural framework. Further use of the TPB framework to explain behaviour and intentions around intake of individual food groups of interest and other key nutrition-related recommendations in pregnancy (e.g. those relating to supplement use, high listeria-risk foods and mercury in fish) is also warranted. This will provide new and valuable insight into the psychosocial factors influencing compliance with recommendations for specific food groups and with the wider range of nutrition recommendations in pregnancy. Lastly, more graphically realistic choice experiments examining preferences for pregnancy supplements are needed to corroborate the findings from this study, which was the first to use the DCE method in this context.

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APPENDICES

Appendix 1: Screening form used for recruitment of focus group participants

DATE: / / 2011 GROUP:

The Diet & SUPPLement study

(Diet & Supplement Use during Preconception, Pregnancy and Lactation)

Recruitment method

☐ In person (other than PINK/STEP) ☐ Poster ☐ E-newsletter

PINK ☐ In person (enrolment/antenatal clinic) ☐ Phone (follow-up/non-consent)

STEP ☐ In person (post-natal ward/clinic appointment) ☐ Phone (follow-up/non-consent)

Name: ______________________________

Phone number: ______________________

Address: ____ **Postcode:** _______

DOB: _______

Pregnant / Breastfeeding / Planning Pregnancy

Gravidity

Is this your first pregnancy? ☐ 1

How many times have you been pregnant? ☐ >1

What is the highest level of education you have completed?

Completed high school (yr 12)
☐ Yes ☐ No

Completed further education?
☐ Tafe/certificate/diploma
☐ Undergraduate
☐ Postgraduate

Most convenient time to visit WCH for 90min FG session:

	Mon	Tues	Wed	Thu	Fri	Sat
9am-12pm						
12-5pm						
5-7pm						
Any time						

Diet & SUPPLement_Questionnaire for participant segmentation_Version 2_14/10/2011 1

Appendix 2: Study advertisement

Women's & Children's
Health Research Institute

The Diet & SUPPLement Study

Diet & Supplement Use during Pregnancy, Preconception and Lactation

Are you Pregnant or Lactating?

We are looking for pregnant and lactating women interested in taking part in a study which will explore women's experiences and feelings towards making dietary changes and taking dietary supplements

The study involves a single group discussion of about 90 minutes

If you are interested, please call us on 8161 8045 and ask for Lenka Malek

This study is approved by the Women's and Children's Health Network's Human Research Ethics Committee.

The Diet & SUPPLement Study
phone: 8161 8045

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Diet & SUPPLement study POSTER Version 1 04/05/2011

Appendix 3: Questioning route to guide focus group and in-depth interview discussions

Introduction for focus groups

Researcher introduction, thank you and purpose **(1 minute)**	Hi. My name is Lenka from the University of Adelaide. I'm going to lead our discussion today. I am not here to convince you of anything or try to sway your opinion. My job is just to ask you questions and then encourage and moderate our discussion. I'd like to start off by thanking each of you for taking the time to come today. You were invited here because you are all either pregnant or breastfeeding and what we are particularly interested in is your views and experiences related to dietary practices and the use of dietary supplements during pregnancy and while breastfeeding.
Ground rules **(2 minutes)**	Before we begin, I'd like to go over some ground rules, which will allow our discussion to flow more freely. 1. Please talk one at a time and avoid side conversations with the people sitting next to you. We are tape recording the session because we don't want to miss any of your comments. If several people are talking at the same time, we won't understand what each of you is saying. 2. Everyone doesn't have to answer every single question, but I'd like to hear from each of you today as the discussion progresses. 3. It's important to remember that there are no right or wrong answers but rather different points of view. So feel free to share your opinion even if it differs from what others have said and feel free to comment on each other's remarks. We will be on a first name basis today but in our reports there will not be any names attached to comments. So you can be assured of complete confidentiality. We'll be here for about an hour and a half and will not be taking a formal break. The rest rooms are [location] and refreshments are [location] so feel free to leave the table if you need any of these or if you need to stretch, but please do it quietly.
Intro activity + **Knowledge section 15min**	Well, let's begin. Let's find out what you all know about diet and dietary supplements. I'm going to give each of you a piece of paper and on it I would like you to list 3-5 things that you know about diet during pregnancy. You can have 2-3 minutes to do this. Now, let's go around circle and one by one I'd like you to introduce yourself to the group (tell us your name and stage of pregnancy you're in) and then share one thing from your list. → *Proceed to questions*

Introduction for in-depth interviews

Researcher introduction, thank you and purpose **(1 minute)**	Hi. My name is Lenka from the University of Adelaide. I'm going to conduct the interview today I am not here to convince you of anything or try to sway your opinion. My job is just to ask you questions and then encourage discussion of your answers. I'd like to start off by thanking you for allowing me to come and interview you today. You were chosen for an interview because you were recently pregnant and breastfed your baby and what we are particularly interested in is your views and experiences related to dietary practices and the use of dietary supplements during pregnancy and while breastfeeding.
Ground rules **(2 minutes)**	Before we begin, I'd like to let you know/make it clear that there are no right or wrong answers but rather different points of view. So feel free to answer honestly and openly because it's your opinion and experiences that we're interested in. I'll be tape recording the interview because I don't want to miss any of your comments. Also your name won't be attached to any of the comments you make. So you can be assured of complete confidentiality. The interview should take around an hour.

Questions

<u>Knowledge (5-10min)</u>

1. What do you know about folate and pregnancy?

   [Probe: What is folate and why is it important in pregnancy?]

   a. Is dietary folate adequate in meeting women's needs for pregnancy?
   b. How much (extra) folate (mg or ug) should women take and when should they take it to prevent birth defects?
   c. Which kinds of foods are high in folic acid?

2. Now, what about iodine, what do you know about iodine and pregnancy?

   [Probe: What is iodine and why is it important in pregnancy?]

   a. Are iodine supplements recommended in pregnancy?
   b. How much extra iodine is recommended in pregnancy?
   c. Which foods are high in iodine?

3. What do you know about iron during pregnancy?

4. What other nutrients do you believe are particularly important either:
    a. When planning pregnancy
    b. During pregnancy
    c. Or while breastfeeding

    (What important roles do they play?)

    [Probe: vitamin D, fish oil]

Information sources (20-25min)

1. Think back to when you needed information about something to do with diet or dietary supplements. Where did you go:
    a. When you were planning your pregnancy (if you planned it)
    b. While you were/while you've been pregnant?
    c. While you're breastfeeding?

    [Probes: GP/obstetrician, midwife, dietitian, naturopath, family/friends, internet, books, magazines]
2. Has this differed between each of your pregnancies? How? What do you think are some reasons for this?

3. What were your impressions of these sources?
    [Probe: was the info timely/suitable, was it accurate or biased, was it practical and useful?]

4. What makes the provider of the information credible or believable to you? How do you know that you can trust the information you receive?

5. If the information you needed about diet/dietary supplements was available from several places and in different forms, how would you most prefer to receive it?
    [Probe: one to one with a certain health professional, pharmacy, internet site, magazine, supermarket.]

Dietary behaviour/practise (15min)

1. {*Thinking about your current pregnancy} Think back to when you first found out you were pregnant or if you planned your pregnancy, think back to when you first started planning. How did you feel about your (current) diet at the time?
    [Probe: Were you happy with how you were eating? What types of concerns/worries did you have about your diet?]

2. What changes (if any) did you make to your diet?

[Probes: different eating patterns, eating more or less of certain foods, avoiding any foods, started taking vitamins/minerals tablets, eating more fortified foods]

3. *How has this differed from what you did during your previous pregnancies?
   [Probes: did you do something in your current pregnancy which you didn't with your first?]

4. What or who influenced your decision to make changes to your diet AND what's motivating you to continue?

[Probe: did other people play a role in you taking/continuing to take supplements (e.g. repeated advice from doctors or friends/family), health concerns, concerns about diet not providing adequate nutrients (not being well balanced/healthy enough)]

5. If you planned your pregnancy, when did you start making dietary changes (if any)?

6. If the pregnancy was not planned at what point in the pregnancy did you make dietary changes (if any)?

7. **For those of you whose diet hasn't changed much**, can you think of any particular reasons?
   a. What would motivate you to change your diet?

   [Probes: different eating patterns, eating more or less of certain foods, avoiding any foods, started taking vitamins/minerals tablets, eating more fortified foods]

8. Now for those of you who are breastfeeding at the moment, how has your diet changed (if at all) since you gave birth?
   a. What types of changes have you made? And what influenced these changes?
   b. If you haven't made any changes, can you think of any reasons for this? (what made or influenced you not to change your diet during breastfeeding)
      i. What would motivate you to change your diet during BF?
   c. Has this differed with your previous breastfeeding experiences? Did you make different dietary changes and if so what influenced them?
   d. Think about how aware you were of your diet during preg, has that changed since you've had your baby? How?
      [Probe: do you think diet/good nutrition is as important as it was during preg, or more or less important?]

9. Are there any individuals or groups who would approve of you changing your diet during pregnancy? OR while breastfeeding?

10. Are there any individuals or groups who would disapprove of you changing your diet during pregnancy? OR while breastfeeding?

SUPPLEMENT QUESTIONNAIRE: After dietary supplements get raised, *provide questionnaire and allow participants 2-3 min to record their responses; later collect questionnaires.*

- I'd like each of you to take a few moments and fill out this list (pass out page). I've listed some common dietary supplements which you may be using or may have used while you were pregnant or breastfeeding. For each stage of pregnancy that you have been through, select the products which you used, if you didn't use any that's okay, if you used some which aren't listed just write them in the 'other' box.

11. {*With your current pregnancy} What or who influenced your decision to start taking dietary supplements? And what's motivating you to continue?

[Probe: did other people play a role in you taking/continuing to take supplements (e.g. repeated advice from doctors or friends/family), health concerns, concerns about diet not providing adequate nutrients (not being well balanced/healthy enough)]

    a. *How has this differed to your previous pregnancies?

12. During breastfeeding what influenced you to either take or not take supplements?
    a. * Has this differed to your previous BF experiences? did different things influence you to take supplements the other times?
    b. What's motivating you to take supplements while BF?

13. What about if you have decided not to use dietary supplements- what or who influenced your decision?
    a. What would motivate you to start taking supplements?
    [Probes: Could you think of reasons to start taking supplements?]

14. Are there any individuals or groups who would approve of you taking supplements regularly during pregnancy? OR while breastfeeding?

15. Are there any individuals or groups who would disapprove of you taking supplements regularly during pregnancy? OR while breastfeeding?

<u>Feelings and attitudes (30min)</u>

Dietary changes

1. What do you believe are the advantages or benefits of making dietary changes before or during pregnancy?
2. What do you believe are the advantages or benefits of making dietary changes while breastfeeding?
3. What are some disadvantages or negative things about making dietary changes? Either before or during pregnancy
4. What about disadvantages or negative things about making dietary changes while breastfeeding?
   [Probe: what don't you like about making dietary changes/what makes it hard to make changes?]

5. What are some of the barriers or what factors or circumstances make it difficult or impossible for you to make changes to your diet?

6. What types of things would make it easier for you to take make changes to your diet? (before or during preg) AND (during BF?)
   [Probe: lower cost of certain foods, Being encouraged by family/friends/GP- what would encourage you?]

Supplements

1. Can you describe to me how you feel about using supplements before and during pregnancy?
   [Probes: any risks involved, feel that its expected that you take them? important/not important, needed to improve nutritional intake, essential for a healthy baby]
   a. What about the benefits of taking supplements while pregnant? [PROBE: same or different benefits to making dietary changes?]
   b. What are some disadvantages or negative things about taking supplements either before or during pregnancy?

2. How do you feel about using supplements while breastfeeding**?**
   a. What about the benefits of taking supplements during BF? [PROBE: same or different benefits?]
   b. What about disadvantages or negative things about taking supplements while breastfeeding? [Probe: risks involved?]

3. What are some of the barriers, or what factors or circumstances make it hard or impossible to take supplements regularly?

[Probe: what do you like/dislike about taking supplements/what makes it hard to take supplements regularly e.g. cost, taste/smell/size of tablets, availability]

4. What types of things would make it easier for you to take dietary supplements on a regular basis? (before or during pregnancy AND during breastfeeding)
   [Probe: having a routine, being encouraged by family/friends/GP- what would encourage you?]

5. If you had to choose between getting your extra nutrients from a tablet/capsule or a food product, which would you choose and what would make that choice more appealing to you?

6. When you are deciding whether to buy a particular dietary supplement, what product characteristics are most important to you?

Conclusion

Is there anything that hasn't already been raised that you think is important to include/mention?

Appendix 4: Supplement questionnaire used in focus groups and in-depth interviews

Stage of pregnancy (please circle)

Planning Pregnant Lactating

This is my 1st 2nd 3rd 4th 5th pregnancy (please circle)

Planning pregnancy

- ☐ No supplements
- ☐ Blackmores Conceive Well Gold
- ☐ Blackmores Folate
- ☐ Cenovis Pregnancy Breastfeeding Formula
- ☐ Nature's Own Folic Acid
- ☐ Nature's Own Conception Support Tablets
- ☐ Other
- ☐ Can't remember product name

During pregnancy

- ☐ No supplements
- ☐ Nature's Own Odourless Omega 3 Ultra Pregnancy
- ☐ Swisse Pregnancy + Ultivite Multivitamin
- ☐ Elevit with Iodine
- ☐ Megafol 0.5
- ☐ FAB FOL Plus
- ☐ Other
- ☐ Can't remember product name

While Breastfeeding

- ☐ No supplements
- ☐ Blackmores Pregnancy Breast-Feeding Gold
- ☐ Cenovis Pregnancy Breastfeeding Formula
- ☐ Nature's Own After Baby Care
- ☐ Everest Pregnancy & Breastfeeding
- ☐ Other
- ☐ Can't remember product name

Diet & SUPPLement_Short Questionnaire on Supplement Use_Version 2_updated_18/07/2011

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Appendix 5: Response summaries for focus group/in-depth interview questions

KNOWLEDGE
1. What do you know about folate and pregnancy? a. Is dietary folate adequate in meeting women's needs for pregnancy? b. How much (extra) folate (mg or µg) should women take and when should they take it to prevent birth defects? c. Which kinds of foods are high in folic acid?

Importance/role in pregnancy

- Prevention spina bifida/reduce risk of neural tube defects/help prevent birth defects
- Important for early brain development
- (n=1) Improved mood so continued taking throughout pregnancy
- To help conceive (subject had previous miscarriage)
- Aware that *'should take folate if you want the baby to be healthy and there's more chance of baby becoming unhealthy if you don't take folate'*

Is dietary folate adequate in meeting women's needs for pregnancy?

- Yes if eating enough leafy greens
  - *'It's difficult to get the amount required just from diet alone unless you're really making sure that your diet is really good sort of thing.'*
- Dietary intake not adequate as supplements wouldn't be recommended if requirements could be met through diet
  - *'I probably wouldn't have known where naturally folate occurred and I trust that if a doctor or medical people are telling me that it's got benefits um and if we could get it from the food we were eating we wouldn't have to take the supplements.'*
- Don't know
- *'Wouldn't know, but I don't I don't, from what I know, there isn't any adverse effects from taking too much of it anyway because your body just expels it, so.'*

How much folic acid (mg or µg) should women take and when should they take it to prevent birth defects?

Extra requirements for pregnancy

- Did not know (indicated by long pauses/group laughter/saying that they didn't know)
- Just take tablet and assume it has the right amount/rely on tablet containing the right amount
- However much is in tablet/supplement/written on the container
- Some women thought it was around 500 (but not sure of units (mg or µg))
- Some women took guess at the amount required but really didn't know/weren't certain of the correct amount. Guesses included: 5ug, 1000ug, 5000ug, 5000mg & 5, 250, 1200 (no units)

Recommended timing of folate supplementation

- 'At least one month before start trying' (preconception)
- 3 or 6 months before you start trying
- 3 months before conception
- First 3 months/first trimester
- Whole pregnancy

How do you know you're getting enough folate??

- Hoping that the supplements provide right amount
  - *'Whatever the bottle says (laughs) (group nods)'*
  - *'If it says one a day or…'*
  - *'I just assume that the bottles been made to a formula that's suitable to take so I don't really question it, I haven't anyway'*

    - *'Yeah but you'd think they've done all the research on our behalf to make sure that the tablet they're trying to market to us contains everything in the right balance in order to promote a healthy fetus.'*
- Not sure- but believes amount from diet and in supplement should be sufficient.
    - *'I'm not sure, my diets, like I do eat a lot of greens, and I don't know is it in almonds? I don't know, I'm not sure. But I don't know, I think I do eat a pretty balanced diet so I'd like to think that having that and the Blackmore's tablets is sufficient…'*
- Taking supplement recommended by GP/obstetrician so assuming it contains requirement amount.
    - *'Because I asked my GP (laughs) what to take and she said yeah that's fine to take that yeah Elevit and stuff or Blackmore's Gold and stuff so yeah.'*

Which kinds of foods are high in folate?

- Green leafy vegetables (spinach, lettuce, broccoli)
- Fortified cereals (breakfast)
- Bread
- Strawberries
- Orange juice
- Banana
- Vegemite
- In dairy foods in a limited amount
- Don't know

2. Now, what about iodine, what do you know about iodine and pregnancy?

a. Are iodine supplements recommended in pregnancy?
b. How much extra iodine is recommended in pregnancy?
c. Which foods are high in iodine?

Are iodine supplements recommended in pregnancy?

- Most women didn't know but assumed that because iodine is in the pregnancy supplements, it must be recommended
    - *'I have no idea all I know is it's in the one that I take so it must be*
    - *Yeah and that's for breastfeeding and pregnancy, yeah.*
    - *Yeah, the marketing says so!'*
- Few women knew that they are recommended in pregnancy. However, n=1 didn't think the iodine supplementation recommendation was aimed at everyone (?meaning all pregnant women)
- Lack of awareness re supplement recommendation during preconception or breastfeeding.

Importance

- Brain development
- Eye development
- Important for/effects thyroid gland function
- To keep metabolism up
- Don't know
    - *'I didn't hear anything about iodine and I didn't take anything extra. I wouldn't even know where to find it if it comes naturally in foods either.'*
    - *'I didn't know about iodine unless you mentioned it'*

How much extra iodine is recommended in pregnancy?

- No idea/don't know – majority (only n=1 was confident that 150ug per day was the recommended supplement level- was participant in iodine study and nutrition/health researcher)
- Women trust the packaging
- Some read 150ug off supplement label

Which foods are high in iodine?

- Fish and seafood
- Bread
- Seaweed
- Iodised salt
- Don't know/no idea
- Dairy (but not as much as in past)

3. What do you know about iron during pregnancy?

Importance of iron during pregnancy

- Iron is needed for Hb, oxygen and blood.
- Iron requirements increase because blood volume increases during pregnancy to maintain baby's circulation.
- Needed for baby's development and brain development.
- Pregnancy and breastfeeding take their toll on iron levels.
- Iron has a lot to do with red blood cell (RBC) development. Body makes more RBCs during pregnancy and then has to get rid of the excess RBCs after delivery.
- If had a lot of haemorrhaging during delivery then need to increase iron intake to restore/normalise levels.
- N=1 had high iron levels anyway so low iron has never been an issue so hasn't worried about iron during pregnancy.

Iron supplementation

- Women who were found to have low iron levels were recommended to take an iron. supplement to increase iron levels (know to take iron supplements if have low iron levels)
- Aware that excess iron causes constipation.

Iron in the diet

- Found in red meat, leafy vegetables and lentils.
- Iron levels depend on diet; if eat red meat should be okay but vegetarians probably need to take a supplement.
- Went off meat completely in first pregnancy so took multivitamin (and increased intake of iron rich plant foods) to ensure enough iron.

Iron and energy levels

- Helps to increase energy levels/reduce tiredness
  - *'During pregnancy you feel dead sometimes, iron helps to give you a boost and feel less dead.'*
  - *'You feel really flat and shocking if you're low in it'*.

Problems associated with low iron

- Anaemia is problem in pregnancy as blood volume increases.
- Low blood pressure can be due to low iron.
- Low iron levels can cause problems in reproductive area- can start bleeding and become anaemic. Need adequate iron levels so that baby can *'sustain itself where it's meant to be growing for months'*.

4. What other nutrients do you believe are particularly important either:

a. When planning pregnancy
b. During pregnancy
c. Or while breastfeeding
(What important roles do they play?)

- Preconception folate is the most important nutrient.
- In general, folate is the main nutrient that women hear/read a lot about. BIG focus on folate- no other nutrient is focused on as much.
- All the vitamins/just general good health (*'a bit of everything'*) is important to ensure you are in a good physical condition to conceive and maintain pregnancy/*'sustain another life inside of you'/'get pregnant and keep pregnant'.*
- Vitamin C mentioned a few times, specifically to prevent sickness during pregnancy. Vitamin A, potassium and zinc also mentioned (though only once each).
- Some women didn't know which other nutrient were important and just assumed that their multivitamin provided them with everything they needed.
    - Just take multivitamin because assume got everything in it that is needed.
- Zinc also important (no reasons given) (n=1) .
- Preconception- barley and spirulina powder for energy and for alkaline blood (n=1).

Calcium

- Important for bone growth (baby strips calcium out of mother's bones to take what it needs. Mothers can become low/calcium depleted if calcium intake isn't adequate).
- Important during pregnancy and breastfeeding
    - Particularly in third trimester (n=1) when bones are being strengthened and weight gain is occurring.

Fish oil

- Omega-3 important at all stages.
- Important for baby's brain development.
- Essential fatty acids good for development of baby.
- Awareness that fish oil is important during pregnancy influenced increased fish consumption during pregnancy.
- Some women hadn't heard anything about fish oils in relation to pregnancy.
- Recommended by doctor to help prevent further miscarriages (n=1).
- Some women relied on supplement label to inform them of fish oil importance-
    - *'Oh it says on the front (indicates supplement container), 'iodine and omega 3 fatty acids for brain, eyesight and hearing development''*
- N= 1 was aware of studies being conducted at WCH involving fish oil and this encouraged her use of fish oil supplements
    - '*Um and then I know they're doing a study at the moment with premies in NICU giving them omega 3 and so I sort of thought, 'well, i'll have some more of that then' (laughs).'*
- N=1 was aware that fish oil is a blood thinner and therefore did not take fish oil during pregnancy- concerned about having a blood thinner and then delivering a baby. She also ate fish regularly so did not feel a need for fish oil supplements.

Vitamin D

- Women were aware vitamin D deficiency is quite common.
- Women who were low in vitamin D were taking a vitamin D supplement.
- Aware that you need to balance sun exposure- while you don't want too much, you want enough to stimulate Vitamin D production.
- Reasons/beliefs for increase in vitamin D deficiency:
    - People don't go out in the sun enough
    - Sun protection/slip slop slap messages too effective at reducing people's sun exposure.
    - 'The high UV or ozone in Australia prevents the production of vitamin D' (n=1)
- Some scepticism that Vit D deficiency may not be as common as it's believed to be (due to possible study errors or errors in assessing normal levels) (n=1).

INFORMATION SOURCES

1. **Think back to when you needed information about something to do with diet or dietary supplements during preconception/pregnancy or while BF. Where did you go?**

- GP
- Use internet once found a good website
- Relied on what knew already (current knowledge)
- Pregnancy and breastfeeding booklets provided by hospital (received at first antenatal appointment)- most women didn't really read
- Pamphlets from GPs
- Midwives (especially if part of midwifery group practice- this was main source for some women)
- Nurses
- Friends who are qualified health professionals or are studying to be a health professional
- Australian Breastfeeding Association website and hotline
- Parent helpline or children's hotline (can ring until child is a certain age; doctors, midwives, nurses answer calls)
- Pharmacists- in person in pharmacy and calling to check if medication is safe while breastfeeding
- Nutritionist/dietician- specific questions. For example, if it is okay not to gain weight during next pregnancy (for reassurance); problems with being underweight preconception; food allergies (cow milk protein).
- Friends with children
- Family- especially female relatives with children (e.g. mum, aunty, grandma)
- Work colleagues with children
- Observing pregnant friends
- Magazines from health food shops (articles regarding preconception)
- Library- borrow books
- Obstetrician
- Journal articles including cochrane review mentioned
- Paediatric immunologist, gastroenterologist, paediatrician- specifically for problems with baby (including dietary issues)
- Child and Youth Health website
- Child and Youth health centres- print out information, appointments
- Free public seminars/presentations
- Tradition/culture- information passed down from relatives
- Knowledge/experience through being on IVF for many years
- Baby books and pregnancy books (including 'It Takes Two: Reproducing Naturally Today' - Dr Judy Ford; 'What to expect when you're expecting'; 'Up the duff')
- Naturopath
- Lactation consultant
- TV- heard about iodine (but didn't pay attention)

Different websites

- Women prefer sites that are user-friendly and present the information they are looking for
- Websites (generally the bigger/better known ones) with weekly email updates (provide information regarding baby's current stage of development and dietary advice). Women liked receiving these brief updates and found them useful.
    - Especially helpful in early stages when visiting doctor less frequently
- Government based sites preferred (some women only go to government sites)
- Australian sites
- Hospital websites
- Australian Breastfeeding Association
- BabyCentre.com (most commonly mentioned) (Aust, USA, UK versions)
- Child and Youth Health website (said to be very good)
- Babble http://www.babble.com/

- BubHub http://www.bubhub.com.au/index.php
- BabyGaga http://www.baby-gaga.com/
- Huggies Australia site
    - nutrition section includes useful recipes
    - updates are sent to Facebook page so don't have to search for info (info is specific to how many weeks you are and baby's development at that stage) (instead of receiving email updates can choose facebook updates)
- Karicare Australia site
- Some women try and avoid commercial sites (like 'Huggies')
- KellyMom.com (information regarding breastfeeding including list of herbs to avoid)
- The 'sceptical OB' http://skepticalob.blogspot.com.au/ (blog articles written by obstetrician gynaecologist)
- Pubmed
- Iphone application- reads barcodes- used to find shop with cheapest supplements

Pregnancy forums

- For information about what you should be eating and what to avoid
- Posts usually written by people with extreme views/strong opinions/*'really good or really bad experiences'*
- Women believe that the people who post on the forums do have good intentions, information can be correct (tend to look for further information to confirm/validate what was posted)
- Interesting reading different women's comments and points of view, women like to check other women's responses/comments as a *'safety net'*/for reassurance.
- N=1 set up own pregnancy forum with friends (with post-graduate education)

2. *Has this differed between each of your pregnancies? How? What do you think are some reasons for this?

- Women tended to seek less information with each pregnancy
    - Become more confident and retain the information learnt in last pregnancy
    - Rely more on own experiences
    - Know/have a better idea of what to expect and know what is/what is not normal

- N=1 didn't look up much at all with first pregnancy (was studying and overwhelmed with unexpected pregnancy) - didn't read any books or search internet- just relied on obstetrician. Did more information searching with subsequent pregnancies.
    - Relied mainly on obstetrician with first pregnancy but with subsequent pregnancies more friends became pregnant and working as nurse, her information pool increased. Also used internet more for specific questions.

- First pregnancy- read 'Up the duff'. Second pregnancy didn't read anything. Third pregnancy had forgotten everything so read books again.

- Women who had first pregnancy more than ~15yrs ago commented that internet wasn't around then/wasn't used much and there was considerably less information available compared to now. Also much less advertising of supplements so didn't take any supplements unless advised by doctor.
    - Relied on health professionals and magazines, whereas now internet mostly and healthcare providers
    - Even 6yrs ago n=1 commented that half the info was available compared to now

- N=1 kept same midwife across pregnancies *('to have some continuity')*

3. What were your impressions of these sources?

- Some women were overwhelmed by large amount of information available so decided to *'take it easy*' and not search for too much information to stay more relaxed.

- A lot of information on the internet is anecdotal with lack of supportive evidence *('A lot of it's anecdotal, it doesn't seem to have a whole lot of research behind a lot of the things they say'.)*
- There is a lot of conflicting/contradictory information
- Trusted information on internet but if wanted personalised information would go to GP (but if pregnancy relatively problem free then happy to just rely on internet)
    - Also women found that one on one, healthcare providers (HCP) sometimes gave some tips which were helpful and women would not have found this information online.

- Pharmacists are seen by some women to be more up-to-date (than GPs) with the new and available supplements and have more knowledge about what they contain and are able to compare them and make more informed recommendations- therefore are more helpful with regards to supplements.
- Impressed with thoroughness of pharmacists who double checked things asking, *'are you sure you're meant to be taking it? has it been prescribed?*' to make sure women weren't having excess of some nutrients
- Unsure whether some pharmacist were just recommending the brands that they were being paid to promote/recommend.
- Saw naturopath- provided a meal plan (based on blood type)
    - Believed/trusted what naturopath said but thought the advice was a bit unrealistic (couldn't follow the meal plan for 9 months).
    - Surprised by advice not to eat fruit

- Trust information in booklets/pamphlets provided by hospital/HCP- use as a reliable source but not all women read these resources- would be more likely to read them if a nurse/midwife went through the booklet, highlighting the most important points.
- Brochures from stands at Child, Youth Health centre- found them useful

- Information from HCPs regarding what you should and shouldn't eat during pregnancy can be conflicting. (GP advised: *'don't eat anything fresh, everything has to be cooked'* (participant thought '*that was crap'*); Obstetrician not too concerned about mercury in fish, but participant still followed low mercury guidelines because she had heard about it from many different sources)
- Thought hospital (including nurses and midwives) and GP would provide more specific information.
- Some women frustrated with GP- relied on GP as a trusted source but felt like they couldn't get the information they needed/wanted. Women searched for information on the internet if it wasn't provided to them by HCPs.
    - Had trouble finding specific information on the internet and then got frustrated when HCPs didn't provide them that specific information either (for example, information regarding vegetarian diets during pregnancy)
- Unsatisfied with level of information received from midwives- wanted more information from the midwives (in particular, wanted more specific information)
    - *'...I couldn't ask the midwives it was the same 'Ahh you're fine, if you're not sick you're fine' and it wasn't 'yes you're doing the right thing' it was 'if there's nothing wrong with you, don't worry about it' and so I just wanted, I had to keep continually finding information for myself um not and I thought you know the hospital would be able to help out a little bit with that and also my GP be a little bit more specific…'*

- Thought there was lack of information regarding foods that decrease breast milk supply. (n=1) Went to a seminar at WCH and nothing relevant mentioned and no chance to write questions for presenter to answer so had to rely on internet/google searches.

- Women received many pamphlets/pieces of paper from hospital/where they went for antenatal

appointments and many were unread- would be better is HCP had let them know about a website that contained all of that information- easier to go on the website than read through the papers.
- Some women find it annoying that pregnancy websites always have the disclaimer 'check with your GP' or 'check with your obstetrician or midwife'. So to save them having to ask the same questions at appointments, they would prefer to go to website that is specific for the hospital where they are having their appointments and is written or endorsed by the HCPs that work there.
- Women found the Child Youth and Health website helpful and informative. They assume that a government source will give the facts.

Information on forums:

- Wouldn't trust it/think it's correct information
- Don't trust forums, must be written by a health professional
- Would trust info written by other mums on forums 'to an extent'
- Sometimes information can be potentially harmful (some women pushing their own/beliefs opinions which can be incorrect)
- In particular, first time pregnant women can get quite anxious about all the different information/things they read on the internet/forums.
- Women go on forums more for interest and amusement (the conflicting opinions/strong personalities/arguments).
- They see what questions are being asked/look at answers/anything relevant to what's happing with their own pregnancy at the time- go there for reassurance, see the range of views and opinions that other women have.

4. What makes the provider of the information credible or believable to you? How do you know that you can trust the information you receive?

- Qualifications/professional accreditation
- Experience
- Place of practise (e.g. respectable pharmacy if you're a pharmacist)
- Check for consistency/repetition
    - Don't just trust one sources, check a few and if information is consistent across sources, then more likely to trust it.
    - Information is more believable if women hear/read same things from different sources (e.g. on 2-3 different websites)
- Rapport with doctor/HCP
- Ask doctor about conflicting information found on internet
- Some women trust/have sought advice from naturopaths while others wouldn't trust/believe naturopaths.
- Some women can be sceptical about listening to pharmacist's advice regarding brand of supplements- women don't know if specific pharmaceutical companies are paying them to advertise/recommend their brand/product.
- When deciding whether to trust information written by a health professional (HP) on a website women take into consideration the HPs qualifications and the area/topic they are providing information about (e.g. would not trust info about nutrition from a GP as much as if it was written by a dietician)
- Different HPs can have different opinions/give different advice- some women reportedly take into consideration how old the HP is, if their information/advice is consistent with the latest research and if it is expert opinion or evidence based.
- Women believe/trust information from the government and HCPs (doctors/nurses/midwives), including information received at hospitals and GP practices.
    - More credible if the information comes from *'somewhere medical or scientific or a university study'*
    - Trust websites written by health professionals e.g. Australian Breastfeeding Association

- Put more trust in the better known websites, ones like BabyCentre.com which also have HPs (including doctors/midwives) contributing information
- Trust hospital based information/hospital websites
- Trust information that is professional/expert opinion/written by specialists
- Check sponsor of website- if any conflict of interest
- Commercial sites- may trust the information but would prefer to go somewhere else. Some women avoid these sites completely
- Some women only go to/trust information from government based sites.
- A lot of conflicting/contradictory information- look at information and see what evidence there is 'to back it up' (what research has been done, how it's been qualified)- need to check whether likely to have accurate/reliable information or if they're trying to 'push'/sell something (check sponsors)
- For research papers/studies:
    - Check source of funding for bias, sample size, references
    - Use Cochrane Review and journals including Lancet, British Medical Journal- put more weight on those than expert opinion (feel like too much information out there, overwhelming so just use few sources)
- Use instinct to judge credibility- '…*I think instinct as well, when you read things you kind of can tell whether someone's you know.. you can kind of yeah just reading how people have written things and whether it seems, you know, where it comes from and things like that'*

5. If the information you needed about diet/dietary supplements was available from several places and in different forms, how would you most prefer to receive it?

- Women feel that is often easier to find the information themselves on the internet as the internet is more accessible, allowing them to search for information at a time that suits them and they can find the information straightaway when they need it (don't have to wait for appointment).
    - In particular, time poor women who are busy with work or family or women who may not be able to drive/have transport issues may not be able to get to appointments very easily. So much easier/more convenient to search for information on the internet.
- In normal/healthy/complication-free pregnancies women are happy to go on internet and find own answers but if complications arise then they would prefer to see a HP one-on-one as they would be more confident in the accuracy of the information they receive (rather than the information they may find on the internet).
- Once find a good website that is what they prefer to use as information source.
- Websites with weekly email updates (provide information regarding baby's current stage of development and dietary advice). Women liked receiving these brief updates and found them useful.
    - Especially helpful in early stages when visiting doctor less frequently (only ~once a month)
- Received little pack of information from hospital at first antenatal appointment- a lot of women didn't read the information/booklets provided or read them after pregnancy/when information no longer as relevant/important – might be more likely to read them if a nurse/midwife went through the booklet, highlighting important points.
- In books you are restricted to the information that is written there. Whereas on internet, what you are reading often includes links to other related information or you may have other questions about what you are reading which you can easily find the answers to by doing an additional search.
- Some women find that they respond best to one-on-one contact with health professionals (e.g. GP/obstetrician).
- Chemists generally provide good information. Also, good experiences with ringing the pharmacy to see if specific medications are safe to take during lactation (quick and easy service)

'A bit of both'

- One-on-one consultations and their own internet searches. What source they consult depends on the questions and answers they get. If women can't find the right answers/specific information on the internet, then they speak to a HP. One of the things that women like about speaking to someone is that the information they receive is often more personalised and they sometimes receive tips which they wouldn't find online.
- For many women, internet is used in the first instance (as 'first port of call') as it is more accessible and then any remaining questions or conflicting information (found online) is double checked with a qualified HP.
- More inclined to definitely believe/trust information from HP during a one-on-one encounter- when search for information on the internet have to do bit of extra work (cross checking with different sources and checking the credibility of the author (qualifications)) before accepting the information as true/reliable. But ease of access is a major advantage and one of the biggest appeals of the internet (most important for busy women who want answers straightaway).

'Pregnancy nutrition hotline'

- Pregnancy nutrition hotline which women can call and ask health professionals nutrition/pregnancy related questions (similar to medicine line at WCH) would be appealing/useful. Would provide central point where can get accurate/current information (often different HPs have different opinions and women receive different advice from different HPs)
- Breastfeeding hotline could also provide general nutrition information relevant to preconception and pregnancy NOT just breastfeeding.

Preferred providers of information (internet and other resources)

- The hospital's (or wherever you go for prenatal care) role is to provide information- want a hospital/healthcare provider specific website or a page that has all of the information that would normally be included in pamphlets or booklets that the healthcare provider provides
- While a range of different websites have been recommended to women, they would prefer to go to one reliable, trusted website/source (authored by a health care provider) that contains all of the relevant pregnancy related information on there (in one place).
- A government website would be best (but they don't always have everything/all the information you're looking for; also don't have personal comments and opinions/experiences that act to reassure women when looking at internet forums)
- GPs lack pamphlets specifically on current nutrition information during pregnancy (currently only provide information on what women should avoid and don't provide information on what they should eat). Current/up-to-date information is important as women are often aware that recommendations change but don't know what the current recommendations are.
- All women should receive (from their HCP) a pamphlet/resource that contains consistent/standard information about what women should and shouldn't eat during pregnancy. This should be written by the government and provided to all pregnant women. This would be helpful and the information would be trusted (as it would be provided by the government).

DIETARY BEHAVIOUR/PRACTISE

**Thinking about your current pregnancy, think back to when you first found out you were pregnant or if you planned your pregnancy, think back to when you first started planning. How did you feel about your (current) diet at the time?*

What changes (if any) did you make to your diet?

<u>Food safety/listeria</u>

- More conscious of what food they're eating and where it came from (i.e. prepared safely)
- Avoiding all those foods that pose a listeria risk
- For some women, the only changes they made was to avoid high listeria risk (HLR) foods
    - E.g. Only avoided soft cheeses and salamis, no other changes
- Some avoid these foods strictly
- Some women more relaxed
- Became less strict/a lot more relaxed with HLR foods towards end of pregnancy/as pregnancy

progressed

- Compare themselves to women in other countries that eat HLR foods like aioli and soft cheeses- thinking they eat this in Europe (aoli) so why not
- Aware of listeria risk but consciously still ate ham and soft cheeses but didn't eat as much as normally would. Of mindset that ate these foods in previous pregnancies (when wasn't aware of listeria risk) and everything was okay.
- Still ate HLR foods but in moderation
- Still ate ham- assumed/trusted that if it was bought from a familiar store/deli they would be following food safety guidelines so less risk of salmonella/food poisoning. But only ate it on day of purchase.
- Wasn't going to stop eating ham because ate it in previous pregnancies
    - But would stay away from certain foods e.g. Ikea meatballs
- No runny eggs or homemade aioli/mayonnaise
- Heard that mayonnaise made/sold in Australian is safe as homogenised eggs are used (unlike in America) (acknowledged that have to be careful where get information from- every country is different)
- Avoided ham and salad bars (stopped eating salads from salad bars)
- Ate out less as hard to choose safe foods
- Did not eat fruit from restaurants (food safety- not sure if washed/questioned cleanliness of utensils used to cut it)
- Avoided cheese
- Stopped eating sushi and soft cheese
- Stopped eating left overs (only made enough food for one meal- no left overs)

<u>Mercury in fish</u>

- Reduced intake of deep sea fish
- Less fish
- Reduced intake of canned tuna (ate less frequently) (read to limit to one can a week)

<u>Minimal changes</u>

- Continued eating as per usual
- Some made changes before they were pregnant/when planning so during pregnancy no real changes
- Didn't make any changes- increased vegetable intake with first pregnancy and continued eating like this
- Generally healthy diet so continued eating as usual but may have increased intake of certain foods/food groups like dairy/yogurt

<u>Increased intake</u>

- More fruit and vegetables ('focused on lots of fruit and veggies')
- More dairy (milk/yogurt/cheese) to increase calcium
- Increased intake of red meat (due to cravings and to increase iron)
- Increased intake of fish- 'more conscious about needing to eat fish'
- Increased water intake and fruit (to reduce constipation)
- Ate more junk food when pregnant (ate healthy diet but on top of that ate more junk food/salty food than usual)
- Tried to increase the level of fruit and vegetables and grains and was more conscious of diet.
- Started eating a lot of lettuce to increase folate intake
- More lettuce and vegetables
- Increased fruit
- 'More healthy foods' (after couldn't stand smell of fried foods)

<u>Reduced intake</u>

- No alcohol
- Reduced intake of fatty foods

- Ate less/ ‘cut out’ fried foods (couldn’t stand smell/nauseas)
- Reduced sugar intake (moderated/cut down on chocolate)
- Cut down on processed foods
- Reduced Coke consumption
- Didn’t snack

Caffeine

- Cut out caffeine
- Stopped drinking coffee
- Reduced caffeine → Changed to decaf tea
    - One coffee but everything else decaffeinated (reduce number of coffees had per day)

Change in behaviour/eating habits

- Had to eat small frequent meals during morning sickness
- Started eating breakfast
- Started taking a morning and afternoon snack to work
- Ate for two- had a mixed healthy/bad diet to start with but after feeling nauseas from the smell of fried/take-away food, ate healthier and enjoyed it.

Outliers (n=1 only each)

- Didn’t have the time or energy to prepare own meals (wasn’t feeling confident with controlling/managing sugar cravings) therefore bought Lite & Easy meals for 4 weeks. Continued eating similar types and level of food after finished the 4 weeks. Was enough to control/stop her sugar cravings, ‘It was almost like it was enough of it that, ‘here’s your strict regimen’ and it’s enough to sort of get you on the right track for the rest of it’, ‘I just felt like it reset things’. Did this in an effort to control weight gain (previous pregnancies gained excessive weight ~35kgs).
- Stuck to gestational diabetes diet (diagnosed in first pregnancy 3yrs ago) - counting carbohydrate serves and eating more fruit, green vegetables, red meat, fish and plain (unflavoured) milk.
- Couldn’t have wheat or dairy because was breastfeeding baby with wheat and dairy intolerance. Craved sardines (sardine and avocado sandwiches) for calcium. Resumed eating wheat and dairy when intolerant baby was weaned.
- Didn’t make any dietary changes until was diagnosed with gestational diabetes (‘*If I had known that dietary changes would have helped me I would have done it from the first week’*)
- Started eating a vegetarian diet (eating junk food and any meats made her feel more sick/nauseas- anything unhealthy made her ‘*feel like crap’*)

***How has this differed from what you did during your previous pregnancies?**

- No changes this time but started eating healthier with first pregnancy- continued healthy eating into lactation and subsequent pregnancies
- Didn’t make any dietary changes with latest pregnancy. With first pregnancy was very sick for most it- couldn’t keep food down and could only eat small amount before feeling full. With other two pregnancies ‘*ate huge amounts of healthy foods’*.
- Still eating same foods as in other pregnancies but now just eating too much and too many carbohydrates (especially bread)
- With earlier pregnancies ate without restriction (*‘I ate what I wanted, when I wanted’*) – wasn’t aware of high listeria risk foods like soft cheeses and ham. This pregnancy was aware which foods were high risk but still ate them (e.g. ham/processed meat and cheese) consciously knowing there could be side effects but was of mind set that ate these foods in previous pregnancies and everything was fine. However ate these foods in moderation (smaller amounts than usual).
    - Still ate same things (high listeria risk foods) as did in previous pregnancies but now ate them in moderation
- Becoming more relaxed about food safety/eating high listeria risk foods with subsequent

pregnancies (‘*I didn't sneak any ham in my previous pregnancies’*)

- First two pregnancies quite strict with what was eating (food safety or overall balance) then with third pregnancy wasn’t as strict and miscarried- that scared her into following very strict diet with current pregnancy.
- New foods available in current pregnancy which are high listeria risk, which weren’t available in earlier pregnancies (several years ago). E.g. pre-packaged lettuce- was eating this until was told that shouldn’t.
- Before first pregnancy only drank soy milk, started drinking cow’s milk/dairy during first pregnancy and has continued with dairy (and not gone back to soy) throughout subsequent pregnancies
- Different cravings for different pregnancies (cheese/sour foods)- stopped eating fried foods in latest pregnancy because smell caused nausea.
- Taste of tomato changed during first pregnancy.

What or who influenced your decision to make changes to your diet AND what’s motivating you to continue?

Baby’s health/development

- Know that should be eating healthier because you are pregnant/’now supporting another life’
    - *‘I know I should be eating healthier because I’m having a baby’*
    - *‘Nobody was an influence in particular, ‘It was just the the knowledge that I probably should be eating healthier anyway, and now i have the added incentive of of of doing so...’*
    - *‘It's just yeah like the focus like there's the, it's all because of you and what you're putting into your body as to what the benefits and the development of the baby are so yeah.’*
- *‘Just to give myself and my baby the very very best chance and best start. That's it, as simple as that really.’*
- *‘You want your baby to grow as best that it possibly can so that's what motivates you to make sure that you eat absolutely the best you can within reasonable in the time and the funds that are involved. That's my motivation.’*
- *‘Responsibility for growing a little one’*
- *‘You don't want them to be sick’*
- *‘You want to give them the best opportunity to start off with’*
- Fear of miscarriage/losing the baby motivated dietary change.

Food safety/listeria risk → ‘Potential negative effect on baby’

- Only changed diet for food safety reasons- avoid high listeria risk foods (no other changes)
- Just the medical advice to avoid soft cheeses/salamis/hams
- *‘The potential effect on the baby that's always the reason you do it’*. Afraid of effect of listeria on baby and early labour.
- Avoided high listeria risk foods – afraid of getting listeria and then the effect of listeria on baby
- Didn’t avoid certain high listeria risk foods or ate them in moderation/smaller amounts because:
    - the same foods are commonly eaten in other countries and the pregnant women there are fine
    - of the mindset that *‘I did it throughout my other pregnancies and everything was okay you know and for years people have been eating what they wanted when they were pregnant, it's only now that it's more publicised um that people don't do it’*.
- Women became more relaxed/less strict with what they ate later in the pregnancy/as pregnancy progressed.
- Women considered some commonly avoided foods like mayonnaise as safe if made/bought in Australia as had read that Australian mayonnaise (sold in the jars) is ‘safe’ (unlike in America).

- If deli ham bought from a familiar store/deli → then they should be following food safety guidelines → should be less risk of food poisoning.
    - Only eaten on day of purchase
    - *'I'm not gonna cut out because I never did with the first born'*

- Wasn't aware with other pregnancies of the need to avoid certain high listeria risk foods- but was informed with current pregnancy.
- Still ate some high listeria risk foods (as husband brought them home) but ate lesser amounts.
- Only ate high risk listeria foods if purchased and prepared them.
- More relaxed about some foods, but more strict with others
- Fear of miscarriage motivated dietary change and strict avoidance of certain foods (due to previous miscarriage (not as strict with diet during that pregnancy as was with the previous two before it)

Pregnancy symptoms/side effects

- Cravings
- Morning sickness- reduced appetite/food intake
- Didn't eat much at all with first pregnancy- was sick for most of pregnancy ('*I hardly ate anything without throwing up'*)
- Didn't like the taste of some foods/some smells made them nauseas
- Gestational diabetes diagnosis was reason for change (made no changes before diagnoses- didn't know dietary changes would help; everything was going fine, no morning sickness, assumed must be eating right things)
- *'I think it was more of an excuse (to eat chips and junk food) rather than a craving yep and you know you're rushing and doing this and doing that.'*

Health professionals

- Dietitian/nutritionist advice
- Naturopath; followed recommended diet plan
- Followed GP recommendations

Other people

- Friends with kids
- Friends and family, especially work colleagues who have had children
- Parents- mum and mother-in-law mostly
- Other people keep women updated about what should be avoided (especially if those people were recently pregnant)
- *'You don't want to take risks when it's your first pregnancy'* – in first pregnancy listen more to friends and other people about what foods to avoid
- Trust others advice/recommendations more because first pregnancy, but in next pregnancy will be more experienced and will trust self more.
    - *'Because I've already had a baby, I would trust myself more than sort of anyone. I know what suits my body now and what does not suit my body.'*
- After first pregnancy, have a better idea of what foods should and shouldn't avoid- more confident making choices because of previous experience

Hospital booklets and internet forums

- Read booklets from hospital for information regarding what foods to avoid (e.g. mercury in fish)
- Information on internet forums influenced what food was avoided – led some women to avoid certain foods such as soft serve ice cream.

Culture

- Kept cultural beliefs in mind when eating (moderate intake of 'cool foods') but did not adhere to them strictly
- A lot of cultural advice/recommendations are outdated- GP (uncle) '*was able to kind of*

demystified a lot of stuff for me'

- Culture and ethnic background- some women don't follow culture specific advice; instead they follow current Australian recommendations.
  - Follow some culture-specific advice (which differs to recommendations for Australian women) but are cautious
  - Still ate foods which should be avoided according to Chinese culture, but ate them with a lot of precaution.
- Receive different advice from friends/people from different cultures (can be contradictory and confusing)
  - End up eating whatever you feel comfortable with (try the food and *'you'll know if it suits you or the baby, if it doesn't suit you, stop eating it, at least try it'*)

To increase intake of important nutrients ('*so baby gets what it needs'*)

- Desire to increase intake of important nutrients from the diet
  - *'That was one of my biggest worries was that I wasn't getting enough folate so I started having a lot of lettuce, and a lot of iron straight away.*'
- Aware of diet- '*just trying to make sure that the baby's actually getting enough of what it needs and um...and that's all I guess'.*
- More conscious of needing to eat certain foods to get right nutrients (lettuce, vegetables, red meat, seafood)
- Craving steak- iron
- Low levels of nutrients (identified from blood tests) and talking to doctor.

Weight gain

- To prevent too much weight gain/to ensure minimal weight gain
- To prevent further weight gain; *'So I'm hoping to not gain any weight over the pregnancy'.*

Mother's health

- (eat better so that can look after them after birth) To prevent yourself becoming depleted after baby takes the nutrients it needs from your diet/nutrient stores (to prevent long term effects on your own health of nutrient depletion)
- Being unhealthy and overweight led to dietary changes in preparation for pregnancy
- Makes you feel better/more energy

Knowledge/awareness

- Awareness and education- re which foods to avoid in pregnancy
- Knowledge to avoid alcohol when pregnant
- Awareness/knowledge of what foods to avoid (e.g. not aware that had to avoid pre-packaged lettuce (not available during previous pregnancies), while at BBQ at friend's house one pregnant lady there wasn't aware that alcohol should be avoided)
- Aware of risks if diet not healthy/if not careful about what eat

Health consciousness

- Having always been health conscious- conscious of what eat
- Aware of diet- '*just trying to make sure that the baby's actually getting enough of what it needs and um...and that's all I guess'*

Eating for two (n=2)

- Changed diet- ate more for two
- Didn't change types of foods, just ate more- ate for two

Others (n=1 each)

- Food availability (husband butcher so was always eating red/processed meat at home, hams and salamis (but lesser amount)) – also helped with energy levels (didn't feel so tired when eating it regularly)

- Eats healthy all the time because has lost so many babies (many unsuccessful IVF attempts)
- Had to avoid certain foods due to allergy/intolerance of other child who was being breastfed during pregnancy- resumed those foods once stopped breastfeeding
    - Cravings of alternate nutrient sources (e.g. craving sardines- alcium source)

Reasons for no or minimal dietary changes

- Not concerned with usual pre-pregnancy diet- believed they were already eating a healthy diet and therefore did not feel a need to make significant changes during pregnancy
- Belief that nothing can be done to improve pregnancy outcome and that dietary changes will have no effect on the baby (n=1)
- Everything was going fine with pregnancy/not feeling unwell so didn't see need for diet changes
    - *'Everything was going fine, I didn't have nausea, I didn't have vomiting, anything so I thought I'm eating the right thing'*

What would motivate you to change your diet more?

- Known deficiency (identified by blood test) or health concern
- Felt that diet was good and no issues with any nutrient levels from blood test (had nutrient levels checked early on- all fine so knew diet was providing right nutrients/was nutritionally adequate). If a deficiency had been identified then would make diet changes or take supplements ('*evidence-based decision'*).
- If felt sick/physically unwell (Felt really well physically all throughout pregnancy so felt no need to change diet)
- Gestational diabetes diagnoses- led to dietary changes (previously thought she was fine and eating right foods as didn't experience any sickness)
- Health concern- if your own or your baby's health was at risk
- Not wanting to miscarry
- Baby's health and happiness (if upset/unsettled or stomach ache or colicy)
- Desire to be fit and healthy (lose weight) and be able to keep up with kids (maintain energy levels)
- Information about what foods to avoid from someone else (getting that information and then seeing results)
- Weight loss- *to be 'size zero'*

Sources who would approve dietary changes

- Partner
- Parents
    - *'Once Mum found out that we were expecting a baby she was extremely (pause) a little bit obsessive about nagging me about you know eating healthy and cutting out caffiene and you know have you given up all your bad habits? Are you eating right? Yeah so she was probably one of the bigger pushers.'*
    - *'Apart from my dad was pushing me to eat more, not really. Yeah so it's normally my dad who keeps calling me, 'have you had your breakfast? what did you have for breakfast?'. It's like oh wow. Yeah so not really, but i guess he makes sure i eat for two and all of that but yeah nothing no one else wants me to change or wanted me to change.'*
- Female relatives (aunty, grandma, mother in law, grandmother in law)- approve of healthy diet
    - *'My um partner's grandma she was a big infleunce, she'd like ring up and go, 'has Yolanda eaten today, what's she had?' so she was more a big support than he was, he'd kind of be off doing his own thing, he'd be sitting at home and she'd ring him and then he would ring me and go, 'have you eaten?', 'No', 'Well, go eat, i need to tell Grandma you're eating!', so.'*

Sources who would disapprove of dietary changes

- Parents in general

- Don't understand why making certain changes/avoiding certain foods (especially when they didn't during their pregnancies)
- *'My Mum would say, 'don't be stupid, like i ate all that when i was pregnant' [yes, i found that as well- AW, MM] but they'd count it that you're being obsessive so then you sort of just don't tell them'*
- *'I thought it was funny, my parents throughout my entire pregnancy, 'here have a glass of wine [yeah- NH; oh yep- ?] Its not problem we drank and smoked and you guys were fine' and constantly saying to me, 'you don't have to believe everything that you hear or read, it's not that bad' but they are..i mean they just dont dont really educate themselves on a lot of things. They just go, 'well it was fine for us'.'*

- Parents from other cultures/ethnic backgrounds with different cuisines
    - *'Yeah I my parents came over so and i said I'm not eating this, I always didn't like because my parents are Slovak so we have such a heavy food not so greasy and I my Mum said 'eat this' and i said 'i'm not eating that', 'ah dont be hysterical!' (grp laughs) so she cant under.. like she thinks that i'm hysterical when i dont want that much or when in my food I 'We ate everything and now you just don't want to eat this and this there's nothing going to happen' and i said, 'ok, that's fine   this is my baby, you had your chance' and ..'*
- Family and friends- encouraging vegetarian of 17yrs to eat meat during pregnancy
- Friends who don't have kids/have not been pregnant- don't understand why avoiding certain foods (when eating out)
    - *'…if we're out eating and you know 'I'm sorry I can't eat fetta cheese' for instance, I'm like, 'I'm sorry I can't eat that' and people who I was quite often eating with, friends who don't have kids, were like, 'god, you're so picky' and i was like (laughs) 'It's not me'. But yeah you're right people force alcohol on you 'just have one, just have two' ['yeah you'll be fine don't worry, you know']. They don't respect your decision a lot of the time [No]. Yeah.'*
- *'Nobody really disapproved'*

Benefits diet change

- Ensure you have good level of nutrients at baseline- are healthy from the start
- (preconception) Ensuring husbands/partners diet was also nutritionally adequate (if she ate healthy and had good diet, then he would also) – *'…so that you know his side of things were all healthy too'*
- Felt so tired during pregnancy and having a good healthy diet increased energy levels (made you feel less tired/ 'zapped')
- Development of the child
- Healthier baby; *'That's all you want', 'That's all you hope for'*
- Get in the habit of healthy eating. Become more aware/conscious of what eating- good practise for when baby starts solids- ensuring healthy diet for you and baby/whole family.

Disadvantages

- Enjoyment- not being able to eat/drink what you enjoy even though you may feel like it (knowing that you can't because you are doing it for the health of the baby)
- Can be stressful- especially if going out to eat (have to think carefully about what eat, cant have certain things of the menu/want what you can't have- can make you not want to go out)
- Time management/needing to plan ahead (time to cook meals and ensure have all ingredients)
- Trying to remember to eat regular meals (and more meals/day) than what may be used to. Have to think about what you eat and how it may affect baby (whatever you eat, the baby gets too)
- Feeling like you're being really picky/inconveniencing people
    - *'Just sort of being just feeling like one of those really anal people [yeah- NH] thats going 'oh no no i can't have that' 'oh no no i can't have that', when you know you really want it or yeah you wouldn't normally be like that.'*

Enablers of dietary change

- Supportive partner- shares same diet, helps around house
- People understanding that making diet changes ‘because you're trying to you know do the best for the baby…’
- Motivation to look after yourself (be as healthy as you can be) and do everything you can to not miscarry/lose the baby.
    - *‘You don't want to lose the baby, you just want to do everything right and you want to be as healthy as you can first because if you're not healthy then sometimes people can miscarry the baby. So just that motivation to look after you or what you've got to carry the baby’*
- Knowledge of required dietary changes would enable women to make healthy dietary changes (and rely less on supplements)
    - Don’t know (specific requirements) how much of certain important nutrients (e.g. Folate and iodine) are required and wouldn’t know what dietary changes would be needed to get sufficient levels/meet requirements.
    - If knew how diet would need to be adjusted to meet requirements and these adjustments were small and had same benefits as taking supplements, would prefer to make diet changes rather than take supplements
    - *‘I don't know because like we were saying we dont know how, no ones actually specifically said like how much folate we shoud be having and how much iodine or that kind of thing so you can't actually, I wouldnt be able to say, well i could up my diet by this much and then i wouldn't need to take a supplement, you know what i mean? It's like i couldnt really gage whether one was better than the other I mean if i knew that i had to eat this much more of this particular food, and this much more of this particualr food i wouldn't have to take supplement, I'd probably take the food really because the supplements are quite expensive and if it was only just a matter of adjusting my diet a bit and i had the same benefit i probably would just do the diet but because like we said we dont know the exact amount we're supposed to be having of different bits and pieces, you cant really make that call, does that make sense?’*
    - *‘Yeah my only other comment i mean general benefit of having supplements is that maybe they act quicker or act different or more relevant amount thats required but i think the same, if i didnt have to take supplements and i knew what i had to replace in my diet or change, I'd probably just do that.’*

Barriers

Feeling tired/lack energy

Feeling unwell/morning sickness

Other people

- Support from partner and family (enabler)
    - *‘If your partner is not supportive of your choices or your family, it makes it a bit more difficult’*
    - Fussy partner or kids who don’t like the way you cook or don’t want to eat what you buy
- Socialising/eating out is a barrier
    - *‘…if you're going out or if you're going even to relatives or friends places who are unaware of what you can and can't have and that kind of thing and you know dont want to be telling them, 'i can only eat this, this and this' necessarily…’*
- Other people (friends and family) not understanding or not being aware of why avoiding certain foods and encouraging you to eat those foods.
- People telling you to eat foods that should be avoided/that you know to avoid or not eat certain foods that you know you can eat.
    - *‘..people trying to get you to eat foods you're not supposed to and then people telling you you can't eat foods that you can'.*

- Culture/ethnic background having influence on what you eat (not always healthy foods- often high saturated fat/fried foods; eating for two)

Time

- **Too busy** to prepare healthy meals
- Need good time management, need to plan ahead to ensure have all ingredients and the time to prepare the food.
- **Lifestyle**- very busy, big family to look after- sometimes easier to grab quick snack that's not very nutritious
    - *'Sometimes if people you know have got 5 or 6 kids already and they're really really busy and you know it's easier just to grab a quick snack that's not so nutritious but they still got to attend to the other children so there's lots of different factors…'*
- **Other commitments/big family** (need to look after and watch over; e.g. Especially if don't have all ingredients for a meal at home and need to travel to the shop with everyone- takes time)
    - *'Income [What do you mean by that?- LM]…Uh well sometimes it's easier to just to go down and grab a heap of chips and feed the kids on chips and rather than try and spend half an hour to an hour cooking up something decent, and if you don't have everything you need in the house and you know you get everyone in the car and then you go donw the street, pick everything up that you need, get it back in time and you know and if you have other stuff that you're supposed to be doing as well, if you have other commitments and yeah sort of makes it difficult.'*

- *'time wise it can be pretty hard, getting all those right nutrients can be hard sometimes'*

Feeling tired/not wanting to cook

Lack of knowledge

- Don't know if eating right thing or if your diet is providing you with all your nutrient requirements- may think you're eating healthy but maybe you're not (and not getting all nutrients you need)
- Own knowledge about what foods contain the important/required nutrients

Work

- Dictates when you eat /eating pattern (especially if work in a restaurant (have dinner after closing))

Money

- Fresh fruit/veg and meat can be expensive (no one said that for them, personally, it was expensive (just said it could be for others).
- Initially more expensive to buy healthier foods but probably cheaper in long term (than eating junk food/take away/less healthy foods)
    - *'Probably initially it would be, um once you sort of have that initial outlay and you have enough in the house for a while, it would be cheaper doing it that way than just going out and buy a heap $5 worth of chips or something because then obviously they'd have to do the same the next day and the next day so it probably seems more expensive and then yeah so overall it's probably not but it seems that way- TM; Yeah the initial outlay of buying it all- JM'*

{*With your current pregnancy} What or who influenced your decision to start taking dietary supplements? And what's motivating you to continue?

<u>**Influences/reasons for using supplements**</u>

Marketing

- Advertising telling women that they need to take supplements to have healthy baby

- Because of marketing, fearful of what baby might be missing out on if don't take supplements
- *'I that I am getting everything really because of the marketing just in case there's anything in my diet that I don't get.'*
- Supplements provide *'that little added extra just in case it's not provided in the diet';'..any help is best and really I'm a sucker for the marketing'*

- *'On television they advertise folate'*
- Saw the supplements on commercials on TV- didn't have pregnant friends/friends with babies so bought ones that saw on TV

Doctor's advice/recommendation (GP/obstetrician)

- GP recommendation and known/identified deficiency
- Doctor's advice (GP/obstetrician)
- *'My doctor (GP) said straight away get in to the vitamins so I did it too'*
- doctors advise (only need folate preconception (some women only took folate because lot cheaper); switch to multivitamin for pregnancy, no one advised to take MV in BF)

Pharmacist/chemist's advice/recommendation

- Talked to pharmacist/chemist- listened to their recommendations
    - Asked: *'Umm what to look for, what to avoid... they recommended a few different ones so I've been changing brands.'*

Known nutrient deficiencies

- Only took most important supplement (folate) because thought diet was adequate/providing all essential nutrients.
- Take specific supplement because of known nutrient deficiency (id by blood test): *'the only reason I take something because I know I'm deficient'.*
- Identify any deficiencies from blood test and then take supplements based on those results

Inadequate diet

- Took supplements as realised/know that wouldn't be getting enough of some nutrients from diet (especially if don't like/normally eat certain foods which are rich in important nutrients)
- *'At least you know that you've got everything covered- then you can relax, especially if you're eating very little of nutritional value just because you can't stomach it or its coming back out, you know a tablet can stay in long enough.'*
- Diet not as healthy as should be so supplement will fill any gaps/provide any nutrients not provided by diet.
- Even if eat balanced diet, food may not contain as many nutrients as it should- so still not getting everything that you need → so take supplements to make sure getting everything

- Lack of knowledge/don't know if getting enough nutrients from diet- take supplements just to cover all bases just in case (if had blood test could find out if diet ok/supplements needed).
    - *'But if i wasn't pregnant i wouldn't bother doing that, i would just rely on my diet and make sure that i was eating really well and..'*

Convenience/inadequate diet

- Easier to take a supplement to make sure that your levels are sufficient (rather than making sure eating healthy balanced diet all the time).
    - *'Depending on lifestyle and how busy you are, um to me a supplement was the easiest thing to do um because sometimes you know working 60 hrs a wk while i was pregnant, i couldn't always get to the shops or the market or what to buy what i needed. So i think your lifestyle plays a role, a big role. Um if i had endless money, endless time, i would like to do it naturally, i would prefer to do it naturally, but that's not going to happen.'*
    - *'Naturally? how do you mean?'- LM*
    - *'You know like food, eating the right foods and increasing your spinachs and those sorts of things, you'd prefer to do that you know but its the you know, the*

inconvenience sometimes of having to cook, to clean up, to look after your kids, to get to work, to get home. So you know, i think it's all about your lifestyle and simplicity if it's in a capsule um it would make it a lot easier, depending on your circumstances, so yeah.'

Health of baby

- For the health of baby and make sure getting all vitamins/minerals that are needed by mother and baby
  - *'as a mum you want to do everything possible to help your baby develop properly in the womb and out. You want to give them the best chance, the best start, whatever'*
- Peace of mind/reassurance/know that will at least be getting minimum amount of nutrients that's required and then try and eat healthy as well. So at least baby is getting what it needs.
- If diet is lacking in some nutrients, supplement will ensure baby is getting everything it needs ('*…so that it's not suffering'*)
- Knowing that supplements are good for baby
- *'Really important for growing a baby'*

Health of self (mum)

- Keep own energy levels up (especially if have other children)

Research

- Some women influenced by studies/research they have heard or read about
  - *'…he suggested it was my choice and he wasn't bothered one way or another because i saw something in the paper about asthma and folic acid in later pregnancy so i asked him about that and he kind of said to me 'it's your choice, it's neither one way or another'. So i just stopped taking them when i was about 8 months.'*
- Folate is the 'only one that has such a clear link between cause and effect'- research about its importance
- Aware of current clinical trials/studies at hospital with fish oil- *'..so i sort of thought, 'well, i'll have some more of that then'.*
- Research that supplements are 'better for the child'

Knowledge/awareness

- Knowledge that folate was so important led her to take supplement highest in folate
- *'I guess just public awareness that i needed to take a folate supplement prior to my pregnancies'*
- Common knowledge to take supplements when planning a baby- want to keep levels of nutrients right- ('*it's the sort of thing you just kind of pick up'*.)
- Don't know what/how much nutrients are in different foods whereas with supplements you can be guaranteed to getting the required nutrients for pregnancy/preconception/lactation.
- Sometimes don't know how much of certain foods you need to eat to get right amount of nutrients unless someone tells you- supplement easier know that required amount is in there.
  - *'i think, oh i'm sorry, i think knowing what nutrients are in certain vegetables and meat and seafood as well, like you dont know, whereas if you take that tablet, that capsule, you could be guaranteed as much as you can be gauranteed that you've got so many ugs so many mgs you know, you know the expected daily intake for a pregnant or preconception woman or lactating like you know that it's in exact form like you don't know you know that you've got to have a kilo of spinach to get the same amount of iron out of it like it's only knowledge and sometimes people don't have that knowledge. So i can put my hand up and say sometimes i don't know exactly unless someone tells me.'*

Social expectations/norms

- Normal/expected thing to do (take supps) when plan preg/preg → family influence (grown up thinking taking supps is normal for better health)
  - *'Yeah, i guess i just didnt sort of* ***that was just what you did when you were pregnant***

so (laughs). You know the same with going to your antenatal appointments and things like that so i just as long as i remembered, that's my problem, is making sure that i remember to take them and yeah otherwise its yeah, i don't feel either negative or positive about them. (MA nods head)'

- *'I just um i just think for myself it was like because we're aware of what you need to have to have like obviously folate and all these other things you need to provide to the growing foetus. I just thought i have to do it, and there's just no question about it like living in this day and age we need to do it so I'm you know I had to and when they ran out, we'd get around to getting them in a few days and i'd be like worried 'oh, i havent been taking my tablets!'. So yeah, i probably am a little bit over the top with it maybe, i dont know but it made me feel good having them (grp laughs) yeah and like you said, if you were feeling a bit run down or you hadn't had the best diet that day or all week whatever few days, it felt like you made up for it a little bit anyway with the tablets. I know that's probably not a good way of looking at it either because you should be having, you know, a good diet all the time..'*

- Recently pregnant family and friends were taking supplements- acted as encouraged to take them, showed it was a positive thing as everyone else was taking them.

Other sources of advice/recommendation

- Advise/recommendation from naturopath
- Word of mouth from people (e.g. friend of another mum from school- showcasing nutritional supplement products- then gave her opinion as to best/her most preferred product (was an ex midwife and nurse)
- Friend recommendation (supplement for E and for alkaline blood)

Other influences (each n=1)

- Continued taking folate throughout entire pregnancy because 'it actually improved my mood really well'
- To help conceive/doctors advise
- To help prevent further miscarriages (omega-3) – doctor's advice
- To succeed in IVF
- Availability- was in Africa during early pregnancy and no folate containing supplements were available

Reasons for not using supplements/using them minimally (i.e. only one nutrient)

- All levels were checked and were ok, showed that getting enough nutrients from diet- no need take supplements- Would only take supplements if a nutrient deficiency was identified through a blood test.
- Didn't take iodine because iodine is added to bread and uses iodised salt so does not feel need to take supplements as already being supplemented.
- Feels better eating and getting nutrients from foods rather than tablet (even fortified food preferred over tablet)
- Would take supplements if had blood test (nutrient levels checked) and deficiency of a certain nutrient/s was identified then would either change diet or take appropriate supplement.
- Mindset that take tablet when sick- when pregnant you are not sick, just trying to be healthy (and being healthy usually involved healthy diet and not taking supplements)

Benefits of taking supplements in pregnancy

Peace of mind

- *'I think it's peace of mind more than anything.'*- peace of mind that you are providing baby with the required nutrients.
- If lacking certain nutrients in diet or if feeling sick then supplements can at least provide minimum amount of the important nutrients- peace of mind that if you take the supplement, the baby will get all the nutrients it needs.
  - *'Well I just felt that if I'm lacking things in some things if I'm feeling sick or this and that at least I'm getting the bare core minimum essential vitamins and whatever else*

goes in these little capsules. So it's more for me, very much peace of mind, so pop a pill, yep you're alright, the baby's getting all the vitamins whatever it should need.'

- If feeling rundown/tired/didn't have the best diet that day/during that week, the supplements made up for it
    - *'...made me feel good having them (grp laughs) yeah and like you said, if you were feeling a bit run down or you hadn't had the best diet that day or all week whatever few days, it felt like you made up for it a little bit anyway with the tablets. I know that's probably not a good way of looking at it either because you should be having, you know, a good diet all the time.'*

Back up for missing nutrients in diet (make up for inadequate diet)

- Fill in any gaps in diet (that you may not be aware of)
- Supplements act as backup- take on top of healthy diet to top up levels of nutrients- make sure that definitely have enough
    - *'the supplement was just like just like a back up plan that i knew i was definitely getting enough'*
    - *'...probably easier just to take a tablet just to sort of bump up what we're not getting in our natural diet...'*
    - *'So I figure that I'll try and eat as healthy as I can and then I'll take my supplements as my stop gap and then we should be okay.'*
- Foods that are high in certain important nutrients may not be part of your usual diet- may not be meeting requirements of some nutrients- multivitamins cover that base/provide you with what may be missing from diet.
    - *'There are some foods that you just you know everyone's got a just slightly different diet and there are some foods that you just don't eat a lot of and so i guess with a multivitamin they just cover that base. Say iodine for instance or zinc or something, you know you may not get enough of that because you, i dont know i think everyone just kind of buys the same food most of the time that they're used to. Still there's a wide range but there's just maybe something you're missing out on.'*

Ensure you are healthy/have adequate nutrient levels at baseline (start of pregnancy)

- Allow you to have sufficient levels of nutrients at baseline- allow you to be healthy right at the start of pregnancy.
    - Make you healthy at baseline- allow you to be healthy (sufficient levels of nutrients) right at the start.
    - *'Just to give you that baseline, get healthy alright at the start'*

- Taking supplements preconception *'will start you off with a pretty good baseline of you know, where you can you know what's, what you are when you're healthy and when everything's kind of normal and then you can kind of build from there what's missing.'*
- Preconception supplementation *'gets you to a healthy level which just enables you to get pregnant if required'*.

Baby's health

- Healthier baby
    - *'That's all you want'; 'That's all you hope for'*
- *'Baby getting good nutrition'*
- *'It's good for the baby, it's good for you'*

Mother's health

- Maintaining energy levels
- *'It's good for the baby, it's good for you'*
- *'Yeah you're benefiting as well as the baby'*

Benefits depend on nutritional adequacy of diet and personal circumstances of individual

- Supplements more beneficial for women with high risk pregnancy, known nutrient deficiencies

or health problems requiring supplementation.
- Supplements not as important or beneficial if diet is providing adequate nutrients

Same benefits as making dietary changes

Others
- *'Maybe they act quicker or act different or more relevant amount that's required…'*

No personal benefits to be gained from taking supplements- only women aged 35+ who are at higher risk of adverse pregnancy outcomes would potentially benefit from taking supplements (n=1)

Disadvantages of supplement use

Cost
- Cost/quite expensive if taken daily
    - *'It's not cheap but …if you know it's going to help then you'll do it…'*
    - *'yeah probably cost actually, yeah i find myself some places are so expensive and just depends on where you go so i find myself driving (laughs) you know like yeah i'm not paying bloody $60 for that and other places are like $38 oh how can there be such a difference in price! so yeah'*
    - *'I think it's so expensive and i was taking Elevit for the first 3 months after he was born but then to keep buying it was just so expensive that i just I just couldn't afford to keep doing it. But now that i'm thinking sbout getting pregnant again, i've started taking the BM instead of the Elevti just because it's a bit cheaper and it's got that thing in it that's not natural that's natural as opposed ot the thing that's man made'*
- Pharmaceutical companies know that women want the best for their child and they will pay for supplements (no matter the cost)

Unnecessary intake of some nutrients
- Can't get some nutrients as individual supplements/can't buy them on their own- must take other nutrients as well- may be unnecessary.
- Concern that may not need to take supplements and that 'it's just lining the pockets of the pharmaceutical companies'
- Concern that may be having too much of some nutrients
- Concern that may not need to be taking all of the nutrients present in the pregnancy multivitamin

Concerned about risks
- Recommendation to take supplement that contains nutrients which may not need- fearful of risks of excess intake
- Reading about research about risks of taking too much of some nutrients – especially if then recommended to take those nutrients by doctor/HP. Worried about possible risks to baby.
- Concern that may be having too much of some nutrients
- Worried about overdosing on some nutrients (especially if taking multivitamin (may not need some of the nutrients) and eating healthy diet)
- May not be comfortable taking a supplement but taking it because it was recommended by a doctor/expert
- Possible effect on uptake of other nutrients- Risk of taking too much of one thing/a particular nutrient- may reduce uptake of other nutrients

Physical properties
- Large size of capsules/tablets
- Liquid fish oil, couldn't swallow/came straight back up – hard to take
- They smell when you're pregnant
- Hard to keep tablets down in early stages of pregnancy/when experiencing morning sickness

Reliance on supplements

- Feeling tired if you don't have them for a few days
- Can sometimes take supplements and then not worry about eating healthy diet (but *'there's other vitamins and stuff in fruit and vegetables that you need, not just the stuff that's in the supplement.*')
- *'Forgetting to take it and then you have a guilty feeling of 'today the baby did not get a supplement'*

Enablers of supplement use

- Making them cheaper/free/subsidised (+if doctors handed them out to everyone at first antenatal appointment/when pregnancy first confirmed)
- Give a pack with 9 month supply of supplements when pregnancy first confirmed/at first antenatal appointment.
- A good memory would make it easier to take supplements regularly
- Having a routine, putting them in an obvious place and making sure take them at certain time of day helped remember to take them
- Knowing that you have a nutrient deficiency (trying to correct it/increase levels to normal)
- Knowing you have everything/all the important nutrients covered and then you can relax
- Peace of mind that the baby's getting all the vitamins/nutrients it needs
- If feeling sick, take supplement and 'at least I'm getting the bare core minimum essential vitamins and whatever else goes in these little capsules'
- GP recommendation was extra push- (was going to take them anyway)

Barriers to supplement use

High cost/expensive to buy

Remembering

- Remembering to take them
- Forgetting to take it and then you have a guilty feeling of 'today the baby did not get a supplement' (yeah- grp laughter)
- Overdose if you forget whether you've already taken one that day; or forgetting to take it in the first place.

Knowledge/awareness

- Some women didn't know iodine was now recommended

Can't be bothered taking them when not pregnant

- Can't be bothered taking them now that not pregnant (while BF) – '*I put myself last, one more thing to do, just oh just doesn't happen.'*

Others

- The time to go out and just replenish your stock- not always highest priority (n=1)

None of the women in the groups experienced these- just commented that these were possibilities for other people

- *I guess there's a lot of people with language barriers who may not get the information either if they come here you know don't speak any English as the first language that could be an issue.*
- *Culture could be as well [Yeah culture] if it's not their culture to not take any supplements or I know there's a lady here whose Indian at work and her mum was telling her that she shouldn't eat certain things and she should and the moon was at a certain level so she should stay in bed for 12hrs one day. So her culture was very different it would dictate what she would and wouldn't take and it could've affected you know different things*

Sources perceived to approve of supplement use

- Parents (mum and dad)

- *'My dad, it was just an expected that I'd you know, once i was pregnant i would start taking my multivitamins and that kind of thing.'*
- *'Um not really, I guess it's just my mum again, she's always checking, she'd still be checking now 'are you still on that? Are you still taking those tablets?', 'Yes yes' so...'*
- *'My mum she was against me not taking it, um something this time when she said i should be taking the pregnancy the breastfeeding pregnancy tablets or someting like that so she was very against me for not wanting to take them'*

- Partner- happy that taking iron tablets (for low levels)
- Doctors (GP/obstetrician)
  - *'My obstetrician probably just encouraged it later in pregnancy when my iron was a little bit low, just said, 'are you taking it? Keep taking it if you are', sort of thing.'*
  - GP encouraged- was an extra push to take them (even though may have taken them anyway)
- Supplement manufactures
- Don't think anyone has tried to influence them

- Previously pregnant family and friends – they all took supplements- showed that it was positive thing to do/encouragement
  - *'Um yeah I guess sort of family and friends of mine who'd been pregnant just beforehand were all taking them and stuff like that so I guess it's more encouragement and it's sort of showing it's a positive thing because everybody else is doing it sort of thing. But yeah.'*

Sources perceived to disapprove of supplements

- Friends that don't/didn't take supplements while pregnant- *'some of them tell me i shouldn't be taking them either because they think there's a lot of dangers involved in taking supplements'*

- *'Everyone just leaves it up to me i suppose so'*

People of mindset that if eating proper diet then don't need to take supplements

- Grandparents
  - *'My grandad may have disapproved but I think the from that generation it was always a case of, 'well if you're eating proper lass, you shouldn't need any of them bloody silly pills'.'*
  - *'That sounds like my grandma as well'*
- Mum
- Mother in law who is also nurse
  - 'My mother in laws a nurse, she's not really into supplements, she's more into diet but yeah'

5. If you had to choose between getting your extra nutrients from a tablet/capsule or a food product, which would you choose and what would make that choice more appealing to you?

PREFER FORTIFIED FOOD

- *'I love food so I'd go with food'*
- If there is a 'fresh' (food) option will prefer that over supplement
- *'Probably from food'*
- If could get same effect as taking supplements from fortified food then would prefer fortified food.
- Open to the idea of eating a fortified food daily instead of taking supplement
  - *'So just take a pregnancy yogurt, just have one a day kind of thing of this yogurt, not bad'*
- Would prefer to get nutrients from food- even if it has to be fortified
  - *'To me it feels better in a way to be eating a food and getting a nutrient from it rather than, even if it has been added to it, rather than taking a tablet.'*

- Would eat food but supplements are easier when going out
- May take a while to accept that eating the fortified food (e.g. one muesli bar a day instead of one capsule a day) will have the same effect as taking a supplement, and to feel comfortable that meeting all your nutrient requirements by eating the food.

- Like convenience of capsule but also like food- if food tasted good would prefer food (because may be better absorbed by body than supplements)

- Food first then supplement as backup/top up of nutrients.
    - *'But always the food for me is first and then the supplement is just the secondary just to top it up.'*

PREFER SUPPLEMENTS

- Would prefer pill/capsule
- If both have same risks involved in taking them- would prefer supplements
- Prefer foods to stay in as natural form as possible and if require supplement- prefer to just take it in capsule/pill form.
    - *'I think I'd just rather keep taking the capsules then mess with food too much.'*
- Trying to stay away from processed foods- fortified foods fall in that category so probably wouldn't eat them (prefer supplements)
- Prefer to eat food '*how it should be'*/in its original form (without being changed)
    - *'Fortified food scares the hell out of me.' I don't know, like, I know that I guess I'm just worried I'm going to forget that it's not real it's not it's not the original, it's been changed kind of thing. Whereas tablets a tablet, I know it's made by a pharmaceutical company or whatever like, I don't know.'* (?possible confusion with GM foods)
- Supplements are easier and more convenient, buy large supply at once and always have it on hand whereas with food have to *'go out and make sure you have enough stocks'*
- Easier to take supplement- rather than having to go out and buy particular product (fortified food)
- Supplements easier/more convenient (especially if going out)
    - Would eat food but supplements are easier when going out
- Convenience is important factor- *'I guess it can seem nicer to eat food. Um yeah perhaps you can be swayed by convenience (laughs) at the end of the day.'*
- Supplements make things easier because it can be impossible to eat all the required nutrients.
    - *'Yeah the supplements make things so much easier because being able to eat all those nutrients is just impossible sometimes, yeah.'*
- Supplements are easier, once you take it can tick box that now got all the important nutrients- don't have to worry about what may be missing out on
    - *'I suppose I felt as well it's almost like you could tick the box, once you took your tablet you could tick the box and then you can eat as well as you can for you know the rest of your meal but you've had that tablet, you know that you're not going to constantly think, 'oh you know do i need to bump up my iron?'; the tablets are easier.'*
- Supplement more convenient- easier/simpler, can take with you anywhere, easier/more convenient if have busy lifestyle/no time to go and buy the fortified food. (lifestyle plays important role- try and make things as simple as possible)
    - *'…but it's the you know, the inconvenience sometimes of having to cook, to clean up, to look after your kids, to get to work, to get home. So you know, I think it's all about your lifestyle and simplicity if it's in a capsule um it would make it a lot easier, depending on your circumstances, so yeah.'*

- Used to regularly getting a regular amount of nutrients from supplements, then if start eating fortified foods- don't know if getting the required amount of nutrients from them.
    - *'Well you know you're getting a regular amount on a regular basis and if you start eating foods out ad hoc you don't know if you're getting the required amount'*

- Trust that getting right amount of nutrients from supplement because nutrients are in 'medical form'. Think/concerned that the food doesn't contain as much as could get from supplement.
    - *'… some of the food companies using you know, that this has got omega 3 in it- who's really proving that they that it is in there kind of thing and how much is in there? is it going to cover what I need? whereas if you go to a doctor and they say you need omega 3 or whatever they can say you need a certain amount and then you know you're getting it because it's in the 'medical' form.'*

- Seem to be resistant to the idea of eating fortified food instead of taking a supplement- used to taking a supplement and feeling reassured that have now got the recommended amount of the important nutrients (peace of mind). Seem to not trust that the fortified food could replace the tablets/seems like wouldn't give them the same peace of mind that meeting nutrient requirements/'getting the right amount' as when taking a supplement.

- Easier to take supplements- they know what their taking and how much (easier than *'having a little bit of yogurt, a little bit of this…')*
    - Supplements more convenient because they *'have the actual measurement in there and what you what you want for the day.'*
- Can't be sure that the food contains the same amount of nutrients as supplements/question whether the food contains the amount of nutrients stated on the packaging
- Know that getting certain/specific amount of nutrients in a supplement- all measured out and all there. With foods, nutrients you get depends on how much you eat and you may not eat it all.

- Easier to just buy supplements- know where to find them- rather than searching supermarket
- Supplement is easier and simpler, used to taking a supplement know where to find/buy it- with a fortified food would have to look for it in the shop then would need to check that it has the right amount of nutrients (even though many women don't know what the 'right amount' of important nutrients such as folate and iodine is) → the supplement *'puts my mind at rest i'm getting the right amount'*

- Depends on whether body absorbs nutrients better from the food or supplements- supported by research/evidence. If there is research/scientific evidence that shows nutrients from the fortified food are better absorbed, then would be happy to eat the food… *'But i think a tablet would be more convenient for everyone and more better for them.'*
    - People seem to be swayed by convenience and simplicity of taking supplements over going out and purchasing and then eating fortified food.

Having a combination of supplement and fortified food- having variety

- Would prefer food but would not be totally reliant on it: Prefer food but would have back up supply of tablets (long shelf life/wouldn't go off for quite a while)- have a supplement on top of the fortified food every now and then as extra back up
    - *'I'd say I definitely prefer the food but just always just have the backup supply of tablets because they wouldn't go off for quite a while initially so just slot one in every now and then as an extra back up as well, so it's not going to hurt.'*

- Do a combination/have variety e.g. supplements one week and fortified food the next
    - *'You could probably do both a combination of both of them just instead of having to have a tablet every day you could do a tablet and that for a week or something and then maybe do a week of just the food supplements.'*
    - Wouldn't replace supplements (supplements so easy to take)- *'Yep, I think it might not it may not um kind of wipe out the supplements like people might buy this (fortified food) and then have the supplement. So on this day oh I'll just have this yogurt and then that will do and then I'll take the supplement kind of thing. But the supplement is just so too easy.'*

- As long as price of food reasonable, would be happy to buy and have it as an extra food but wouldn't rely on it to replace supplements everyday
  - *'I think as long as the price of that particular food isn't too costly then I would be happy to purchase and eat it and have it as an extra you know food but I wouldn't rely on it to you know supplement every day. I think that everybody is different in that, that's just my opinion. I can't imagine eating yogurt like that particular yogurt like every day.'*

<u>Conditions/important factors decision would depend on:</u>

Taste

- Depends on taste (and smell) of food
- Taste is most important factor- because supplements easy to take, just swallow and done.

Food product

- Would depend on food product – what other nutrients that food would be providing ('*so it's not an extra thing that have to add to the diet but something that already may be eating anyway that's been made even better (more nutritious)'*)
  - *'… i don't really like taking supplements if there's a way you can get it from a like a different, from a food product and if it's a product that I'd never eat in a million years that i don't like and it's fortified, then that's different but if it's something that could be part of the diet anyway and it has got .. and it isn't ridiculously expensive or doesn't taste terrible then.'*
  - '*It has to be a food that everyone eats.'*
  - *'It would be something really basic- like bread'*
- Would depend on the food product (what it is)- e.g. if yogurt, could buy it every week just make it part of weekly shopping.
- Definitely food- but has to be one they like/can eat on regular basis
- Has to be available in range of foods
- *'Or can you just get an additive that add to food?'*

Convenience

- Can you take it with you when you go out/can it last? E.g. can take tablets with you anywhere.
  - *'If it's a muesli bar or something or you could just grab it and eat it on the run because if you've got a busy lifestyle I suppose that's convenient because you've always got to eat when you're pregnant. A tablets sort of like a mindset of a medication, it's like a but then you think that it is good for what's going on so I will have it, yeah'*
- As long as the food isn't something extra that they don't usually eat- must be able to incorporate into diet normally.
  - *'So as long as it's something that I can, you know that's not something that's going to be like extra that I can incorporate into my diet normally then any food really.'*
- Has to be a food that is already eaten/easily incorporated into diet

Cost

- Might be cheaper to buy a big box of supplements rather than the fortified food.
- Don't know if reason why supplements feel so expensive is because they are a once of large/expensive purchase, but food product would be buying every week (purchases more spread out and less money per purchase compared to supplements) so wouldn't feel as expensive. (psychological- not buying big expensive amount at one time, purchases more spread out and pay relatively small price each time)
  - *'I don't know because I don't know if the reason the supplements hurt so much is because it's one hit, whereas if it's more spread out over like if you were buying it every week in the shops maybe it wouldn't feel quite as much, even if it worked out more, if you know what I mean, it's a psychological thing of not buying a big amount first up'*
- As long as price of food reasonable, would be happy to buy and have it as an extra food but

wouldn’t rely on it to replace supplements everyday

- Would depend on cost- which option is cheaper to take/eat over same period of time *(‘that would be a big factor for me’).*

Serve size/equivalence to supplement

- Serve size has to be achievable/realistic amount of food
- Depends on serving size that has to be eaten to equal nutrients in supplements/amount of food required to match nutrients contained in supplements.
- The food would have to contain same amount of nutrients as supplement
- **If knew that the food contained the same amount of nutrient as the supplement and were educated/informed about this then would prefer the food.**
    - ***‘****The problem is we don’t have this information so it's hard to work out by yourself, 'ok, if i eat this and this and this it's enough for my baby', mmm’*
    - Prefer to be informed by someone qualified who can answer your questions rather than reading about it because then have lots of questions but no one to answer them.
        - *‘I would prefer someone qualified because you can ask them some questions because you can read but then you ask so many questions in your head and you have no one to answer that so then you take the option they give you, 'ok, that this and that's enough'.’*
    - Leaflet produced by a trusted source (e.g. research centre or hospital) would be acceptable way of informing women about the fortified food- could be including in the pack received at the first antenatal appointment. Leaflet from reliable source would be fine.
    - Would be less inclined to eat the fortified food over supplements if leaflet/information abut the food was provided only by the food company/manufacturer.
        - *‘if it was a publication produced again by a sort of government funded public source, you probably would think it should be in the general public's interest more than if it was coming from some company or anything like that.’*

Others

- *‘Can you eat it if you have morning sickness?’*
- Also concerned with what other ingredients may be in the fortified foods
- Scared of having an excess of some nutrients/excess intake; *‘...you can control it and have your own dosage if it's in a tablet, i think that's best.’* If food is fortified, may be easier to have too much of a certain nutrient.
    - *‘Yeah I’m not into the fortified food at all because like for example with this iron condition where I store too much, I heard they're going to fortify rice in Asia with iron and I’d be screwed like I’d have yeah. So um it’s you can control it and have your own dosage if it's in a tablet, i think that's best.’*
- Psychology/mindset that, *‘supplement is a tablet and we take a tablet when we are sick or need something so there's the whole so I would guess there'd be the psychology to think, 'oh this is medical, this must be good for me sort of thing'.’*
    - *‘when you're pregnant, you're not sick you're just trying to be healthy and you know being healthy normally involves a healthy diet’*

Foods mentioned for fortification:

- Bread, yogurt, muesli bar, chocolate,
- Fortified chocolate bar, pregnancy chocolate box or chocolate coated pill- mentioned as appealing options

6. When you are deciding whether to buy a particular dietary supplement, what product characteristics are most important to you?

Cost

- What is best value for money- compare cost; Don’t care about the brand. *‘if there's a generic brand available, I’ll grab it’*

Brand

- Recognisable/well-known brand
- Trusted brand- bigger/more well-known brand. *'My sort of thing was sort of going with the trusted sort of brand that I knew and the sort of bigger one and and so you didn't want some small unknown company making it'*
- Choose doctor recommended brand or the most famous/well-known brand (more likely to trust it).

- Recommended by someone
- Previous use or heard about it from health professional (doctor or nurse)- has to have heard of brand otherwise won't buy it

Nutrient content:

- **Compare levels & also if contains required/recommended nutrients**
  - Compare levels of nutrients- which nutrients, how much?
  - Look for higher amount of certain nutrient/s
  - Read ingredients/nutrition information panel to see if includes nutrients that you need
  - Recommended to take specific nutrients (iodine and folate) looked for supplement that contained both and had highest amount of them. *'…you're told to take those specific things, not that I knew how much I should be having, but I was like, 'which one's got the most is probably the better one"*
- **Single nutrient or multivitamin /combination** (often can't get nutrient on its own so have to take multivitamin).
  - *'So I guess it's sort of about the level that's in there and and whether it's you know pure supplement as opposed to a mixture of various things where you're not quite you might not actually need the other thing that's in there. So that was really what influenced me; it wasn't so much the brand or the price.'*

Natural ingredients- chose the one that *'seemed to be a more like natural product'*

Supply

- Longer supply is better- it is good not having to worry about it for a while

Dose

- How many have to be taken at a time… e.g. One a day vs. Three

Free/loose capsules more convenient/easier vs. tablets in blister pack

Physical properties

- Taste- vanilla flavour of blackmore's capsules, cant have liquid fish oil- odourless capsules best
- Taste/after taste/reflux- reason for swapping to different supplement
- Size (large tablets/capsules can be issue)

Previous use

- Take same ones that took in last pregnancy

Amount of information on label/packet (more information the better (re health benefits) → health claims) (n=1fg)

Label/packaging appearance- more attractive is better (n=1)

Place of purchase '*from a responsible you know pharmacist or something, it has to look nice and clean and not like dusty (laughs).' (n=1)*

More thoroughly assessed- approved by regulatory body (n=1)

- *'I have this recollection, it could've happened, it could have not happened. Um but at the time the* *supplement that I was taking someone said that it had iodine or something in it and for that reason it had gone through the equivalent of like the FDA whatever the Australian equivalent is, it had gone through the FDA approval that vitamins and stuff don't normally go through and so I guess that kind of helped me go with that one in the sense that it seemed like it had been a bit more thoroughly assessed and approved so.'*

Example of decision process: compare nutrient content**-** if similar, compare price**-** if similar get better known brand

Appendix 6: Online survey questionnaire

[Numbering of questions corresponds to numbering used in SPSS database]

Introduction: Part 1

Thank you for participating in this survey.

Please take as much time as you need to answer the questions. Most questions only require you to check a box. A few questions ask you to type in a response. All your answers to the questions are strictly anonymous. No one will contact you after the survey, and no sales solicitation is involved. Your answers will be used for research purposes only.

This nation-wide survey is being conducted by researchers at the *Women's and Children's Health Research Institute*, the *University of Adelaide* in South Australia and the *Centre for the Study of Choice (CenSoC)* at the *University of Technology Sydney*.

The survey begins with a few simple demographic questions about you. Please DO NOT USE the 'Back' and 'Forward' buttons in your browser. Please use the buttons at the bottom of each screen.

If you would like to pause the survey to return to it later, simply close the window and click on the original link in the invitation. It will return you to the last point of entry in the survey.

Please click on " >> " button to proceed.

>>

SCREENING QUESTIONS

[Industry] Do you work in any of the following industries?

- ☐ Automotive
- ☐ Media and Advertising
- ☐ Marketing
- ☐ Education
- ☐ Consulting
- ☐ Nutrition (Screen out)
- ☐ Construction
- ☐ Market Research (Screen out)
- ☐ Nutrition-related health research (screen out)
- ☐ None of the above

[Age] To which age group do you belong?

- ☐ Under 18 years
- ☐ 18-24 years
- ☐ 25-29 years
- ☐ 30-34 years

- ☐ 35-39 years
- ☐ 40-44 years
- ☐ 45-49 years
- ☐ 50-54 years (screen out)
- ☐ 55-59 years
- ☐ 60-64 years
- ☐ 65-69 years
- ☐ 70-74 years
- ☐ 75 years and over

[Gender] Are you?

- ☐ Male (screen out)
- ☐ Female

[S1] Which of the following best describes you?

- ☐ Currently pregnant
- ☐ Currently trying for a baby (screen out)
- ☐ None of the above (screen out)

Introduction: Part 2

This survey explores **women's knowledge, attitudes and practice regarding nutrition and weight gain during pregnancy**. The survey will take about 30 to 60 minutes depending on how many questions are relevant to you.

You will be asked a range of questions about your:

- knowledge, views and experiences with diet, dietary supplements and weight gain during pregnancy
- views and experiences with different sources of information related to nutrition during pregnancy
- preferences for different dietary supplements

Your participation in this research is valuable as the results will be used to develop more useful information, advice and food products for this important time of your and your baby's life.

This study has been reviewed by the University of Adelaide Human Research Ethics Committee (Ethics approval number H-2013-016). We wish to reassure you that your individual survey responses will remain confidential and no personally identified survey responses will be released to the researchers involved in this study.

Please answer the questions honestly and take appropriate time to read and understand the questions so that you can give thoughtful responses. If you have any questions, please feel free to contact Ms Lenka Malek at lenka.malek@adelaide.edu.au or if you wish to contact someone independent of the project please email hrec@adelaide.edu.au.

Participation is completely voluntary. You are free to withdraw from the study at any time before submitting the survey without any explanation. Once submitted, you will be unable to withdraw the survey information as this survey is anonymous and we will not be able to identify the information you provided as yours.

By clicking the 'yes' button below, you are indicating that you have read and understood the above information and consent to participating in this study titled "Understanding women's knowledge, attitudes and practice regarding nutrition and weight gain in pregnancy".

Please select one answer.

- ○ Yes
- ○ No

[Research] While pregnant, have you been involved in any other studies relating to nutrition or dietary supplements?

- ☐ Yes
- ☐ No

[S2] How many previous births have you had (≥20 weeks gestation)? _____ (fill in box)

[Location] In which area do you live?

- ☐ Sydney Metro
- ☐ NSW Other
- ☐ Melbourne Metro
- ☐ Victoria Other
- ☐ Brisbane Metro
- ☐ Queensland Other
- ☐ Perth Metro
- ☐ WA Other
- ☐ Adelaide Metro
- ☐ SA Other
- ☐ TAS
- ☐ NT
- ☐ ACT

[Postcode] What is the postcode where you live? _______ (fill in box)

[S5] Please indicate the category that best describes the highest level of education that you have completed.

- ☐ Below Year 10
- ☐ Year 10
- ☐ Year 11
- ☐ Year 12

- ☐ Certificate (III or IV)
- ☐ Diploma level or advanced diploma
- ☐ Bachelor degree
- ☐ Graduate certificate or graduate diploma
- ☐ Postgraduate degree (masters or PhD)

PREGNANCY RELATED BACKGROUND

2. **Who is your <u>main healthcare provider</u> during this pregnancy (the health professional that you see most often for antenatal appointments)? (select one option only)**

- ☐ GP
- ☐ Obstetrician
- ☐ Midwife
- ☐ I have not had a main healthcare provider **[skip Q27-28]**

3. **Approximately how many weeks pregnant are you? _____ wks (fill in box)**

4. **Approximately how many weeks into your pregnancy were you when you found out you were pregnant?**

_____ wks **(fill in box)**

5. **Was this pregnancy planned?**

- ☐ Yes
- ☐ No

6. **Were fertility treatments used to assist this conception?**

- ☐ Yes
- ☐ No

7. **How many times have you been pregnant <u>in total</u> (including this pregnancy)?**

_____ (fill in box)

8. **Have you had miscarriages before (<20 weeks gestation)?**

- ☐ Yes (go to q8b_1)
- ☐ No (skip q8b_1)

8b_1. How many miscarriages have you had _____ (fill in box)

9. **What is your <u>usual</u> pre-pregnancy weight (approximately)?**

_____ kg or _____ stone **(fill in box)**

10. **What is your approximate height? _____ cm or ____ feet ___ inches (fill in box)**

11. Have you GAINED weight since becoming pregnant?

- ☐ Yes
- ☐ I don’t know
- ☐ I have lost weight

11b. Approximately how much weight have you GAINED since becoming pregnant?

_____ kg or _____ stone **(fill in box)**

12. Have you smoked cigarettes DURING this pregnancy?

- ☐ Yes
- ☐ No

13. Did you smoke cigarettes in the 3 MONTHS LEADING UP TO this pregnancy?

- ☐ Yes
- ☐ No

14. A. Have you consumed any alcohol DURING this pregnancy?

- ☐ Yes (go to Q14B)
- ☐ No (go to Q15)

B. Please indicate how often you have had alcohol DURING this pregnancy:

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Less than once a month

C. On any one drinking occasion DURING this pregnancy, how many standard drinks would you usually have?

- ☐ 1 or less
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ More than 4

NUTRITION KNOWLEDGE

[For Q 16 each row must have one box ticked before proceeding]

16. There are various nutrients that might be added to food, drinks or vitamin tablets and which might be claimed to have health benefits. Some of these benefit an unborn child, some benefit the person who takes them, whilst others have no demonstrated clinical benefit. Please consider each nutrient below and tick the box(es) to indicate which health claim(s) you believe to be true.

(select all that apply for each nutrient; select at least one option in each row)

Nutrient	Important for baby's brain development	Prevents neural tube defects such as spina bifida	Lowers risk of premature birth	Lowers risk of childhood allergy	Strengthens baby's bones	Improves general health and well-being	No benefit	Don't know
Iodine	☐	☐	☐	☐	☐	☐	☐	☐
Folate	☐	☐	☐	☐	☐	☐	☐	☐
Omega-3 Fatty Acids	☐	☐	☐	☐	☐	☐	☐	☐
Vitamin D	☐	☐	☐	☐	☐	☐	☐	☐

Proceed to Choice Experiment

We would like you to imagine that you have just found out you are pregnant and you are shopping for a product to enhance your dietary intake during pregnancy.

You will be shown 18 scenarios which each contain three products, which will be a fortified food, fortified drink and a supplement tablet.

***'Fortified'** means that specific nutrients (e.g. vitamins or minerals) have been deliberately added to the product to improve its nutritional quality and to provide a health benefit with minimal risk to health. Examples of fortified foods include probiotic yogurts and omega-3 milk and eggs.*

In each scenario we will ask you to make choices between the three products on the basis of the following information.

Base product
The type of product being fortified: bread, yogurt, cereal, drink or supplement tablet.

Fortification
The nutrients that are added to the product: Vitamin D, folate, iodine, and omega-3 fatty acids.

Health claim

Refers to the effect of the fortified product on a health function OR its relationship to a serious disease.

Endorsement
A third-party approves the nutrition or health claims made regarding the fortified product.

Absorption
Whether the fortified product is easily digested and absorbed by the body.

Cost per day ($)
The daily cost of consuming the product in the quantities described (e.g. cost per 2 slices of bread). The quantity is the recommended serving size for the product.

Brand

On the following screens you will be shown the different types of products and different types of brands that will be considered for each product.

SUPPLEMENT TABLETS

1 per day	2 per day	1 per day
Multivitamin tablet with additional vitamins and minerals [Click to see]	**Multivitamin tablet** with additional vitamins and minerals [Click to see]	**Vitamin tablet** with NO additional vitamins or minerals

Additional Vitamins & Minerals
B group vitamins
Vitamin C
Vitamin E
Calcium
Iron
Magnesium
Phosphorus
Copper
Manganese
Zinc

Additional Vitamins & Minerals
B group vitamins
Vitamin C
Vitamin E
Calcium
Iron
Magnesium
Phosphorus
Copper
Manganese
Zinc

EXAMPLES OF SPECIFIC BRANDS

BLACKMORES®
elevit
CENOVIS®
Swisse®
Nature's Own™
Nature's Way®

EXAMPLES OF NON-SPECIFIC BRANDS OR GENERIC BRANDS

Chemists' Own®
Your trusted brand in pharmacy

Other no name/unbranded products

FORTIFIED FOODS

Bread
(2 slices)

Cereal
(1 cup)

Yoghurt
(1 tub, 200g)

FORTIFIED DRINKS

Milk
(1 cup, 250ml)

Fruit juice
(1 cup, 250ml)

Water
(1 cup, 250ml)

EXAMPLES OF NON-SPECIFIC BRANDS OR GENERIC BRANDS
(for all food and drink products)

HOME BRAND

Select

coles smart buy™

Franklins No Frills

Black&Gold

IGA

EXAMPLES OF SPECIFIC BRANDS

Bread

Bakers Delight	TIP TOP
Brumby's	Buttercup
Bürgen	Wonder White
HELGA'S Continental Bakehouse	MOLENBERG THE GOODNESS OF GRAINS
Lawsons TRADITIONAL BREAD	COUNTRY LIFE BAKERY

Cereal

Kellogg's	Sanitarium
UNCLE TOBYS	Nestlé
Carman's	freedom FOODS
LOWAN WHOLE FOODS	Norganic

Yoghurt

Yoplait	vaalia
DANONE	Nestlé
Dairy Farmers	GIPPSLAND DAIRY Dairy Craftsmen
CHOBANI GREEK YOGURT	Jalna

EXAMPLES OF SPECIFIC BRANDS

Milk

PURA	Devondale WHOLLY AUSTRALIAN
Dairy Farmers	a2
Anlene	Pauls
LIDDELLS	macro wholefoods market

Fruit Juice

BERRI	Bickford's PREMIUM JUICES
V8	Sunraysia natural. nutritious. delicious.
Ocean Spray	nudie
Charlie's	golden circle

Water

MOUNT FRANKLIN	evian
SANTA VITTORIA	AQUA PURA
vitaminwater	DEEP SPRING
SNOWY MOUNTAIN	cocobella coconut water
KOKOMO	FIJI WATER

<u>Example of choice task</u>

We would like you to imagine that you have just found out you are pregnant and are shopping for a product to enhance your dietary intake during pregnancy.

Please consider the following three options:

Women's & Children's Health Research Institute | THE UNIVERSITY of ADELAIDE | UTS:CenSoC Centre for the Study of Choice

Scenario 1 of 18

	Fortified food	Fortified drink	Supplement Tablet
Product			
Cost per day	$4.00/day	$0.90/day	$0.25/day
Brand	No specific brand or a generic brand	A specific brand	A specific brand
Endorsement	Endorsed by the CSIRO	Endorsed by the Dietitians Association of Australia (DAA)	Endorsed by the Heart Foundation
Absorption	No claim	Easy to digest and absorb	Easy to digest and absorb
Iodine	-	250 µg	-
Folate	400 µg	400 µg	800 µg
Omega 3	Yes	Yes	Yes
Vitamin D	-	Yes	-

If you want to review the above attributes again, please <u>click here</u> to open a separate glossary page.

<u>**Some extra information on nutrient benefits**</u>

Iodine plays an important role in the normal development of the baby's brain.

Adequate **folate** helps prevent neural tube defects such as spina bifida.

Omega-3 fatty acids play an important role in the normal development of the baby's brain and may help prevent premature birth and childhood allergy.

Q1 Which product do you like most? (choose one answer)

- (•) Fortified food
- ( ) Fortified drink
- ( ) Supplement tablet

Q2 Which product do you like least? (choose one answer)

- ( ) Fortified food
- (•) Fortified drink
- ( ) Supplement tablet

Q3 Would you actually buy your preferred product or go without? (choose one answer)

- (•) Yes
- ( ) No

<< >>

Survey progress: 28%

NUTRITION KNOWLEDGE cont.

19. When PLANNING pregnancy, <u>health authorities</u> recommend that ALL women take dietary SUPPLEMENTS containing: (select one option per row)

	Yes	No	Don't know
Iron	☐	☐	☐
Folate	☐	☐	☐
Iodine	☐	☐	☐
Calcium	☐	☐	☐
Vitamin D	☐	☐	☐
Omega-3 fatty acids (e.g. Fish oil)	☐	☐	☐

20. DURING pregnancy <u>health authorities</u> recommend that ALL women take dietary SUPPLEMENTS containing: (select one option per row)

	Yes	No	Don't know
Iron	☐	☐	☐
Folate	☐	☐	☐
Iodine	☐	☐	☐
Calcium	☐	☐	☐
Vitamin D	☐	☐	☐
Omega-3 fatty acids (e.g. fish oil)	☐	☐	☐

[Q21 only if Iodine=Yes in Q19 or Q20, otherwise go to Q22]

21. According to the recommendations, how much IODINE should be obtained from SUPPLEMENTS? (select one option only)

- ☐ 100ug
- ☐ 150ug
- ☐ 250ug
- ☐ However much is in the supplement I am taking
- ☐ I don't know

22. Please list any foods or drinks that you think are good sources of IODINE?

(One item per row) (5 rows)

☐ Don't know

[Q23&24 only if Folate=Yes in Q19 or Q20, otherwise go to Q25]

23. <u>Health authorities</u> recommend women take FOLATE SUPPLEMENTS: (select one option only)

- ☐ At least 3 months before conception and the 1st trimester of pregnancy
- ☐ At least 1 month before conception and the 1st trimester of pregnancy
- ☐ At least 1 month before conception and throughout pregnancy
- ☐ At least 3 months before conception and throughout pregnancy
- ☐ During pregnancy only
- ☐ I don't know

24. According to the recommendations, how much FOLATE should be obtained from SUPPLEMENTS? (select one option only)

- ☐ 250µg
- ☐ 400µg
- ☐ 500µg
- ☐ 800µg
- ☐ However much is in the supplement I am taking
- ☐ I don't know

25. Please list any foods or drinks that you think are good sources of FOLATE?

(One item per row) (5 rows)

☐ Don't know

NUTRITION INFORMATION SOURCES

27. Did you receive ANY information about <u>nutrition</u> from your <u>main healthcare provider</u> for this pregnancy?

- ☐ Yes (go to Q28)
- ☐ No (skip Q28)

28. Which of the following nutrition related items did you receive information about from your <u>main healthcare provider</u>? (select one option per row)

[At least one box should be ticked before proceeding]

	Received information from HEALTHCARE PROVIDER
Iron	☐
Folate	☐
Calcium	☐
Iodine	☐
Vitamin D	☐
Omega-3 fatty acids (e.g. fish oil)	☐
Dietary intake/nutrition for pregnancy	☐
Weight gain during pregnancy	☐
Listeria/food safety	☐
Mercury	☐
Dietary supplements/multivitamins	☐
None of the above	☐

36. Think about when you are <u>making choices</u> around <u>nutrition (food and supplements)</u> DURING this pregnancy, who or what MOST INFLUENCES YOUR DECISIONS?

RANK <u>up to 3</u> of your most important sources by selecting one option in each column: 1=most important

[Only one selection can be made in each column. One box must be ticked in at least one column before proceeding]

	Rank
GP	
Obstetrician	
Midwife	
Nurse	
Nutritionist/dietitian	
Naturopath	
Pharmacist/chemist	
Pregnancy helpline	
Women's or family health centres	
Antenatal classes	
Family or friends	
Government/hospital health websites	
Other websites (e.g. blogs, forums, commercial pregnancy sites)	
E-mail updates	
Online journal articles/research papers	
Facebook (updates, pregnancy pages)	
Booklets/pamphlets from hospital or GP	
Books	
Magazines	
TV programs or advertisements	
Radio	
Mobile phone applications	
Public seminars/presentations	
Common-sense	
Own previous experience	

37. If <u>new</u> pregnancy related nutrition information was to become available, <u>how</u> would you MOST PREFER to receive this information? ***(select <u>up to 3</u> options)***

- ☐ Verbally during an appointment with my main healthcare provider
- ☐ Booklet/pamphlet received during an appointment with my main healthcare provider
- ☐ Booklet/pamphlet received in the mail/posted to me
- ☐ Booklet/pamphlet available at the chemist
- ☐ Booklet/pamphlet available in child/family health clinics, GP clinics and the hospital
- ☐ In a small group session led by a health professional
- ☐ In a public seminar
- ☐ Via a pregnancy-nutrition hotline
- ☐ On the internet
- ☐ Through TV advertisements
- ☐ Through radio advertisements
- ☐ In pregnancy magazines
- ☐ Other (please specify)

(PROVIDE SPACE FOR RESPONDENT TO INDICATE: allow 2-3 Rows for other)

DIETARY INTAKE

38. Did you make any changes to your <u>usual</u> (pre-pregnancy) diet <u>specifically for this pregnancy?</u> ***(Excluding changes made due to morning sickness)***

- ☐ Yes (go to Q40)
- ☐ No (go to Q39 and skip Q40)

39. I didn't make any changes to my usual diet because: (select all that apply)

- ☐ It was too difficult
- ☐ My diet was already healthy and balanced
- ☐ I didn't think I needed to make any changes
- ☐ I didn't know what changes I should be making
- ☐ Other (please explain)

(PROVIDE SPACE FOR RESPONDENT TO INDICATE: allow 2-3 Rows for other)

40. A. When did you <u>first</u> start making changes to your diet? ***(select one option only)***

- ☐ As soon as I started planning pregnancy [This option only shown to women who answered Yes to Q5 (planned pregnancy); the 3 options directly below will be grey until this option is selected- at which point they will turn black- indicating a need to select one of the options before proceeding to Q41]

40B. This was:

- ☐ Less than 1 month before pregnancy
- ☐ 1-3 months before pregnancy
- ☐ More than 3 months before pregnancy

- ☐ As soon as I found out I was pregnant
- ☐ After I found out I was pregnant and had the time to make changes
- ☐ After my morning sickness went away
- ☐ After being diagnosed with gestational diabetes
- ☐ After other pregnancy complications
- ☐ Other (please specify)

If any of the following options are selected, Q40C will be presented and will need to be answered before proceeding

(PROVIDE SPACE FOR RESPONDENT TO INDICATE: allow 2-3 Rows for other)

40 C. This was during my*:*

- ☐ 1st trimester (first 3 months)
- ☐ 2nd trimester (between 3-6 months)
- ☐ 3rd trimester (between 6-9months)

[For Q41 Each Row must have a number in last column before proceeding; only one box in each row can have a number in it]
[Do not allow respondents to enter ranges e.g. 2-3 only allow whole numbers or numbers followed by decimals e.g. 2.5]

41. Think about the foods you have eaten SINCE BECOMING PREGNANT.

Please record the estimated number of serves you eat from each food group DURING AN AVERAGE WEEK OF YOUR PREGNANCY.

Complete one box in each row:

- For foods that you **usually eat every day**, complete the **'per day'** box
- For foods that you **don't usually eat every day**, complete the **'per week'** box

Account for all food eaten, including the ingredients added to recipes, eaten in mixed meals and restaurant or take away meals.

Examples of what 1 serve looks like in each food group are listed in the middle column

Food group	Examples of 1 serve	Estimated number of serves
Bread, cereal, rice, pasta, noodles 	• 2 slices of bread • 1 medium bread roll or flat bread • 1 cup porridge, 1 1/3 cup breakfast cereal flakes or ½ cup muesli • 2 crumpets, small English muffins or plain scones • 1 cup cooked rice, pasta, noodles, other grains • 6 crisp breads (35g each)	____ per day OR ____ per week (fill in one box only)
Vegetables and legumes 	• ½ cup raw or cooked orange (e.g. carrots or pumpkin) or cruciferous (e.g. broccoli, cauliflower or cabbage) vegetables • 1 cup green leafy vegetables or salad vegetables (raw) • 1 small-medium tomato • ½ cup cooked or canned beans, peas or lentils • 1 small or ½ a medium potato or other starchy vegetable e.g. sweet potato, sweet corn, taro or cassava.	____ per day OR ____ per week (fill in one box only)
Fruit 	• 1 medium piece (e.g. apple, banana) • 2 small pieces (e.g. apricots, kiwi fruit) • 1 cup diced pieces/canned fruit • ½ cup juice • Dried fruit (e.g. 4 dried apricot halves, 1.5 tablespoons sultanas)	____ per day OR ____ per week (fill in one box only)
Milk, yoghurt, cheese 	• 1 cup milk (250mL) • ½ cup evaporated milk • 2 slices cheese or 4 pieces (3x2cm) • 1 tub of yoghurt (200g) • 1 cup custard (250mL) • 1 cup soy, rice or other cereal drink with at least 100 mg of added calcium per 100 mL	____ per day OR ____ per week (fill in one box only)
Meat, fish, poultry, eggs, nuts, legumes 	• 65g cooked meat (beef, veal, lamb, pork, kangaroo or goat) e.g. ½ cup lean mince, 2 small chops or 2 slices roast meat • 80g cooked poultry (e.g. ½ chicken breast) • 100g cooked fish fillet or small can of fish • 2 eggs • 1 cup cooked or canned beans, peas, lentils or tofu • 1/3 cup nuts (e.g. peanuts, almonds) • ¼ cup seeds (e.g. sunflower, sesame)	____ per day OR ____ per week (fill in one box only)
Extras 	• 2 scoops regular ice cream (75g) • 1 slice plain cake or doughnut • 2-3 sweet biscuits • 1 small bar of chocolate (25g) • 2 tablespoons cream • 1 tablespoon butter, margarine, oil • 1 can soft drink (375mL) • 1/3 meat pie or pastie (60g) • 12 hot chips	____ per day OR ____ per week (fill in one box only)

42. For the each of following foods/drinks, please indicate the <u>type</u> that best describes your <u>usual</u> intake DURING this pregnancy. (select one option per row)

Bread	☐ White	☐ Wholemeal, Whole/multi grain, Rye	☐ NA
Milk	☐ Full fat	☐ Reduced fat	☐ NA
Yogurt	☐ Full fat	☐ Reduced fat/Diet	☐ NA
Cheese	☐ Full fat	☐ Reduced fat	☐ NA
Soft drink	☐ Regular	☐ Diet	☐ NA

43. Do you use <u>iodised salt</u> at home, either in cooking or at the table (added to meals)?

☐ Yes (go to Q45)
☐ No (go to Q46)
☐ Don’t know (go to Q46)

45. Do you add <u>more</u> salt to your food <u>because it is iodised</u>?

☐ Yes
☐ No

46. Think about your usual intake of fish DURING AN AVERAGE MONTH:

a. BEFORE PREGNANCY [this presented if 'No' in Q5]

BEFORE PLANNING PREGNANCY [this presented if 'Yes' in Q5]

AND

b. SINCE BECOMING PREGNANT

- *For each row please record the estimated number of serves you ate of that type of fish.*
- *If you did not have the fish item write 0.*

[Do not allow respondents to enter ranges e.g. 2-3 only allow whole numbers or numbers followed by decimals e.g. 2.5]
[All boxes in last 2 columns should have number in them before proceeding]

Type of fish	Serve size		Amount per month BEFORE PREGNANCY or BEFORE PLANNING PREGNANCY [instructions as above]	Amount per month DURING PREGNANCY
Billfish (swordfish, broadbill and marlin) and shark (flake)	150g cooked fillet		……….. (fill in box)	……….. (fill in box)
Orange roughy (deep sea perch) or catfish	150g cooked fillet		……….. (fill in box)	……….. (fill in box)
Any other fish or seafood (e.g. salmon, tuna, prawns, calamari, etc.)	150g cooked fillet, 6-8 medium prawns or 8 calamari rings **OR** 1 small can	  **OR** 	**No. serves (uncanned)** ……….. (fill in box) **No. of cans** ……….. (fill in box)	**No. serves (uncanned)** ……….. (fill in box) **No. of cans** ……….. (fill in box)

47. A. COMPARED to your usual diet BEFORE pregnancy, how has your consumption of the listed foods/drinks CHANGED DURING pregnancy? [Q47A presented if 'No' in Q5]

B. COMPARED to your usual diet BEFORE PLANNING pregnancy, how has your consumption of the listed foods/drinks CHANGED DURING pregnancy? [Q47B presented if 'Yes' in Q5]

*Please select one option in each row. Select **'Never consume'** for any item which you never eat/drink (whether pregnant or not)*
[Each Row should have one box ticked before proceeding]

	Eat more	No change	Eat less	Avoid now	Never consume
Pre-prepared or pre-packaged salads	☐	☐	☐	☐	☐
Eggs (cooked)	☐	☐	☐	☐	☐
Eggs (raw or semi-cooked)	☐	☐	☐	☐	☐
Soft cheeses *(brie, camembert, ricotta, feta, blue-vein)*	☐	☐	☐	☐	☐
Processed meat *(cold meat/deli meat, ham, salami, luncheon meat, smoked meat, paté)*	☐	☐	☐	☐	☐
Nuts	☐	☐	☐	☐	☐
Oily fish (e.g. mackerel, herring, sardines, tuna, salmon)	☐	☐	☐	☐	☐
Cooked fish and seafood in general	☐	☐	☐	☐	☐
Raw fish and seafood	☐	☐	☐	☐	☐
Coffee *(excluding decaffeinated)*	☐	☐	☐	☐	☐
Tea *(excluding herbal tea)*	☐	☐	☐	☐	☐

48. How does your current diet (DURING pregnancy) COMPARE to your usual diet BEFORE pregnancy?

- ☐ Less healthy
- ☐ More healthy
- ☐ No change in healthiness

49. Please select the number that best describes your opinion.

	Very unhealthy		Neither		Very healthy
My diet **DURING** this pregnancy has been	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

50. As my pregnancy has progressed, I have become:

- ☐ Less concerned about healthy eating
- ☐ More concerned about healthy eating
- ☐ No change (same level of concern)

Instructions

- **Throughout this survey the word 'DIET' refers to <u>all the foods and drinks that you consume</u>**. It does not refer to any 'weight loss diet' or special eating plan.
- **The word 'SUPPLEMENT' or 'DIETARY SUPPLEMENT' refers to <u>any vitamins, minerals or other nutrients not obtained from food but taken in pill, capsule or liquid form</u>.**
- Please read each question carefully and answer it to the best of your ability.
- Many questions in this survey make use of rating scales with 7 places.
    - You are to select the number that best describes **your opinion**. For example, if you were asked to rate 'the weather in Tasmania' on such a scale, the 7 places should be interpreted as follows:

The weather in Tasmania is:

good :____1____:____2____:____3____:____4____:____5____:____6____:____7____: **bad**

extremely good   quite good   slightly good   neither   slightly good   quite good   extremely good

IMPORTANT

If you do not have an opinion or belief about a question then you would *choose 4 (neither)*

For the following section: numbers from 1 to 7 or -3 to +3 not to be shown to respondents (will only be used for scoring). Respondents will only see tick boxes and scale headings on screen.

ATTITUDES TOWARDS '*EATING A HEALTHY BALANCED DIET DURING THIS PREGNANCY*'

Eating habits vary widely among people.

In the following questions we are specifically interested in your <u>personal opinions</u> regarding:

'Eating a healthy balanced diet DURING THIS PREGNANCY'

By a *'healthy balanced diet'* we mean a diet which includes a variety of foods from all of the food groups and provides you with all the nutrients you need for pregnancy, in the recommended amounts.

There are no correct or incorrect responses; we are simply interested in your personal point of view!

Please note some of the questions may appear to be similar, but they do address somewhat <u>different issues</u>

[For Qs 51-62 Each Row should have one box ticked before proceeding]

51. Eating a healthy balanced diet during pregnancy is:

Very easy for me	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	**Very difficult for me**
Beneficial for me	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	**Harmful for me**
Useful	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	**Worthless**
Beneficial for baby	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	**Harmful for baby**
Good	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	**Bad**

52. How likely is it that eating a healthy balanced diet during pregnancy will:

	Extremely likely			**Neither**			**Extremely unlikely**
Result in the baby getting all the nutrients it needs	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Be very expensive	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Help me keep up my energy levels	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Help me have a healthy baby	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Ensure I get all the nutrients I need for my own health	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Help prevent excessive weight gain during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Mean that I can't eat or drink what I enjoy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Make me feel stressed when I eat away from home	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Make me feel better	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Make me feel like I am being picky and an inconvenience to others when I eat away from home	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

53. How likely is it that the following sources think that you should eat a healthy balanced diet during pregnancy?

	Extremely likely			Neither			Extremely unlikely
My main healthcare provider *(e.g. GP, midwife, obstetrician)*	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Health experts in general	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Books/magazines	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Internet sites	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
My partner	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
The female members of my family *(e.g. Mum, sister, aunty, grandma)*	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

54. It would be MUCH MORE DIFFICULT to eat a healthy balanced diet during pregnancy if:	Strongly agree			Neither			Strongly disagree
I got cravings for unhealthy foods	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
Work or employment placed considerable demands on my time	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
Family duties and responsibilities placed considerable demands on my time	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I felt tired	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I didn't know which foods I needed to eat and how much of them to meet my dietary requirements	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
Healthy food was expensive	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I didn't have support from my partner	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I felt unwell	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I didn't plan ahead	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3
I felt stressed	☐ -3	☐ -2	☐ -1	☐ 0	☐ +1	☐ +2	☐ +3

55. Please indicate how much you agree or disagree with each of the following statements.

	Strongly agree			Neither			Strongly disagree
I want to eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Whether I eat a healthy balanced diet during pregnancy **is entirely up to me**	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
It is expected of me that I eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
There are **factors outside of my control** that could prevent me from eating a healthy balanced diet during pregnancy	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
I expect to eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Most people who are important to me think that I should eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I am confident that I could eat a healthy balanced diet during pregnancy **if I wanted to**	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
My friends who are or have been pregnant ate a healthy balanced diet during pregnancy	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
I feel under pressure from other people to eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I intend to eat a healthy balanced diet during pregnancy	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

56. Please indicate how desirable or undesirable each of the following is to you.

	Extremely desirable			Neither			Extremely undesirable
Spending lots of money on healthy food is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Keeping up my energy levels is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Feeling stressed when I eat away from home is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Not being able to eat or drink what I enjoy is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Preventing excessive weight gain during pregnancy is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Feeling picky and inconveniencing others when I eat away from home is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

57. For each item, please tick the box that best describes how you feel.

	Extremely important						Not at all important
Having a healthy baby is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
The baby getting all the nutrients it needs is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Getting all the nutrients I need for my own health is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Me feeling better is	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

58. The consequences of:	Very minor			Neither			Very severe
Delivering a premature baby would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Having pre-eclampsia (high blood pressure) during pregnancy would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Having a miscarriage would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Developing gestational diabetes would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Having anaemia (iron deficiency) during pregnancy would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Delivering a baby with a birth defect would be	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

59. **For each item, please indicate <u>how often</u> the following occur DURING PREGNANCY.**

	Always			Sometimes			Never
I don't know which foods I need to eat and how much of them, to meet my dietary requirements	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I get cravings for unhealthy foods	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Support from my partner has an effect on what I eat	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
The cost of healthy food has an effect on what I eat	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I feel tired	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Family duties and responsibilities place considerable demands on my time	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

	Always			Sometimes			Never
Work or employment places considerable demands on my time	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Not planning ahead has an effect on what I eat	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I feel stressed	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
I feel unwell	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

60. When it comes to matters of health, I want to do what the following sources <u>think I should do</u>:	Very much			Neither			Not at all
My main healthcare provider	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Health experts in general	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Books/magazines	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Internet sites	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
My partner	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
My female family members	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
Advertisements (TV/radio/newspaper/magazines/internet/ product labels)	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
61. When it comes to matters of health, how much do <u>you want to be like</u> your friends who are or who have been pregnant?	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

62. Eating a healthy balanced diet during pregnancy <u>will reduce my risk of</u>:	Extremely likely			Neither			Extremely unlikely
Having anaemia (iron deficiency) during pregnancy	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Developing gestational diabetes	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Having a miscarriage	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Delivering a baby with a birth defect	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

Having pre-eclampsia (high blood pressure) during pregnancy	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Delivering a premature baby	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

SUPPLEMENT USE

63. Did someone <u>directly tell you</u> to take SUPPLEMENTS containing any specific nutrients?

	Yes	No
When **PLANNING** pregnancy [show this row only if 'Yes' to Q5]	☐ (complete Q62)	☐ (skip Q62)
DURING pregnancy	☐ (complete Q63)	☐ (skip Q63)

64a. When PLANNING your pregnancy which of the following SUPPLEMENTS were you recommended to take AND by who? (select all that apply)

- ☐ Folate
- ☐ Iodine
- ☐ Omega 3 fatty acids (e.g. fish oil)
- ☐ Vitamin D
- ☐ Iron
- ☐ Multivitamin
- ☐ Other (please specify) ________

64b.Who recommended that you take ____ (insert name of nutrient from Q64a)

- ☐ Doctor
- ☐ Midwife
- ☐ Nurse
- ☐ Pharmacist
- ☐ Naturopath
- ☐ Dietitian/nutritionist
- ☐ Family/friends
- ☐ Other (please specify)

65a. DURING PREGNANCY which of the following SUPPLEMENTS were you recommended to take AND by who? (select all that apply)

- ☐ Folate
- ☐ Iodine
- ☐ Omega 3 fatty acids (e.g. fish oil)
- ☐ Vitamin D
- ☐ Iron
- ☐ Multivitamin
- ☐ Other (please specify) ________

65b.Who recommended that you take ____ (insert name of nutrient from Q65a)

- ☐ Doctor
- ☐ Midwife
- ☐ Nurse
- ☐ Pharmacist
- ☐ Naturopath
- ☐ Dietitian/nutritionist
- ☐ Family/friends
- ☐ Other (please specify)

68. Usually, when I am NOT pregnant or NOT PLANNING pregnancy: (select one option only)

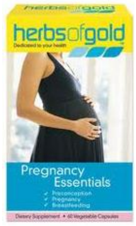
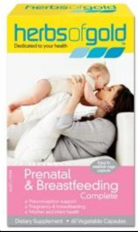
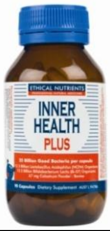
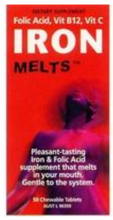
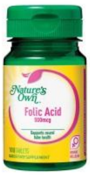
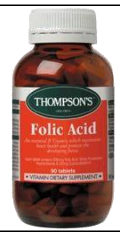
- ☐ I take vitamin/mineral supplements **only**
- ☐ I take herbal supplements **only**
- ☐ I take **both** vitamins/minerals and herbs
- ☐ I don’t take any vitamins/minerals **or** herbs

69. I took supplements:

	Yes	No
In the ONE MONTH LEADING UP TO this pregnancy	☐	☐ **skip Q70&71**
DURING this pregnancy	☐	☐ **skip Q72&73**

70. Please select <u>ALL</u> of the supplements you took in the ONE MONTH LEADING UP TO this pregnancy

					
BioSource Vitamin D	**Blackmore’s Conceive Well Gold**	**Blackmore's Bio-Iron**	**Blackmore’s Folate**	**Blackmore’s I-Folic**	**Blackmore's Pregnancy Breast Feeding Gold**
					
Blackmore’s Fish Oil	**Cenovis Pregnancy Breastfeeding Formula**	**Elevit With Iodine**	**Ethical Nutrients Pregnancy Support**	**Fabfol Plus**	**Fefol Iron & Folate Supplement**

					
Fefol Multi-Preg	**Folic Acid Complex With Iodine**	**Forelife! Natal Care Gel Caps**	**Ferro-Gradumet**	**FGF Iron and Folic Acid**	**GNC Women's Prenatal Formula WITH IRON**
					
GNC Women's Prenatal Formula WITHOUT IRON	**Herbs Of Gold Folic Acid Complex**	**Herbs Of Gold Pregnancy Essentials**	**Herbs Of Gold Prenatal And Breastfeeding Complete**	**Inner Health Plus Probiotics**	**Iron Melts**
					
Megafol 0.5	**Megafol 5**	**Nature's Own Folic Acid**	**Nature's Own Odourless Fish Oil**	**Nature's Own Pregnancy Platinum Multivitamin**	**Nature's Way Pregnancy Vita Gummies**
					
Ostelin Vitamin D	**Spatone Liquid Iron**	**Swisse Iron**	**Swisse Pregnancy Fish Oil**	**Swisse Pregnancy + Ultivite Multivitamin Plus Omega 3**	**Thompsons Folic Acid Complex**

Other (please specify brand and product name): *(excluding herbal supplements)*

(PROVIDE SPACE FOR RESPONDENT TO list other items: allow 5 separate Rows for 'other'- each item to be listed on separate row

[Picture of all selected supplements containing folate and/or iodine (highlighted in blue) will be presented on screen each with same set of Qs below picture → e.g.] + ask same Qs for all supplements listed under 'other' in case contain folate or iodine.

71. Please answer the following questions regarding the pictured supplement:

e.g. 

a. Approximately how long BEFORE pregnancy did you start taking this:
- ☐ Less than 1 month
- ☐ 1-3 months
- ☐ 3-6 months
- ☐ More than 6 months

ON AVERAGE:

b. I took this supplement ____ day(s) per week. (fill in box)

c. I took this supplement ____ time(s) per day. (fill in box)

d. How many capsules or tablets or mLs did you consume each time? _____ (fill in box)

e. Please select/complete only one item below.

I stopped taking this supplement:
- ☐ ____ wks before pregnancy **(fill in box)**
- ☐ ____ months before pregnancy **(fill in box)**
- ☐ When I found out I was pregnant
- ☐ ____wks after becoming pregnant **(fill in box)**
- ☐ **I am still taking it**

72. Please indicate ALL of the supplements you have taken DURING this pregnancy.

[Show supplement pic grid- same as for Q70]

73. Please answer the following questions regarding the pictured supplement:

[Picture of all selected supplements containing folate and/or iodine will be presented on screen each with same set of Qs below product image] + ask same Qs for all supplements listed under 'other' in case contain folate or iodine??

[Do not show Q73a&b if this supplement was selected in Q70 and 'I am still taking it' was selected in Q71e]

a. I started taking this:
- ☐ Before pregnancy
- ☐ When I was approximately ____ wks pregnant **(fill in box)**

b. **Please select/complete only one item below.**

I stopped taking this supplement when I was:

- ☐ _____ wks pregnant **(fill in box)**
- ☐ _____ months pregnant **(fill in box)**
- ☐ **I am still taking it [if selected, words highlighted in grey will be presented in Q73 c,d,e; if not selected, non-highlighted wording will be used]**

ON AVERAGE, DURING pregnancy:

c. **I take/took this supplement ____ day(s) per week. (fill in box)**
d. **I take/took this supplement ____ time(s) per day. (fill in box)**
e. **How many capsules, tablets or mls do/did you consume each time? _____ (fill in box)**

[Q74 only show if this is not first pregnancy- entered value >1 in Q7]

74. Did you take any dietary supplements during your last pregnancy (the one before this)?

- ☐ Yes
- ☐ No
- ☐ I can't remember

PHYSICAL ACTIVITY, HEALTH ATTITUDES & STRESS

86. Usually, when you are NOT PREGNANT or NOT PLANNING PREGNANCY about <u>how many days each week</u> do you accumulate <u>at least 30min</u> of moderate-intensity physical activity?

Moderate intensity activity causes a slight but noticeable increase in your breathing and heart rate.

Examples are: brisk walking, mowing the lawn, digging in the garden, or medium-paced swimming or cycling.

- ☐ 0 days/wk
- ☐ 1 day/wk
- ☐ 2 days/wk
- ☐ 3 days/wk
- ☐ 4 days/wk
- ☐ 5 days/wk
- ☐ 6 days/wk
- ☐ Every day

87. Please select the number that best describes how much you agree or disagree with each of the following statements <u>about yourself</u>.

	Strongly agree			**Neither**			**Strongly disagree**
I am a healthy eater **in general**	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
If you don't have your health you don't have anything	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
In general, I am someone who is concerned about the health consequences of what I eat	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
Good health is of only minor importance in a happy life	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
In general, I am someone who enjoys the pleasures of eating	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
There are many things I care about more than my health	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
I am someone who is concerned with 'healthy eating' **in general**	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3
There is nothing more important than good health	☐ +3	☐ +2	☐ +1	☐ 0	☐ -1	☐ -2	☐ -3

[Numbers from -3 to +3 will not be shown to respondents (will only be used for scoring). Respondents will only see tick boxes and scale headings on screen.]

88. The following questions ask about your feelings and thoughts DURING THE LAST MONTH.

IN THE LAST MONTH, how often have you:

	Never	**Almost never**	**Sometimes**	**Fairly Often**	**Very often**
Felt that you were unable to control the important things in your life?	☐	☐	☐	☐	☐
Felt confident about your ability to handle your personal problems?	☐	☐	☐	☐	☐
Felt that things were going your way?	☐	☐	☐	☐	☐
Felt difficulties were piling up so high that you could not overcome them?	☐	☐	☐	☐	☐

WEIGHT GAIN DURING PREGNANCY

89. There are many things you will have been thinking about during your pregnancy (e.g. concerns or questions). How would you describe your level of interest in finding out *'what amount of weight should I gain during my pregnancy?'*

- ☐ I haven't thought about it
- ☐ I thought about it but haven't decided if I will seek this information
- ☐ I have chosen not to seek this information
- ☐ I have decided to get some information (but I haven't yet)
- ☐ I have got some information
- ☐ I have been using this information to check my weight gain

90. What type of information about weight gain during pregnancy did you receive or would you like to have received from your main healthcare provider?

		I DID NOT RECEIVE	
	I have received	**But I would like to have received**	**And I am not interested in receiving**
What is a healthy amount of weight to gain	☐	☐	☐
How to monitor my weight gain	☐	☐	☐
Dietary information to help me manage my weight gain	☐	☐	☐
Information on exercise/physical activity to help manage my weight gain	☐	☐	☐
How weight gain affects the baby	☐	☐	☐
How weight gain affects me	☐	☐	☐
Realistic time-frame (after birth) for losing weight gained during pregnancy	☐	☐	☐
Other (please specify)	☐ (PROVIDE SPACE FOR RESPONDENT TO INDICATE: allow 3-5 Rows for other)	☐ (PROVIDE SPACE FOR RESPONDENT TO INDICATE: allow 3-5 Rows for other)	

91. How often have you had your weight measured by a health professional DURING this pregnancy? *(select one option only)*

- ☐ **At none** of my antenatal appointments
- ☐ **At** my first antenatal appointment **only**
- ☐ At some of my antenatal appointments **including** the first one
- ☐ At some of my antenatal appointments **but not** the first one
- ☐ At **all** of my antenatal appointments

92. Approximately how often have you weighed yourself DURING this pregnancy? (select one option only)

- ☐ More than once a week
- ☐ Weekly
- ☐ Fortnightly
- ☐ Monthly
- ☐ Less than once a month
- ☐ Never

93. How comfortable do you feel about the following in relation to checking your weight gain DURING pregnancy?

	Very uncomfortable	Uncomfortable	Undecided	Comfortable	Very comfortable
Having my healthcare provider measure my weight	☐	☐	☐	☐	☐
Having my healthcare provider keep a record of my weight gain	☐	☐	☐	☐	☐
Measuring my own weight/weighing myself	☐	☐	☐	☐	☐
Keeping my own record of my weight gain	☐	☐	☐	☐	☐

94. I have set a maximum amount of weight I would like to gain DURING this pregnancy.

- ☐ **Yes**
- ☐ **No**

95. I have been deliberately restricting my food intake to control how much weight I gain DURING this pregnancy.

- ☐ **Yes**
- ☐ **No**

96. Please indicate how strongly you agree/disagree with each of the following.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The less weight I gain, the easier the birth will be	☐	☐	☐	☐	☐
I have no control over how much weight I gain during pregnancy	☐	☐	☐	☐	☐
The more weight I gain, the healthier the baby will be	☐	☐	☐	☐	☐
Keeping track of how much weight I gain during pregnancy is important to me	☐	☐	☐	☐	☐

97. What do you think is a realistic amount of weight <u>for you</u> to gain DURING this pregnancy?

(select one option only)

- ☐ Less than 5kg (<11lbs)
- ☐ 5-9kg (11-20lbs)
- ☐ 7- 11kg (15-25lbs)
- ☐ 11- 16kg (25-35lbs)
- ☐ 13-18kg (28-40lbs)
- ☐ More than 18kg (40lb)
- ☐ I don't know

SOCIODEMOGRAPHIC QUESTIONS

98. What is your age in years? _____ (fill in box)

99. What is the age of the baby's father? ___ yrs **(fill in box)**

- ☐ I don't know

100. Which of the following best describes your living arrangements?

- ☐ Single mother
- ☐ Living with a partner

101. How many adults (aged 18yrs or over) are living in your household (including yourself)? _______(fill in box)

102. How many children (under 18 years) are living in your household? _______ (fill in box)

[Q103 only if Q102>0, otherwise go to Q104]

103. Please indicate the age categories of your children living at home. (select all that apply)

- ☐ Less than 1 year old
- ☐ 12 to 24 months (1-2 years old)
- ☐ 3-4 years old
- ☐ 5-9 years old
- ☐ 10-14 years old
- ☐ 15-17 years old

104. Currently I am...

(choose the one option that best describes you)

- ☐ Working full time [go to Q106]
- ☐ Working part time [go to Q106]
- ☐ A full time student [if selected <Bachelor degree for Screening Q5, go to Q105, otherwise go to Q106]
- ☐ A part time student [if selected <Bachelor degree for Screening Q5, go to Q105, otherwise go to Q104]
- ☐ Both working and studying [if selected <Bachelor degree for Screening Q5, go to Q105, otherwise go to Q106]
- ☐ Engaged in full time home duties [go to Q106]
- ☐ Not in paid work but looking [go to Q106]
- ☐ On a pension (other than age pension) [go to Q106]

105. Are you currently a <u>university</u> student?

- ☐ Yes
- ☐ No

106. Which one of the following categories best describes your annual total household income (before tax)?

- ☐ Below $20,000
- ☐ $20,001 - $40,000
- ☐ $40,001 - $70,000
- ☐ $70,001 - $105,000
- ☐ $105,001 - $205,000
- ☐ >$205,000

107. Were you born in Australia?

- ☐ Yes (go to Q110)
- ☐ No (go to Q108)

108. How many years have you been living in Australia? _____ yrs (fill in box)

109. In which country did you spend most of your time before you came to Australia?

- ☐ China
- ☐ India
- ☐ Germany
- ☐ Greece
- ☐ Italy
- ☐ Japan
- ☐ France
- ☐ New Zealand
- ☐ Thailand
- ☐ UK
- ☐ USA
- ☐ Vietnam
- ☐ Africa other
- ☐ America other
- ☐ Europe other
- ☐ Asia other
- ☐ Oceania other
- ☐ Any other

110. What is your ethnic background?

Oceanian	North-west European	Southern and Eastern European
☐ Australian peoples ☐ New Zealand peoples ☐ Melanesian and Papuan ☐ Micronesian ☐ Polynesian	☐ British ☐ Irish ☐ Western European ☐ Northern European	☐ Southern European ☐ South Eastern European ☐ Eastern European
North African and Middle Eastern	**South-East Asian**	**North-East Asian**
☐ Arab ☐ Jewish ☐ Peoples of the Sudan ☐ Other North African and Middle Eastern	☐ Mainland south-east Asian ☐ Maritime south-east Asian	☐ Chinese Asian ☐ Other north-east Asian
Southern and central Asian	**People of the Americas**	**Sub-Saharan African**
☐ Southern Asian (Indian) ☐ Central Asian	☐ North American ☐ South American ☐ Central American ☐ Caribbean Islander	☐ Central and West African ☐ Southern and East African

Appendix 7: Results of chi-square tests (X^2) examining associations between participant characteristics and supplementation[1]

	Folic acid compliance[2]			Iodine compliance[3]			Any dietary supplements during pregnancy		
	National (n=449)	**SA (n=398)**	**Total (n=847)**	**National (n=452)**	**SA (n=402)**	**Total (n=854)**	**National (n=455)**	**SA (n=402)**	**Total (n=857)**
Area of residence (metropolitan area, other)	0.79	0.00	0.88	1.21	1.10	3.71	0.78	0.70	0.03
Educational attainment (secondary education only, post-secondary but not tertiary, tertiary undergraduate, tertiary postgraduate)	2.65	4.54	6.97	6.59	0.81	6.60	5.43	9.38* (0.15)	10.82* (0.11)
Household income (quintiles)	12.34* (0.17)	5.26	14.29** (0.13)	13.17* (0.17)	4.83	11.48* (0.12)	35.12*** (0.28)	13.21* (0.18)	23.71*** (0.17)
Living with a partner (y, n)	4.45* (0.10)	0.50	3.64	8.94** (0.14)	0.12	5.05* (0.08)	16.33*** (0.19)	8.05** (0.14)	22.43*** (0.16)
Born in Australia (y, n)	1.57	0.04	0.34	0.48	0.02	0.36	0.01	2.93	1.64
Overweight or obese pre-pregnancy	0.01	2.65	0.93	0.08	8.13** (0.14)	2.42	0.17	0.69	0.22
Previous birth(s) (y, n)	2.58	0.34	1.00	3.57	4.34* (0.10)	11.02** (0.11)	1.39	0.77	5.17* (0.08)
Planned pregnancy (y, n)	30.83*** (0.26)	25.62*** (0.25)	55.08*** (0.26)	10.44** (0.15)	10.49** (0.16)	19.67*** (0.15)	0.87	4.63* (0.11)	2.72
Main health care provider during current pregnancy (GP, obstetrician, midwife, none)	13.00** (0.17)	3.20	12.34** (0.12)	12.91** (0.17)	3.46	4.66	27.79*** (0.25)	3.13	29.65*** (0.19)
Received some information about folic acid from main healthcare provider for this pregnancy (y, n)	0.00	0.58	0.32	-	-	-	5.73* (0.14)	0.03	3.89* (0.08)
Received some information about iodine from main healthcare provider for this pregnancy (y, n)	-	-	-	2.51	1.21	3.87* (0.08)	0.02	2.30	0.08

*P<0.05, **P<0.01, *** P<0.001

[1] Data are X^2 for non-significant associations and X^2 (*Phi* coefficient) for significant associations in 2x2 contingency tables or X^2 (Cramer's V) for significant associations in larger tables. *Phi* and Cramer's V indicate effect size: 0.00-1.00=negligible association, 0.10-0.20=weak association, 0.20-0.30=moderate association [237].

[2] Folic acid compliance defined as supplementing with ≥400μg/d at least one month preconception and during the first trimester

[3] Iodine compliance defined as supplementing with ≥150ug/d during pregnancy, started before pregnancy or within 5 weeks of conception

Appendix 8: Results of chi-square tests (X^2) examining associations between participant characteristics and knowledge regarding recommendation for periconceptional folic acid supplementation[1]

	Supplementation recommended in preconception and pregnancy			Link between folic acid and prevention of neural tube defects			Correct timing[2]			Correct dose[3]		
	National	SA	Total	National	SA	Total	National	SA	Total	National	SA	Total
Area of residence (metropolitan area, other)	0.58	0.13	0.003	0.08	0.42	0.62	1.61	0.53	5.58* (0.08)	0.32	0.53	1.69
Educational attainment (secondary education only, post-secondary but not tertiary, tertiary undergraduate, tertiary postgraduate)	0.88	0.29	0.50	2.14	9.62* (0.16)	4.55	2.20	14.51** (0.19)	14.69** (0.13)	9.62* (0.15)	14.51** (0.19)	24.99*** (0.17)
Household income (quintiles)	16.03** (0.19)	5.34	11.60* (0.12)	11.81* (0.16)	26.41*** (0.26)	25.90*** (0.17)	4.51	13.07* (0.18)	11.55* (0.12)	11.66* (0.16)	13.07* (0.18)	21.56*** (0.16)
Living with a partner (y, n)	4.39* (0.10)	0.12	3.28	11.32** (0.16)	0.25	7.83** (0.096)	0.16	0.74	0.66	0.26	0.74	0.88
Born in Australia (y, n)	1.33	2.39	0.03	4.65* (0.10)	8.57** (-0.16)	3.62** (0.11)	0.30	2.92	4.97* (0.08)	0.12	2.92	2.98
Overweight or obese pre-pregnancy (y, n)	0.15	0.24	0.02	1.11	0.41	0.88	0.14	0.67	0.63	2.43	0.67	3.41
Previous birth(s) (y, n)	1.09	0.01	0.09	0.09	0.84	0.31	1.74	3.24	3.57	0.001	3.24	3.20
Planned pregnancy (y, n)	0.54	4.63* (0.11)	3.08	1.04	14.49*** (0.19)	8.88** (0.10)	0.34	11.80** (0.17)	4.05* (0.07)	4.58* (-0.10)	11.80** (0.17)	14.73*** (0.13)
Main health care provider during current pregnancy (GP, obstetrician, midwife, none)	14.42** (0.18)	1.93	10.46* (0.11)	20.21*** (0.21)	2.51	19.46 *** (0.15)	1.03	3.46	0.47	10.37* (0.15)	3.46	11.00* (0.11)
Received some information about folic acid from main healthcare provider for this pregnancy (y, n)	10.07** (0.19)	8.00** (0.17)	18.41*** (0.18)	12.76*** (0.21)	3.66	16.58*** (0.17)	4.21* (0.12)	4.28* (0.13)	9.15** (0.13)	10.19** (0.19)	4.28* (0.13)	14.24*** (0.16)

*P<0.05, **P<0.01, *** P<0.001

[1] Data are X^2 for non-significant associations and X^2 (*Phi* coefficient) for significant associations in 2x2 contingency tables or X^2 (Cramer's V) for significant associations in larger tables. *Phi* and Cramer's V indicate effect size: 0.00-1.00=negligible association, 0.10-0.20=weak association, 0.20-0.30=moderate association [237].

[2] Correct timing defined as 'at least one month before conception and the first trimester of pregnancy'

[3] 400ug and 500ug considered correct response.

Appendix 9: Results of chi-square tests (X^2) examining associations between participant characteristics and knowledge regarding recommendation for iodine supplementation[1]

	Supplementation recommended in preconception and pregnancy			Link between iodine and brain development			Correct dose[2]		
	National	**SA**	**Total**	**National**	**SA**	**Total**	**National**	**SA**	**Total**
Area of residence (metropolitan area, other)	1.37	0.21	1.21	0.26	0.00	0.45	0.07	1.46	0.95
Educational attainment (secondary education only, post-secondary but not tertiary, tertiary undergraduate, tertiary postgraduate)	6.01	1.79	5.28	8.93* (0.14)	18.80*** (0.22)	24.39*** (0.17)	1.02	2.48	2.22
Household income (quintiles)	4.13	2.75	1.50	4.09	12.12* (0.17)	12.47* (0.12)	1.30	1.72	0.82
Living with a partner (y, n)	0.00	0.38	0.17	2.11	3.64	5.55* (0.08)	0.12	1.98	1.45
Born in Australia (y, n)	1.85	0.49	0.15	0.23	0.97	1.35	0.81	0.45	0.04
Overweight or obese pre-pregnancy (y, n)	0.00	5.67* (0.12)	2.61	1.25	0.04	0.35	0.07	1.89	1.27
Previous birth(s) (y, n)	3.86	0.19	2.41	1.44	0.85	0.26	0.46	4.10* (0.10)	2.99
Planned pregnancy (y, n)	7.18** (0.13)	3.58	0.36	2.86	8.69** (0.15)	10.30** (0.11)	0.61	0.01	0.41
Main health care provider during current pregnancy (GP, obstetrician, midwife, none)	5.00	11.69** (0.17)	14.20** (0.13)	4.80	1.02	5.15	2.34	6.54	1.98
Received some information about iodine from main healthcare provider for this pregnancy (y, n)	13.65*** (0.22)	16.27*** (0.24)	29.40*** (0.23)	6.17* (0.15)	12.90*** (0.22)	18.48*** (0.18)	6.28* (0.15)	0.00	3.36

*P<0.05, **P<0.01, *** P<0.001

[1] Data are X^2 for non-significant associations and X^2 (*Phi* coefficient) for significant associations in 2x2 contingency tables or X^2 (Cramer's V) for significant associations in larger tables. *Phi* and Cramer's V indicate effect size: 0.00-1.00=negligible association, 0.10-0.20=weak association, 0.20-0.30=moderate association [237]

Appendix 10: Results of chi-square tests (X^2) examining associations between participant characteristics and ability to identify at least one good dietary sources of folate and iodine[1]

	Folate			Iodine		
	National	SA	Total	National	SA	Total
Area of residence (metropolitan area, other)	1.59	0.00	2.92	0.02	0.02	0.43
Educational attainment (secondary education only, post-secondary but not tertiary, tertiary undergraduate, tertiary postgraduate)	10.59* (0.15)	25.08*** (0.25)	33.19*** (0.20)	2.96	17.40** (0.21)	17.30** (0.14)
Household income (quintiles)	6.62	10.48* (0.16)	10.93* (0.11)	10.22* (0.15)	8.75	12.35* (0.12)
Living with a partner (y, n)	4.10* (0.10)	7.08** (0.13)	10.29** (0.11)	11.16** (0.16)	1.34	3.56** (0.11)
Born in Australia (y, n)	0.34	20.59*** (0.23)	16.44*** (0.14)	0.19	3.06	1.82
Overweight or obese pre-pregnancy (y, n)	3.69	6.93** (0.13)	11.96** (0.12)	0.74	4.61* (0.11)	5.55* (0.08)
Previous birth(s) (y, n)	1.96	0.26	5.26* (0.08)	4.38* (0.10)	0.09	7.68** (0.10)
Planned pregnancy (y, n)	0.73	2.29	2.09	2.53	5.73* (0.12)	6.34* (0.09)
Main health care provider during current pregnancy (GP, obstetrician, midwife, none)	5.89	4.61	4.24	5.37	1.73	7.08
Received some information about folic acid from main healthcare provider for this pregnancy (y, n)	-	-	-	8.23** (0.17)	3.85	12.59*** (0.15)
Received some information about iodine from main healthcare provider for this pregnancy (y, n)	14.04*** (0.22)	17.70*** (0.26)	33.18*** (0.24)	-	-	-

*P<0.05, **P<0.01, *** P<0.001

[1] Data are X^2 for non-significant associations and X^2 (*Phi* coefficient) for significant associations in 2x2 contingency tables or X^2 (Cramer's V) for significant associations in larger tables. *Phi* and Cramer's V indicate effect size: 0.00-1.00=negligible association, 0.10-0.20=weak association, 0.20-0.30=moderate association [237].

Appendix 11: Linear regression of behavioural intention onto direct measures of TPB constructs and additional variables

	National cohort		SA cohort		Total	
Predictors[1]	**β**	**SP**	**β**	**SP**	**β**	**SP**
Step 1, ΔR²	0.030***		0.065***		0.082***	
Cohort	-	-	-	-	0.225***	0.220
Previous birth(s)	-0.157***	-0.157	-	-	-0.142***	-0.139
Metropolitan area	-0.105**	-0.105	-	-	-	-
Smoked during pregnancy	-	-	-0.203***	-0.202	-	-
Nutrition knowledge	-	-	0.154***	0.154	-	-
Step 2, ΔR²	0.655***		0.419***		0.549***	
Cohort	-	-	-	-	0.082***	0.078
Previous birth(s)	-0.025	-.024	-	-	-0.051**	-0.049
Metropolitan area	-0.039	-.039	-	-	-	-
Smoked during pregnancy	-	-	-0.123***	-0.121	-	-
Nutrition knowledge	-	-	0.085**	0.084	-	-
Attitude	0.158***	0.131	0.173***	0.157	0.180***	0.149
Subjective norm	0.345***	0.243	0.471***	0.445	0.423***	0.358
PBC	0.439***	0.299	0.297***	0.284	0.340***	0.285
Step 3, ΔR²	0.010***		0.013***		0.010***	
Cohort	-	-	-	-	0.081***	0.076
Previous birth(s)	-0.028	-0.028	-	-	-0.051**	-0.050
Metropolitan area	-0.048*	-0.047	-	-	-	-
Smoked during pregnancy	-	-	-.108***	-0.105	-	-
Nutrition knowledge	-	-	.077**	0.075	-	-
Attitude	0.130***	0.105	.151***	0.135	0.160***	0.130
Subjective norm	0.330***	0.227	.451***	0.419	0.411***	0.342
PBC	0.410***	0.270	.248***	0.220	0.303***	0.239
Perceived stress	-0.017	-0.016	-.075*	-0.070	-0.033	-0.031
Health value	0.016	0.012	.012	0.010	0.017	0.013
Self-identity	0.113***	0.082	.116***	0.093	0.099***	0.076
Final model R²	0.695***		0.497***		0.641***	

*P<0.10, **P<0.05, ***P<0.01
Abbreviations: β=standardised regression coefficient; SP=semi-partial correlation.

Appendix 12: Linear regression examining effects of stress on healthy eating intention (independent effects and interaction effects)

	National cohort		SA cohort		Total	
	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	0.245***		0.195***		0.257***	
Cohort membership		-		-		.176***
Previous birth(s)		-.135***		-		-.124***
Living in metro area		-.114***		-		-
Smoked during pregnancy		-		-.141***		-
Nutrition knowledge score		-		.123***		-
Perceived stress		-.128***		-.186***		-.149***
Self-identity		.430***		.308***		.378***
Step 2	0.451***		0.303***		0.384***	-
Cohort membership		-		-		.080***
Previous birth(s)		-.028		-		-.051**
Living in metro area		-.047*		-		-
Smoked during pregnancy		-		-.108***		-
Nutrition knowledge score		-		.078**		-
Perceived stress		-.017		-.075**		-.033
Self-identity		.122***		.122***		.108***
Attitude		.131***		.150***		.159***
Subjective norm		.332***		.452***		.413***
Perceived behavioural control		.410***		.247***		.303***
Step 3	0.002*		0.002		0.002*	
Cohort membership		-		-		.081***
Previous birth(s)		-.026		-		-.049**
Living in metro area		-.052**		-		-
Smoked during pregnancy		-		-.11***		-
Nutrition knowledge score		-		.08**		-
Perceived stress		-.057		.06		-.399*
Self-identity		.126***		.12***		.110***
Attitude		.011		.21**		.137*
Subjective norm		.246***		.35***		.310***
Perceived behavioural control		.610***		.32***		.290***

Attitude X Perceived stress	.288	-.33	.047
Subjective norm X Perceived stress	.242	.39	.317**
Perceived behavioural control X Perceived stress	-.480**	-.17	.011
Final model R^2	0.698***	0.500***	0.643***

*P<0.10, **P<0.05, ***P<0.01

Abbreviations: β=standardised regression coefficient.

Appendix 13: Published peer abstracts from this thesis

1. Motivations for dietary supplementation in pregnancy- Evidence from focus groups

Malek L, Zhou SJ, Makrides M, Umberger WJ, Collins CT

Abstract presented as a 3 min oral and poster presentation at the 17th Annual Congress of the Perinatal Society of Australia and New Zealand (PSANZ) Adelaide in April, 2013.

The body of work that appears in this conference abstract is drawn from the results of the focus group discussions the methods of which were described in Chapter 3, and the findings summarised in Appendix 5.

Background: Nutrient requirements of folate, iodine and iron increase during pregnancy, and dietary modification is often required. Women often take dietary supplements to meet increased nutrient requirements and reasons for this are poorly understood. Previous studies have found that populations least at risk of poor nutrition are often the most likely to take supplements. This study aimed to increase understanding of factors motivating supplement use during pregnancy.

Method: Ten focus group discussions and two in-depth interviews were conducted with 40 women aged 21-45 years who were either pregnant or <12 months postpartum. Groups were stratified by socioeconomic status (SES). A script comprising questions based on study objectives was used. All discussions were recorded, transcribed verbatim and analysed using a framework approach.

Results: The majority of women took multivitamins containing folate and iodine during pregnancy. Reasons for taking supplements included compensation for nutrients believed to be low or missing in the diet and achieving peace of mind knowing that the baby is 'definitely' receiving all required nutrients. The majority of women did not know the recommended amounts of folate or iodine. Low SES women had particularly limited knowledge regarding folate and iodine rich food sources. Some women also questioned the nutritional quality of the food supply. Others indicated that they would not take supplements if they were able to ensure their diet was nutritionally adequate.

Conclusion: Women have little knowledge of how to ensure adequate nutrient intake from foods during pregnancy and rely on dietary supplementation as an insurance policy.

2. Examining the relationship between perceived and actual diet quality during pregnancy: Evidence from a national study of Australian women

Malek L, Umberger WJ, Makrides M, Zhou SJ

Abstract presented as a 3 min oral and poster presentation at the 18th Annual Congress of the Perinatal Society of Australia and New Zealand (PSANZ) Perth in April, 2014.

The body of work that appears in this conference abstract is drawn from the results in the Chapter 4.

Background: Adequate nutrition in pregnancy is essential for providing offspring a healthy start to life. Evidence-based dietary guidelines exist for pregnant women that recommend the number of daily servings from each food group. This study aimed to increase understanding of relationships between dietary intake in pregnancy and women's perceptions regarding healthy eating.

Method: Between June and August 2013, a reputable online consumer panel-provider recruited and administered a web-based survey to 455 pregnant women living in Australia. Data on dietary intake, supplement use, perceptions regarding healthiness of diet, nutrition knowledge and socio-demographic information were collected. Pearson's chi-square test was used to explore statistically significant relationships between variables.

Results: Median gestational age was 22 weeks. Fifty-six percent, 26% and less than 10% of women consumed the recommended daily servings (RDS) of fruit, grain foods and other core food groups, respectively. Significant positive relationships were found between perceived healthiness of diet and compliance with RDS for fruit (P=0.000; *phi*=0.17) and dairy (P=0.018; *phi*=0.12). No other significant relationships were found between perceived healthiness and compliance with RDS of other core food groups, or with use of dietary supplements during pregnancy.

Conclusion: Pregnant women perceive their diets to be healthy, yet the majority do not consume the RDS of core food groups. Additional analysis will explore relationships between diet quality, nutrition knowledge and socio-demographic factors. These results will be included in the presentation to provide insight on how we can improve translation and increase adoption of dietary guidelines by women during pregnancy.

Appendix 14: Other abstracts from this thesis presented at conferences

1. A discrete choice experiment to understand women's preferences for nutritionally enhanced food and dietary supplements during pregnancy

Malek L, Zhou SJ, Makrides M, Flynn ,T Umberger WJ

Abstract presented WJU on behalf of LM as a 20 min oral presentation at the Agricultural & Applied Economics Association 2014 Annual Meeting in Minneapolis, Minnesota, USA, July 27-29, 2014.

The body of work that appears in this conference abstract is drawn from the results in Chapter 6.

Introduction, Relevance to the Profession and Objectives

Substantial scientific research has shown that maternal nutrition from preconception through to lactation may impact infant's growth, cognitive development and lifetime risk of developing chronic disease (Osmond & Barker). Dietary requirements of certain nutrients such as folate, iodine and iron increase during pregnancy. Women may take dietary supplements to meet increased nutrient requirements during pregnancy and lactation, but reasons for this are poorly understood. Notably, even when women do take dietary supplements, they do not always adopt specific evidence-based nutrient recommendations (Conlin et al.). In fact, previous studies have found that populations most at risk of poor nutrition are least likely to take supplements, and those least at risk are most likely to take them (Kirk et al.). There are increasing concerns that some supplement users may be over-supplementing potentially introducing new health risks for both the mother and the unborn child (Alwan et al.).

The lack of understanding around the dietary practices of pregnant women is not surprising considering current literature shows consumers' decisions to make dietary changes, including use of nutritional supplements and adoption of nutritionally-enhanced food products, are influenced by a set of complex social, psychological and economic factors (Miller et al. 2003; Conner et al. 2001; Cox et al. 2011). While these influencing factors may differ on an individual basis, consumer behaviour research plays a vital role in providing insights to key obstacles and success factors when developing nutrition and health education materials, new food products and recommendations that will be adopted by target populations. By exploring the relative importance placed on and the trade-offs pregnant women make between product attributes when purchasing dietary supplements (including pills/capsules and nutritionally enhanced foods and beverages), this study aims to increase understanding of the drivers of women’s dietary decisions during pregnancy and to determine the factors influencing their demand for dietary supplements during pregnancy. Consumer segments with unique preference criteria and individual characteristics are identified. To do this, a novel discrete choice experiment (DCE) was conducted. DCEs are often preferred research methods because of their ability to predict consumers’ market behaviour and relative values for multiple product attributes.

Research Methods, Analysis and Initial Results

The DCE was part of an online survey of a nationally representative Australian sample of 455 pregnant women conducted between June and August 2013. Respondents answered socio-demographic, dietary practice, supplement, knowledge, and attitudinal questions.

For the DCE, women were asked to imagine they were considering dietary supplements and fortified food products to enhance their diet during pregnancy. For each choice set respondents indicated their most likely and least likely choices and if they would realistically purchase their most likely choice. The attributes and levels in the DCE were chosen after conducting a substantial literature review and focus group discussions with pregnant and <12month postpartum women. The DCE included three alternatives per choice set (pill/capsule, fortified food and fortified beverage). Attributes included endorsement (e.g. scientifically proven, endorsed by the Dietitians Association of Australia (DAA), endorsed by the Heart Foundation, endorsed by the National Health and Medical Research Council (NHMRC), endorsed by the CSIRO), brand, (‘specific brand’, ‘non-specific or generic brand’), absorption (no claim, easy to digest and absorb), folate (0, 400, 800 µg), iodine (0, 150, 250 µg), omega-3 fatty acids (0, 115, 500 mg) and vitamin D (0, 200, 400 IU).

Alternative-specific attributes included specific base product (for included multivitamin, vitamin tablet (1 per day) and vitamin tablet (2 per day) for pills/capsules; bread, yoghurt and cereal for fortified foods; and fruit juice, milk and water for fortified beverages) and daily cost (3 levels per specific base product). A between-subject (2^J) design ensured each respondent saw a specific combination of health claims from the 16 total possible claims (e.g. folate prevents neural tube defects, omega-3/fish oil prevents premature birth, iodine assists with brain development, etc.).

The DCE used an orthogonal design resulting in 162 choice sets in total. To avoid respondent fatigue, respondents were randomly allocated to one of nine different versions of 18 choice sets. Respondents’ choices were analysed using conditional logit regression and its extensions, notably the scale-adjusted latent class analysis (LCA). The LCA was used to segment the sample, both in terms of preferences and willingness-to-pay and choice consistency. The optimal solution was characterised post-hoc by socio-demographics and behavioural variables in an attempt to link choice heterogeneity to observable covariates and better understand different consumer segments.

Preliminary data analysis suggests unique consumer segments exist that prefer supplements to fortified foods and beverages. Cost was the most important determinant of consumers' supplement choices among those who preferred pills/capsules, followed by endorsement, nutrients, and brand. For segments preferring fortified foods or beverages, specific base product was the most important determinant of choice, followed by endorsement, cost, nutrients, and brand. Full segmentation analysis will increase understanding of how different segments of consumers make decisions related to nutritional supplementation during pregnancy.

Potential for Generating Discussion

This study provides unique insight into the relative importance placed on and the trade-offs pregnant women make between product attributes when purchasing dietary supplements including pills/capsules and nutritionally enhanced foods and beverages. No known studies have explored the relative importance of such a wide variety of attributes in the context of choosing nutritional supplements for pregnancy. The information from this study will assist health professionals, policy makers and industry in developing effective strategies (translation and provision of information, advice and products) which will help women achieve optimal nutrition during pregnancy. We expect our study to be of interest to a wide variety of conference attendees because of the innovative study design methods and unique population sampled (pregnant women).

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2. A novel study to understand psychosocial factors influencing healthy eating intention during pregnancy

Malek L, Zhou SJ, Makrides M, Umberger WJ

Abstract presented as a 20 min oral presentation at the Agricultural & Applied Economics Association, 2014 AAEA/EAAE/CAES Joint Symposium, Montreal, Quebec, Canada, May 28-30, 2014.

The body of work that appears in this conference abstract is drawn from the results in Chapter 5.

Introduction and Objectives

Nutrition in early life, from preconception through to lactation, can influence the growth, development and long-term health of children. Requirements of many nutrients increase in pregnancy and, therefore, some dietary changes are generally required. Evidence-based dietary recommendations exist, which aim to improve the nutritional status of mothers and reduce the risks of adverse pregnancy outcomes. However, women do not always adopt these recommendations and the reasons for this are poorly understood. Understanding the motivating factors behind women's dietary choices in pregnancy, is essential to developing effective strategies for encouraging healthier dietary choices and increasing compliance with evidence-based guidelines.

Dietary choices are influenced by a complex set of physiological, psychological, social and economic factors. Individuals are often unaware of the true role that these factors (e.g. attitudes, perceptions, beliefs and norms) play in their decision-making and behaviour; thus, data on such factors can be difficult to obtain. The Theory of Planned Behaviour (TPB) is a well-established psychological framework used to quantitatively measure social and psychological factors influencing behaviour. The framework can be used to predict and understand factors motivating healthy and unhealthy behaviour (e.g. adopting healthier eating habits) in order to identify strategies for changing behaviour.

According to the TPB, the most important determinants of a specific behaviour are the individual's intention to perform the behaviour (*behavioural intention*) and the individual's actual control over performing the behaviour. Behavioural intention is determined by an individual's 1) *attitude* toward a behaviour, 2) perceptions of the social pressure (e.g. from friends, family or health practitioners) to perform or not to perform a behaviour, also known as *subjective norm*, and 3) *perceived behavioural control* (PBC) or an individual's belief about their ability to control a specific behaviour. Attitudes are influenced by an individual's perceived beliefs regarding behavioural outcomes (*behavioural beliefs*), whereas an individual's 'subjective norm' is influenced by their beliefs about what specific social sources think about a specific behaviour (*normative beliefs*) as well as their personal motivation to comply with these sources. Finally PBC is influenced by beliefs about inhibiting and enabling factors (*control beliefs*) and how these factor influence their behaviour.

The TPB has previously been used to examine factors influencing milk consumption in low-income pregnant women in the US, and an earlier version of the TPB (the 'Theory of Reasoned Action') was used to examine pregnant women's intention to 'try healthier eating'. The latter study was conducted over 20 years ago in the UK and it was not clear whether the behaviour under investigation was healthier eating during pregnancy or in general. Nonetheless, no previous research has applied the TPB to the study of healthy eating intention in pregnancy. Using the TPB, this study aims to examine the psychosocial factors influencing women's intention to consume a healthy balanced diet during pregnancy. Underlying beliefs associated with TPB constructs will also be examined to provide insight into beliefs which have a significant independent effect on attitude, subjective norm and PBC.

Research Methods, Analysis and Initial Results

The TPB questionnaire was part of an online survey of a national sample of 455 pregnant women living in Australia conducted between June and August 2013. Respondents also answered a range of socio-demographic, dietary practice, supplement, knowledge, information source and attitudinal questions. In the TPB questionnaire, the behaviour under investigation was 'eating a health balanced diet during pregnancy', with all items in the questionnaire referring to this specific behaviour. The included behavioural (8), normative (7) and control (10) beliefs were elicited during focus group and individual discussions with 40 pregnant and postpartum women. In particular, the normative belief items examined the influence of women's main health care provider, health experts in general, social media (e.g. the Internet, books/magazines), and peers including partners, female family members, and pregnant or previously pregnant friends.

The internal consistency of the direct TPB measures was assessed by calculating the Cronbach's alpha coefficient (>0.60 considered acceptable). Behavioural intention measures as well all direct measures of attitudes, subjective norm and PBC had acceptable to high internal consistency (Cronbach's alpha ranged from 0.648 for PBC to 0.938 for attitudes). Multiple linear regression analysis was used to determine the effect of TPB constructs (direct and indirect measures) on behavioural intention and to determine which specific beliefs had a significant and independent effect on their respective TPB construct. To determine which specific beliefs had the greatest influence on intentions, the sample was divided into two groups based on mean behavioural intention score being below the median (low-intenders) or at or above the median (high-intenders). Independent samples t-tests ($p<0.05$) were used to compare scores for each underlying belief assessed.

Behavioural intention was most strongly predicted by subjective norm, with 70% of the variance explained by subjective norm, PBC, behavioural beliefs and attitudes. The assessed normative beliefs explained 48% of the variation in direct subjective norm scores. The underlying normative beliefs which made a significant and independent contribution to explaining variance in subjective norm scores were those regarding female family members ($\beta=0.283$; $P<0.001$), pregnant or previously pregnant friends ($\beta=0.230$; $P<0.001$), health experts in general ($\beta=0.160$; $P=0.013$) and women's partners ($\beta=0.112$; $P=0.031$). High-intenders believed more strongly that each of the social sources assessed were in favour of them eating a healthy balanced diet during pregnancy and wanted to comply with these sources more than low-intenders. In decreasing order, the most influential social sources were health experts in general, main health care provider, partners, female family members, books/magazines, the Internet, and pregnant or previously pregnant friends. Further analyses will explore whether additional variables assessed in the survey can explain additional variation in behavioural intention not accounted for by TPB constructs.

Potential for Generating Discussion

This study reveals subjective norm to be an important predictor of women's intention to consume a healthy balanced diet during pregnancy. The social sources found to have a significant influence on women's intentions may be effective targets for intervention strategies aimed at positively influencing dietary behaviour of pregnant women and/or young women considering pregnancy. We expect our study will be of interest to a wide variety of symposium attendees, including those interested in food policy, nutrition and healthcare, psychosocial models of behaviour and consumer behaviour.

3. A discrete choice experiment to understand factors influencing women's dietary decisions during pregnancy

Malek L, Zhou SJ, Makrides M, Umberger WJ

Abstract presented as a 20 min oral presentation at the Agricultural & Applied Economics Association, 2014 AAEA/EAAE/CAES Joint Symposium, Montreal, Quebec, Canada, May 28-30, 2014.

The body of work that appears in this conference abstract is drawn from the results in Chapter 6.

Introduction and Objectives

Maternal nutrition from preconception through to lactation may impact the long-term health of the developing child. Folate, iodine and iron requirements increase during pregnancy and dietary modification is often required. Women often take dietary supplements to meet increased nutrient requirements, but reasons for this are poorly understood. Previous studies have found that populations most at risk of poor nutrition are least likely to take supplements, and those least at risk are most likely to take them. This study aims to increase understanding of the drivers of women's dietary decisions during pregnancy and to determine the factors influencing women's demand for dietary supplements (including pills/capsules and nutritionally-enhanced foods and beverages) during pregnancy. Consumer characteristics and social sources influencing product preferences are identified. To do this, a discrete choice experiment (DCE) was conducted. DCEs are a quantitative valuation method used to assess the trade-offs consumers make between different levels of product attributes. DCEs are often preferred research methods because of their proven ability to predict consumers' market behaviour and relative values for multiple product attributes.

Research Methods, Analysis and Initial Results

The DCE was part of an online survey of a national sample of 455 pregnant women living in Australia conducted between June and August 2013. Respondents answered socio-demographic, dietary practice, supplement, knowledge, and attitudinal questions. Questions around influential sources of nutrition information were also asked and revealed that family/friends and websites (including blogs, forums, and commercial pregnancy sites) were considered one of the top three most influential sources by 24% and 15% of women, respectively.

For the DCE, women were asked to imagine they were considering dietary supplements and fortified food products to enhance their diet during pregnancy. For each choice set respondents indicated their most likely choice, their least likely choice and if they would realistically purchase their most likely choice.

The attributes and levels in the DCE were chosen after conducting a substantial literature review and focus group discussions. The DCE included three alternatives per choice set (pill/capsule, fortified food and fortified beverage). Attributes included endorsement (6 levels), brand (2), absorption (2), folate (3), iodine (3), omega-3 fatty acids (3) and vitamin D (3). Alternative-specific attributes included specific base product (3) and daily cost (3). A between-subject (2^J) design ensured each respondent saw a specific combination of health claims from the 16 total possible claims (e.g. "folate prevents neural tube defects"). Respondent's choices were analysed using conditional logit regression. Preliminary data analysis suggests a preference for fortified foods over supplements and fortified beverages. Significant alternative-specific effects were found for the type of base product, increased amounts of folate, iodine, omega-3 and vitamin D; endorsement and daily cost. Specific base product, brand and absorption claim did not significantly affect product choice.

Further analysis will identify which individual related variables (e.g. socio-demographic characteristics, knowledge, dietary practices, attitudes, and pregnancy related variables) have a significant influence on product choice. A variable representing influential information sources will also be included to examine and compare the influence of various social sources including healthcare providers, friends and family, and social media. This will increase understanding of how different individual and social variables influence purchase decisions around nutritional supplementation during pregnancy, allowing more effective targeting of information and products to specific consumer segments.

Potential for Generating Discussion

The information gained from this study will support health professionals, policy makers and the food/supplement industry to formulate effective strategies (translation and provision of information, advice and products) to help women achieve optimal nutrition during pregnancy. We expect our study will be of interest to a wide variety of congress attendees, including those interested in functional food and supplement marketing, food policy, nutrition and healthcare, DCE methods and consumer behaviour.

4. Understanding consumer preferences for nutritional supplements during pregnancy: A choice experiment study

Malek L, Zhou SJ, Makrides M, Flynn T, Umberger WJ

Abstract presented as a 15min oral presentation at the 9th World Congress on Health Economics of the the International Health Economics Association, in Sydney, Australia, in 2013.

The body of work that appears in this conference abstract is drawn from the results in Chapter 6 (preliminary findings were presented).

Introduction and Objectives

Maternal nutrition from preconception through lactation can impact the long-term health of the developing child. Folate, iodine and iron requirements increase during pregnancy and dietary modification is often required. Women often take dietary supplements to meet increased nutrient requirements, but reasons for this are poorly understood. Previous studies have found that populations most at risk of poor nutrition are least likely to take supplements, and those least at risk are most likely to take them. This study aims to increase understanding of the drivers of women's dietary decisions during pregnancy and to determine the factors influencing women's demand for dietary supplements (including pills/capsules and nutritionally-enhanced foods and beverages) during pregnancy. Consumer segments with unique preference criteria and individual characteristics are identified. To do this, a novel discrete choice experiment (DCE) was conducted. DCEs are often preferred research methods because of their proven ability to predict consumers' market behaviour and relative values for multiple product attributes.

Research Methods, Analysis and Initial Results

The DCE was part of an online survey of a nationally representative Australian sample of 600 pregnant women conducted in June 2013. Respondents answered socio-demographic, dietary practice, supplement use, knowledge, and attitudinal questions. For the DCE, women were asked to imagine they were considering dietary supplements and fortified food products to enhance their diet during pregnancy. For each choice set respondents indicated their most likely choice, their least likely choice and if they would realistically purchase their most likely choice.

The attributes and levels in the DCE were chosen after conducting a substantial literature review and focus group discussions. The DCE included three alternatives per choice set (supplement tablet, fortified food and fortified beverage). Attributes included endorsement (6 levels), brand (2), absorption (2) and the nutrients folate (3), iodine (3), vitamin D (3) and omega-3 fatty acids (3). Alternative-specific attributes included delivery system (3) and daily cost (3). A between-subject (2^J) design ensured each respondent saw a specific combination of health claims from the 16 total possible claims (e.g. that folate prevents neural tube defects).

Respondent's choices were analysed using conditional logit regression and scale-adjusted latent class analysis. The latter segments the sample in terms of preferences, willingness-to-pay (WTP), and choice consistency, conceptualised as the respondent's 'certainty of response'. Preliminary data analysis suggests unique consumer segments exist that prefer supplements to fortified foods and beverages. Sociodemographic variables help to explain segments, but full segmentation analysis will increase understanding of how different segments of consumers make purchase decisions around nutritional supplementation during pregnancy.

Potential for Generating Discussion

The information gained from this study will support health professionals, policy makers and the food/supplement industry to formulate effective strategies (translation and provision of information, advice and products) to help women achieve optimal nutrition during pregnancy. We expect our study will be of interest to a wide variety of congress attendees, including those interested in functional food and supplement marketing, food policy, nutrition and healthcare, DCE methods and consumer behaviour.