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Measuring BMI in an Aboriginal population survey: who are the non-responders?

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Abstract

Objective

To describe the characteristics of South Australian Aboriginal respondents reporting unhealthy weight, as well as those not knowing their height or weight.

Methods

Trained Aboriginal interviewers undertook 399 face-to-face interviews with Aboriginal people 15 years and over from randomly selected dwellings, in metropolitan, rural and remote areas of South Australia (response rate: 57.7%). Questions were included to determine prevalence of unhealthy weight in this representative population.

Results

Self-reported prevalence of unhealthy weight was $n=79/106$, (74.5% 95% CI 65.1-81.6), and these respondents were more likely to have diabetes, high blood pressure, or had lived in their residence for more than 6 months; and less likely to have asthma, or experience food insecurity, than those who were underweight or normal weight. Those who did not know their height and weight ($n=247/353$, 70.1%, 95% CI 65.0-74.5), were more likely to be unemployed, undertake home duties, or be retired or unable to work; and less likely to live in rural or remote South Australia, be aged 45 years and over, or have a mental health condition than those who had answered the height and weight questions.

Conclusions

Unhealthy weight in the Aboriginal population exceeds general population levels. The main limitation to assessing accurate levels of unhealthy weight was that a large proportion of Aboriginal

people in this study did not know their height and weight. Limited access to primary health care, the social undesirability of reporting increased weight, or the conflict of health and lifestyle priorities, may explain this.

Implications

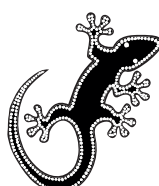
Identification of the characteristics of this population is important; strategies may be defined to prevent non-response in similar surveys. These data are a powerful resource informing policy and future research involving the social determinants of Aboriginal health.

Keywords: obesity, Aboriginal, prevalence, missing data

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Background

Identification of modifiable health risk factors, such as obesity, provide an opportunity to address significant health issues that may contribute towards closing the life-expectancy gap of the Australian Aboriginal population within a generation [1]. Overweight and obesity are risk factors for chronic conditions such as coronary heart disease, hypertension, hypercholesterolaemia, stroke, Type 2 Diabetes Mellitus, sleep apnoea, and some cancers [2]. Unhealthy weight is a major health issue in Australia, and in 2003, overweight and obesity was estimated to have contributed to 11.4% of the total burden of disease in the Aboriginal population, using a number of different data sources including self-report [3]. This compares with high body mass (greater than a Body Mass Index (BMI) of 21) in the overall Australian population being responsible for 7.5% of the total burden of disease [4]. In 2012-2013, after age-adjustment, the level of obesity/overweight was 1.5 times higher for Aboriginal people than for non-Aboriginal people [5]. This is up from 2004-2005, where after age-adjustment, the level of obesity/overweight was 1.2 times higher for Aboriginal people [6].

Recent epidemiological research describing overweight and obesity in the Aboriginal population varies in methodology, and often only specific regions are targeted. Biomedical studies are undertaken around birth cohorts [7], or rural and remote communities [8-11], and are a costly exercise. Data from a number of years may also be combined, as well as collected from vast geographical areas covering the whole of Australia, urban, rural and remote areas [12]. In larger national surveys prior to the SAAHS, the proportion of the population sampled from South Australia (SA) is often not enough to produce reliable estimates, and some areas, such as very remote, are excluded from the sample entirely [13]. However, the recent AATSIHS survey in 2012-13 has addressed many of these problems [5]. A dedicated South Australian survey however can address particular problems, situations and priorities that are specific to the state, at the same time as being comparatively low cost. There have been calls for further research into Aboriginal health, particularly in urban areas [14].

On average, it has been found that respondents for health surveys in Australia overestimate their height and underestimate their weight [15]. However, previous research has shown that Aboriginal respondents with a BMI greater than or equal to 25 are generally able to classify themselves appropriately as overweight [16].

Due to differences in body proportion, BMI may not describe the same degree of unhealthy weight in populations other than Caucasian. Ranges of BMI for Aboriginal and Torres Strait Islander populations, who have relatively long legs in relation to their torso, a factor known to influence BMI, are yet to be verified [17]. Thus, estimates of overweight and obesity according to BMI may not be adequate due to these anatomical and physiological factors [18]. It has been suggested that a BMI of 22 might be a more appropriate

'cut off' to indicate healthy weight for Aboriginal people [9].

The most recent published self-reported data source found to gauge BMI in the Aboriginal population for the whole of Australia is the 2004-05 *National Aboriginal and Torres Strait Islander health survey* (NATSIHS) [19]. After removing the 16% of Aboriginal people who did not know or did not state their height and weight, and adjusting for age, the proportion of Aboriginal people reporting underweight or normal BMI was 36.0%, those overweight, 31.0% and obese, 34.0%. Additionally, in 2012-13, height and weight measurements were obtained from only 82.5% of Aboriginal and Torres Strait Islander people aged 15 years and over as part of the 2012-13 Australian Aboriginal and Torres Strait Islander Health Survey (AATSIHS) [5]. This survey found that, two-thirds (66%) Aboriginal and Torres Strait Islander people aged 15 years and over were overweight or obese (29% and 37% respectively), according to their BMI [5]. Specifically, in South Australia, 5,000 (26.2%) Aboriginal and Torres Strait Islander people were found to be overweight and 6,300 (33.1%) were classified as obese, equating to 11,300 (59.3%) Aboriginal and Torres Strait Islander people having an unhealthy weight. In New South Wales, 60% of Aboriginal people reported being overweight or obese, compared with 54% of non-Aboriginal people during 2010 [20].

Similarly, the South Australian Monitoring and Surveillance System (SAMSS), a Computer Assisted Telephone Interview (CATI) system, produced estimates for the SA Aboriginal population, combining 3.5 years of data collected monthly July 2002 to December 2005 (n=100) [21]. Again after removing the 14.6% of Aboriginal and Torres Strait Islander respondents who did not know their height and weight, 33.3% (95% CI 24.2 - 43.8) were categorised as underweight or normal, 36.9% (95% CI 27.5 - 47.5) as overweight and 29.8% (95% CI 21.1 - 40.2) as obese. More recently using the same data set over the last three years (2010 to 2012), the following prevalences were found for Aboriginal and Torres Strait Islander respondents; 28.3% underweight or normal, 36.3% overweight and 35.3% obese (n=93) [22]. This is a shift in the proportions of Aboriginal people being classified as obese.

Differences in sex have been examined in rural Far North Queensland, with Aboriginal women reporting higher rates of overweight and obesity (53.8%) than Aboriginal men (40.5%) [11]. Comparisons have also been made between the BMI of remote dwelling Aboriginal peoples and the general Australian population [10] however, only recently with the AATSIHS has there been research investigating the differences in BMI of Aboriginal people dwelling in metropolitan, rural and remote regions of Australia, with a prevalence of 53.2% for Major Cities, 56.1% for regional areas and 51.8% for remote areas [5].

The *South Australian Aboriginal health survey* (SAAHS) [23] was developed in response to funding allocated from the *South Australian implementation plan* under the Council of Australian Governments (COAG) National Partnership Agreement on Closing

the Gap in Indigenous Health Outcomes [1]. The survey aimed to provide stable estimates of these important risk factors for developing ill-health amongst the Aboriginal population, such as obesity. Generally, there has been a lack of representative SA research into Aboriginal health and wellbeing [14], along with a lack of information about Aboriginal survey respondents who do not know, or do not report their height and weight. This survey was also undertaken prior to the national AATSIHS survey in 2012-2013 [5].

This paper aims to describe the characteristics of South Australian Aboriginal respondents reporting unhealthy weight and those who did not know or did not report either their height or weight.

Methods

Data were obtained from the 2011 SAAHS and a detailed description of the methodology has been reported elsewhere [23, 24].

A stratified, multi-stage, area sampling strategy based upon the Australian Bureau of Statistics (ABS) Census Collection Districts (CDs) was used to identify a sample of Aboriginal and Torres Strait Islanders where approximately 47% of the population lived in Metropolitan SA, 31% in rural SA, and the remaining 22% in remote areas and discrete communities [25]. All CDs included in the selection process where the number of Aboriginal people was greater than or equal to ten and the ratio of Aboriginal people to total number of dwellings was 0.05 or more for metropolitan and rural areas, and greater than zero in remote areas.

Randomly selected private dwellings (not institutions such as hospitals or prisons) within each CD were approached to ascertain eligibility. All Aboriginal people aged 15 years and over living either temporarily (living at the address for 6 months or more) or permanently in each selected dwelling were eligible for participation in the survey. The interviewers explained the study to participants and an information sheet was supplied. The interviewers also explained that the participants were free to discontinue the interview at any stage. The participants then gave verbal consent as to whether they wanted to participate.

Data were collected by trained Aboriginal interviewers, through personal face-to-face interviews using a paper questionnaire. Interviewers were accompanied, wherever possible, by community facilitators who assisted in the conduct and completion of the interviews. As interviewers usually travelled in pairs consisting of both male and females, respondents were given a choice about the sex of their interviewer, allowing questions of a more sensitive nature to be addressed appropriately by respecting cultural and sensitivity protocols [26]. The questionnaire was piloted with Aboriginal Health Workers.

Raw data from the questionnaires were entered into Microsoft Excel (10% check undertake for quality purposes) and subsequently

imported into SPSS Version 19.0 for analyses. Data were weighted by age, sex, and region to the ABS Census 2006 Aboriginal population. Univariate associations between both unhealthy weight, and also whether the respondent knew their height and weight, and demographic, socioeconomic and behavioural variables were assessed using the χ^2 test of significance using a p value of ≤ 0.05 to determine statistical significance. From the initial eligible sample of 691 persons, 399 interviews were conducted. The response rate was calculated at 57.7%.

The relationship between a number of variables, demographics, chronic conditions and other risk factors for those with health and unhealthy weight, as well as reporters of height and weight and non-reporters, were also explored using multivariate logistic regression analyses. A model was constructed using related variables ($p < 0.25$). In order to determine a model to predict statistically significant urinary incontinence with comorbid depression, related variables ($p < 0.25$) were entered into a logistic regression [27]. Variables determined to be insignificant were progressively omitted until a satisfactory model was obtained. The associations were examined to ensure there were no multicollinearity effects.

Ethics approval for the survey was obtained from the Aboriginal Health Research Ethics Committee (AHREC) and SA Health Human Ethics Committee (HREC). A decision was made not to include the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands, for logistical reasons at the time.

The analysis presented here is predominantly concerned with Aboriginal respondents aged 18 years and over who reported both their height and weight in the survey, in order to calculate BMI. Respondents were asked "What is your weight when you are undressed in the morning?" and also "What is your height when you are not wearing shoes?" In total, 29.9% ($n=106/353$) answered both of these questions. Overall, 64.6% (95% CI 60.6-70.5) of respondents 18 years and over did not report their height and 65.7% (95% CI 60.9-70.7) did not report their weight. Accordingly, we investigated the characteristics of those respondents who did not report either their height or their weight (the "non-reporters") ($n = 247/353$).

Results

Overall, data were collected for 399 Aboriginal adults aged 15 years and over. No interviews were undertaken with Torres Strait Islander people in South Australia. The final SAAHS dataset closely reflected the male/female ratio, age structure, and regional breakdown of the SA Aboriginal adult population (excluding the APY Lands) as reported in the 2006 Census [25].

An analysis of the demographics for reporters and non-reporters has been provided in Table 1. There were no significant differences found for sex or education between reporters and non-reporters

Table 1: Univariate analyses of demographic characteristics of the study population (n=353) – by Reporters and Non-reporters of height and weight

	Reporters		Non-reporters		OR (95% CI)	p value	Overall	
	n	% (95% CI)	n	% (95% CI)			n	% (95% CI)
Sex								
Male	48	45.6 (36.4 - 55.1)	119	48.0 (41.8 - 54.2)	1.00		167	47.3 (42.1 - 52.5)
Female	57	54.4 (44.9 - 63.6)	128	52.0 (45.8 - 58.2)	0.91 (0.58 - 1.43)	0.680	186	52.7 (47.5 - 57.9)
Age								
18 – 29 years	29	28.6 (20.7 - 38.1)	87	35.3 (29.6 - 41.5)	1.00		116	32.9(28.2 - 38.0)
30 – 44 years	23	21.9 (15.1 - 30.7) *	104	42.1 (36.1 - 48.3) *	1.48 (0.80 - 2.75)	0.211	127	36.1 (31.2 - 41.2)
45 and over	54	50.8 (41.4 - 60.2) *	56	22.6 (17.8 - 28.2) *	0.34 (0.19 - 0.6)	<0.001	109	31.0 (26.4 - 36.0)
Region								
Rural and Remote areas of SA	31	29.6 (21.7 - 38.9) *	144	58.1 (51.9 - 64.1) *	1.00		178	49.6 (44.4 - 54.8)
Metropolitan Adelaide	74	70.4 (61.1 - 78.3) *	103	41.9 (35.9 - 48.1) *	0.30 (0.19 - 0.49)	<0.001	175	50.4 (45.2 - 55.6)
Length of time in household								
Temporary (> 1 but < 6 months)	10	9.6 (5.3 – 16.7)	21	8.6 (5.7 – 12.8)	1.00		321	8.9 (6.4 - 12.3)
Permanent (> 6 months)	95	90.4 (83.3 – 94.7)	226	91.4 (87.2 – 94.3)	1.13 (0.51 - 2.47)	0.766	31	91.1 (87.7 - 93.6)
Total Annual Household income								
Up to \$20,000	43	40.3 (31.4 - 49.8) *	28	11.3 (7.9 - 15.8) *	1.00		70	20.0 (16.1 - 24.5)
\$20,001 to \$40,000	28	26.4 (18.9 - 35.5) *	5	2.1 (0.9 - 4.8) *	0.29 (0.10 - 0.82)	0.020	33	9.4 (6.8 - 12.9)
\$40,001 or more	19	18.3 (12.1 - 26.7) *	11	4.3 (2.4 - 7.7) *	0.85 (0.35 - 2.06)	0.714	30	8.5 (6.0 - 11.9)
Not stated	16	15.0 (9.5 - 23.1) *	203	82.2 (77.0 - 86.5) *	19.51 (9.7 - 39.27)	<0.001	219	62.1 (56.9 - 67.0)
Employment Status								
Employed (self , wages, salary, etc)*	41	38.8 (30.0 - 48.4) *	63	25.9 (20.8 - 31.8) *	1.00		103	29.8 (25.2 - 34.8)
Unemployed	20	18.9 (12.6 - 27.5) *	81	33.7 (28.1 - 39.9) *	2.67 (1.42 - 5.02)	0.002	102	29.3 (24.7 - 34.2)
Economically Inactive	44	42.3 (33.2 - 51.8)	97	40.4 (34.4 - 46.7)	1.43 (0.84 - 2.43)	0.185	102	29.2 (35.9 - 46.2)
Education								
Post school qualifications	31	31.7 (23.4 - 42.5)	79	35.2 (29.2 - 42.7)	1.00		212	34.1 (29.2 - 39.5)
No school to secondary	67	68.3 (58.5 - 76.7)	145	64.8 (58.3 - 70.8)	0.99 (0.61 - 1.61)	0.968	117	65.9 (60.5 - 70.8)
Visited a doctor in last 6 months								
No	10	9.0 (4.9 - 16.0) *	82	33.5 (27.9 – 39.6)	1.00		92	26.2 (21.8 - 31.0)
Yes	96	91.0 (84.0 - 95.1) *	163	66.5 (60.4 - 72.1) *	0.20 (0.1 - 0.4)	<0.001	259	73.8 (69.0 - 78.2)
Overall	106	100.0	247	100.0			353	100.0

Note: The weighting of data can result in rounding discrepancies or totals not adding

*Statistically significantly higher or lower (p<0.05) than the other categories combined.

Table 2: Univariate analyses of Demographics for Unhealthy Weight (BMI \geq 25 kg/m²)

	Unhealthy Weight (BMI \geq 25 kg/m ²)		OR (95% CI)	p value
	n	%		
Sex				
Male	39/79	49.4	1.00	
Female	40/79	50.6	0.54 (0.22 - 1.34)	0.181
Age				
18 – 29 years	40/79	50.6	1.00	
30 – 44 years	19/79	24.5	1.08 (0.33 - 3.48)	0.901
45 years and over	16/79	20.2	2.10 (0.75 - 5.90)	0.160
Region				
Metropolitan Adelaide	52/79	66.6	1.00	
Rural and Remote SA	26/79	33.4	0.45 (0.15 - 1.33)	0.148
Length of time in household				
Permanent (> 6 months)	74/79	94.2 *	1.00	
Temporary (> 1 but < 6 months)	5/79	5.8 *	0.23 (0.06 - 0.88)	0.031
Total Annual Household income				
Up to \$20,000	33/79	42.1	1.00	
\$20,001 to \$40,000	17/79	21.8	0.46 (0.16 - 1.30)	0.143
\$40,001 or more	18/79	22.3	2.90 (0.52 - 16.28)	0.226
Not stated	11/79	13.7	0.61 (0.17 - 2.18)	0.442
Employment Status				
Employed (self, wages, salary, etc)*	31/78	40.3	1.00	
Unemployed	15/78	18.8	0.84 (0.24 - 2.90)	0.782
Economically Inactive (inc Students)	32/78	40.9	0.76 (0.28 - 2.02)	0.581
Education				
No school to secondary	51/76	67.4	1.00	
Post school qualifications	25/76	32.6	1.60 (0.62 - 4.13)	0.326
Overall	79/106	74.5		

Note: The weighting of data can result in rounding discrepancies or totals not adding

* Statistically significantly higher or lower (p<0.05) than the other categories combined.

to the height and weight questions. However, those who reported both their height and weight were more likely to be aged 45 years and older, live in metropolitan Adelaide, have a household income less than \$40,000 per annum or be employed, when compared to the non-reporters to these questions.

Those reporting were also more likely to report being told by a doctor that they had diabetes, a current mental health condition, asthma, or high blood pressure. They were also found to be more likely to currently take medication, report fair or poor overall health, eat one or more serves of fruit per day, eat one or more serves of vegetables per day, have food security and have visited a doctor at least once in the last twelve months, when compared to non-reporters to the height and weight questions.

Overall, the proportion of underweight and normal weight in the Aboriginal population was 25.5% (95% CI 18.1-34.5), with 28.5% (95%CI 20.1 - 37.6) classified as overweight and 46.0% (95% CI 36.6 - 55.3) classified as obese. Thus, 74.5% (95% CI 65.1-81.6) were classified as having an unhealthy weight; that is being overweight or obese or a having a BMI over 25 kg/m².

Reporters who were found to have an unhealthy weight were more likely to have spent more than six months at their current dwelling (Table 2) and to have been diagnosed with diabetes or high blood pressure, and less likely to have been diagnosed with

current asthma or to have had experienced food insecurity in the last twelve months (Table 3).

Multivariable analysis of Aboriginal South Australian adults found that those who were classified as overweight or obese, were more likely to report currently taking medication and less likely to report having been told by a doctor they have current asthma ($\chi^2=35.085$, p<0.001), when compared to those with a healthy weight.

Further multivariable analysis presented in Table 4 found that respondents who did not report either their height or weight or both were more likely to be unemployed or undertake home duties, be retired, unable to work, and less likely to live in rural or remote SA, be aged 45 years and over, and report being told by a doctor that they had a mental health condition ($\chi^2=191.65$, p<0.001) when compared to those who knew their height and weight.

Table 3: Univariate analysis of Chronic Conditions and Risk Factors for Unhealthy Weight (BMI \geq 25 kg/m²)

Unhealthy Weight (BMI \geq 25 kg/m ²)				
	n	%	OR (95% CI)	p value
Overall Health Status				
Good, Very Good or Excellent	29	37.5	1.00	
Fair or Poor	49	62.5	1.19 (0.47 - 2.98)	0.715
Diabetes				
No	52	65.9 *	1.00	
Yes	27	34.1 *	7.13 (1.45 - 35.12)	0.016
Kidney				
No	71	90.7	1.00	
Yes	7	9.3	0.81 (0.20 - 3.37)	0.775
Mental health				
No	59	77.1	1.00	
Yes	17	22.9	0.52 (0.20 - 1.34)	0.175
Asthma				
No	67	85.5 *	1.00	
Yes	11	14.5 *	0.28 (0.10 - 0.77)	0.014
High Blood Pressure				
No	44	56.5 *	1.00	
Yes	34	43.5 *	3.48 (1.19 - 10.23)	0.023
Sufficient Physical Activity				
No	44	62.1	1.00	
Yes	27	37.9	1.13 (0.45 - 2.84)	0.800
Food Insecurity				
No	54	71.6 *	1.00	
Yes	21	28.4 *	0.33 (0.13 - 0.82)	0.017
Current Medication				
No	33	41.6	1.00	
Yes	46	58.4	1.74 (0.72 - 4.22)	0.216
Current Smoker				
No	34	43.6	1.00	
Yes	44	56.4	0.75 (0.31 - 1.86)	0.540
Fruit				
No	54	74.0	1.00	
Yes	19	26.0	0.98 (0.36 - 2.67)	0.968
Vegetables				
No	27	34.4	1.00	
Yes	51	65.6	0.99 (0.39 - 2.50)	0.986
Overall	79	74.5		

Table 4: Multivariate analysis of demographics, chronic conditions and other risk factors for non-reporters

Non responders to Height or Weight Questions (n=247)				
	n	%	OR (95% CI)	p value
Region				
Metropolitan Adelaide	144/247	58.1	1.00	
Rural and Remote SA	103/247	41.9	0.41 (0.18 - 0.95)	0.039
Employment Status				
Employed (self, wages, salary, etc)*	63/247	25.9	1.00	
Unemployed	81/247	33.7	8.06 (2.08 - 31.26)	0.003
Home duties/retired/unable	64/247	26.6	4.95 (1.51 - 16.23)	0.008
Students	33	13.8	1.42 (0.28 - 7.17)	0.671
Age				
18 – 29 years	87	35.3	1.00	
30 – 44 years	104	42.1	2.27 (0.84 - 6.16)	0.106
45 years and over	56	22.6	0.28 (0.06 - 0.82)	0.031
Mental health				
No	236/247	95.6	1.00	
Yes	11/247	4.4	0.22 (0.06 - 0.82)	0.023
\$20,001 to \$40,000	17/79	21.8	0.46 (0.16 - 1.30)	0.143
\$40,001 or more	18/79	22.3	2.90 (0.52 - 16.28)	0.226
Not stated	11/79	13.7	0.61 (0.17 - 2.18)	0.442
Employment Status				
Employed (self, wages, salary, etc)*	31/78	40.3	1.00	
Unemployed	15/78	18.8	0.84 (0.24 - 2.90)	0.782
Economically Inactive (inc Students)	32/78	40.9	0.76 (0.28 - 2.02)	0.581
Education				
No school to secondary	51/76	67.4	1.00	
Post school qualifications	25/76	32.6	1.60 (0.62 - 4.13)	0.326
Overall	79/106	74.5		

Note: The weighting of data can result in rounding discrepancies or totals not adding

Discussion

The SAAHS has provided an ideal opportunity to collect current data on a number of health risk factors and chronic conditions in the SA Aboriginal population, across metropolitan, rural and remote areas. Here, two main questions were examined; who did not answer the height and weight questions and who were able to be classified as having an unhealthy weight. The self-reported SAAHS 18 years and over results were much higher than the measured South Australian results from the 2012-13 AATSIHS 15 years and over age group [5]. This may have been due to the large number of non-reporters in the SAAHS population (70%) as compared with the non-reporters in the AATSIHS population. The AATSIHS survey as part of a larger national health survey was extremely well funded and had a far more significant reach than the SAAHS survey.

Who did not answer the questions about height and weight?

We have been able to identify the two thirds of the population that did not, or were not able to respond to some items in the survey, including height and weight. This may have been because they did not know either of these measurements [28], or did not wish to report them. Five times as many reporters to the height and weight questions had visited a doctor in the last twelve months compared to non-responders. This could also be the reason reporters told of far more diagnosed chronic health conditions than non-reporters. Access to health care is a known key determinant to the health outcomes of Aboriginal people; and it is known that Aboriginal Australians access primary health care much less than their non-Aboriginal counterparts [29].

It may not be socially desirable or culturally appropriate for some Aboriginal people to report their weight or height [30, 31], and this can also be influenced by the method of data collection, such as whether the survey is telephone based or face to face. Most of the people who could report their height and weight accessed the health system, thus they may have been able to associate the importance of lifestyle and healthy weight in the prevention of chronic conditions. However, some doctors, particularly in rural and remote areas, may also be under resourced to take measurements or counsel about obesity at consultation time [32] and remembering the measurements taken at appointments may not be a priority for some people. When there are other priorities in a chaotic life, such as feeding children, finding money to pay bills, or dealing with other social issues, healthy behaviours such as eating healthy food or getting enough exercise lose significance [33]. Healthy food may not be available or can be very expensive in rural areas [34]. Opportunities for physical activity may be limited. Knowing one's height and weight becomes of little importance.

In the SAAHS survey, when asked about the three most important health issues facing Aboriginal and Torres Strait Islander people today, 78.9% (95% CI 74.7-82.7) chose alcohol abuse, 46.6% (95% CI 41.8-51.5) chose education, and 29.8% (95% CI 25.5-34.5) said employment. Diabetes was ranked 6th on the list, chronic health problems was 9th, cancer 12th, cardiovascular disease 14th and poor diet and nutrition was ranked 19th [23]. The link between obesity and chronic disease is not mentioned. Although obesity is included in the top seven risk factors that require a continued focus in the *National Aboriginal and Torres Strait Islander health plan 2013-2023* [35].

In the SAAHS, respondents reporting their height and weight were older, employed, were more likely to state their income, were urban dwellers, and had been diagnosed with a mental health condition. When comparing responders and non-responders to the height and weight questions, there were no differences between the sexes or education groups. Aboriginal people living in urban areas were perhaps more exposed to health campaigns and information, health professionals and had greater accessibility to health services, such as wellness checks, and those with a mental health condition may also access health services more often [36-38]. Employed people may also know their height and weight as a result of medical examinations for their employment. These characteristics may also indicate higher health literacy, greater access to wellness checks where height and weight can be measured and recognition of the importance of knowing about height and weight, and the risks of an unhealthy weight. Analysis by some health literacy indicators, such as understanding information about medications, or filling out medical forms, found no difference between non-reporters and reporters, except that non-reporters were more likely to read instructions when they bought new medicines.

There were no health literacy indicators included in the final model, nor were there any differences found in access to health care, or prevalence of chronic conditions. However, this may be a product of access to health care and diagnosis more than the presence of these factors.

Every effort was made to minimise non-response bias, by acknowledging culturally appropriate practices such as using only Aboriginal interviewers [26], respecting local protocols and adhering to culturally appropriate research methods. However, reporting rates for the height and weight questions were low, although prevalence of unhealthy weight was not dissimilar to other population surveys with higher reporting rates [19, 21, 22].

Who were classified with an unhealthy weight?

We have also examined the population who were able to report their height and weight. Slightly less than three quarters of Aboriginal respondents were found to be overweight or obese.

This compares to the 67.1% of the overall SA population reporting unhealthy weight, with 16.3% not reporting their height and weight [39].

Respondents with an unhealthy weight were more likely to reside permanently at their current dwelling or have been diagnosed with diabetes or high blood pressure and less likely to have been diagnosed with current asthma, or have experienced food insecurity in the last twelve months. Predictably, respondents in this category were also more likely to be currently taking medication, perhaps for these chronic conditions.

Multivariate analysis confirmed that respondents classified as overweight or obese were significantly more likely to report currently taking medication and less likely to report having been told by a doctor they have current asthma. Perhaps because of greater access to food and permanent living arrangements, other determinants of health may influence the presence of chronic conditions such as asthma.

It is suggested that in order to collect more specific data on height and weight in the Aboriginal population, biomedical studies, using anthropometric measures are necessary, particularly for SA. Soon to be released data from the *Australian health survey* may provide this information, but typically sample sizes from SA may be low [39].

Also of concern, was that even when responding to the question, self-reported information such as height and weight may be changed to seek the interviewers approval, such that the respondent may be ashamed to tell the truth [40, 41]. Respondents may have provided the information they thought was expected which may have affected the reliability of the results. There is a concern that height and weight may become increasingly socially desirable responses as health promotion campaigns influence community perceptions and beliefs [42].

Our study has been a unique approach to data collection in Aboriginal populations, based upon methodologies used elsewhere [43, 44]. Keeping true to evidence based methodological principles provided a major strength of the project; however this was challenging both financially and logistically. However, the final dataset closely reflected the male/female ratio, age structure, and regional breakdown of the SA Aboriginal adult population (excluding the APY Lands) as reported in the 2006 Census [24, 25].

Conclusions

This study confirms the findings of the AATSIHS that unhealthy weight in the SA Aboriginal population far exceeds levels experienced by the state's general population. Additionally, Aboriginal people in SA report not knowing their height and

weight. The reasons for this are unclear; however, it may reflect low health literacy, or issues of accessibility, or mode of collection problems. Self-reported height and weight measures may be inefficient in this population, and anthropometric methods of waist circumference measurements may be more viable. Identification of the characteristics of Aboriginal populations are very important because it may help in defining strategies to prevent non-response, such as refusal to participate or non-reporting on particular questions in similar surveys. It may be necessary to design different strategies to increase participation for each of these groups, as there may be different reasons, such that people may simply not want to participate in that question or may just not know the answer.

A large proportion of the Aboriginal population do not know their height or weight. Although self-reported height and weight are an important part of the population monitoring and surveillance of overweight and obesity, there are many limitations. Those who do know their height and weight are more likely to be older and in the health care system – thus surveys based on self-reported measures of height and weight will only provide limited and potentially bias information on the association of overweight and obesity and health. Other more accessible methods such as waist circumference may be more reliable in population studies.

The AATSIHS survey demonstrates that it is possible to collect measured data on a nationally representative sample of the Aboriginal population, however this is a very costly exercise, and these types of surveys are only carried out periodically, prior to AATSIHS the previous survey was carried out in. Smaller, state based and less resource intensive surveys are needed in-between larger national level surveys and, due to funding, these may use self-reported data.

Greater access to, and culturally appropriate primary health care, where complete health checks and anthropometric measurements can be taken, may lead to an increased number of Aboriginal people being able to link the relationship between unhealthy weight and chronic diseases.

An opportunity exists to examine if knowledge of height and weight as an indicator of obesity is a health priority for Aboriginal people. Additionally considering strategies to find out why Aboriginal people do not know or decline to answer questions about height and weight in surveys is necessary if we are to continue to use this measurement in population surveys.

Authors' contributions

Avery, J. was involved in the drafting of the manuscript, the acquisition, analysis and interpretation of data. Dal Grande, E. and Taylor, A. were involved in the conception and design of the study and revising the paper critically for important intellectual content.

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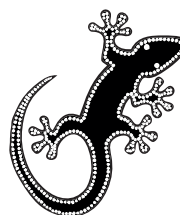
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