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Overweight and Obesity, Indigenous Australians

1994

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Indigenous Australians

1994

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This Occasional Paper is intended to make the results of current research available to other interested parties. The aim is to encourage discussion and comment.

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LIST OF ABBREVIATIONS AND OTHER USAGES

ABS	Australian Bureau of Statistics
ATSIC	Aboriginal and Torres Strait Islander Commission
BMI	body mass index
CDEP	Community Development Empoyment Projects
CI	confidence interval
NATSIS	National Aboriginal and Torres Strait Islander Survey
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
NNS	National Nutrition Survey
p	probability
r	correlation coefficient
SE	standard error
WHO	World Health Organization
. .	not applicable
*	$p < 0.05$
**	$p < 0.01$
***	$p < 0.001$

SUMMARY

This report presents information on the distributions of height, weight and body mass index (BMI) in a large, nationally representative sample of Indigenous Australians aged 5 years and over. Where possible, the results have been compared with reference data from other populations, including data from surveys representative of all Australians. The report also provides the results of analysis of a variety of factors which may be associated with BMI. (For more information about BMI, see page 5.)

Data were collected as part of the first National Aboriginal and Torres Strait Islander Survey, conducted by the Australian Bureau of Statistics in 1994. The analysis was undertaken jointly by researchers at the Australian Bureau of Statistics' National Centre for Aboriginal and Torres Strait Islander Statistics and the Menzies School of Health Research in Darwin.

The results highlight the considerable heterogeneity of the Indigenous population. Indigenous children aged 5–9 years were, on average, short for their age and heavy for their height, based on international reference values. However, there were differences by place of residence, with rural children being the shortest for their age on average, and children in capital cities being the heaviest on average for their height. There was greater than expected variability for all geographic locations, especially in weight for height.

Among children aged 7–15 years, both underweight and overweight were more common than expected, based on Australian reference data. The proportion of children in these weight categories varied according to whether they lived in capital cities, other urban areas or rural areas. Underweight was more common in rural areas and overweight was more common in urban areas. However, even in rural areas the proportion overweight was greater than expected. Similarly, the proportion of children in capital cities who were underweight was more than expected.

Among adults, Indigenous males were on average about 3–4 cm shorter and Indigenous females were about 2–3 cm shorter than their all-Australian counterparts up to age 65 years. There was little difference in mean height among those aged 65 or more. Mean weight was generally lower among Indigenous males than all-Australian males, but the reverse was true for Indigenous females. Based on BMI, about 25% of Indigenous males and 28% of Indigenous females aged 18 or more could be classified as obese. This compares unfavourably with 19% of all-Australian males and females aged 18 or more.

Torres Strait Islander adults were, on average, taller and considerably heavier than Aboriginal adults and had a higher mean BMI. Among Torres Strait Islanders, about 43% of adult males and 50% of adult females could be classified as obese, compared with 24% of Aboriginal adult males and 27% of Aboriginal adult females. The appropriateness for these two Indigenous groups of the BMI cutpoints used for classification remains a point of debate, however.

A number of factors were associated with mean BMI among children and adults. Among children, mean BMI increased with age and was generally higher among children who spoke English as their main language and lower among those who lived in a household

where it was reported that someone had gone without food in the past month and/or where there were more than two people per bedroom. Among adults, mean BMI increased with age up to a certain point and then decreased. Mean BMI was higher among adults who reported they had diabetes, identified as Torres Strait Islander, said they had not drink alcohol recently or said they did not drink at all, and was lower among smokers and those living in households with more than four people per bedroom.

Not everyone included in the survey was measured. Measurements of height and weight were available for 62% of children aged 5–17 years and 73% of adults aged 18 years or more. In contrast to most studies, some information was available about the characteristics of those not measured, such as age, sex and questionnaire responses. This information was used to assess whether a bias in the reported results due to non-measurement was likely to have occurred. Although a number of factors were significantly associated with whether someone was measured, it appears they may have worked in opposite directions. Taking all these factors into account, the analysis suggested that any such bias is likely to have been quite small.

The heterogeneity in the distributions of height, weight and BMI among Indigenous people means that it would be inappropriate to assume that the national results apply to every location and every age group. Wherever possible, local information should be used to inform decision-making.

CHAPTER 1 INTRODUCTION

Relative body weight is important both as an indicator of past health and as a predictor of future health. However, the relationship between body weight and health is a complex one. For example, both excess weight and underweight are associated with increased mortality in adults and/or children (WHO 1995a; Larsson 1992; Pelletier, Frongillo & Habicht 1993).

Excess weight increases the risk of cardiovascular disease, cerebrovascular disease and diabetes (Larsson 1992), and these are important causes of morbidity and mortality in Indigenous adults (Anderson, Bhatia & Cunningham 1996; Australian Bureau of Statistics & Australian Institute of Health and Welfare 1997). While the focus of attention in adults is generally on overweight and its associated problems, underweight in pregnant women is associated with an increased risk of having low birthweight babies (Kramer 1987). Babies of Indigenous mothers are lighter on average than babies of non-Indigenous mothers (Plunkett, Lancaster & Huang 1996) and a high prevalence of underweight in pregnant Aboriginal women has been reported in some locations (Rae unpub.). In addition, a number of studies over the last several decades have described a high prevalence of underweight in Aboriginal children living in remote locations (see, for example, Kirke 1969; Rousham & Gracey 1997; Dugdale, Muller & Alsop-Shields 1994; Ruben & Walker 1995).

The prevalence of excess weight is increasing in Australia as a whole (National Health and Medical Research Council Working Party on the Prevention of Overweight and Obesity 1997), but little is known about the distribution of body weight in the Indigenous population on a national level. The 1994 National Aboriginal and Torres Strait Islander Survey (NATSIS) was the first survey to provide measurements of height and weight from a nationally representative sample of Indigenous Australians, and the results are presented here.

The main purposes of the current report are to describe the distributions of weight, height and body mass index (BMI) among Indigenous children and adults in the NATSIS and to compare these to what has been observed in other populations. This report also provides the results of an analysis of demographic, socioeconomic, health, cultural and other factors which may be associated with BMI, and an assessment of the sources and likely magnitude of any potential bias due to non-measurement.

CHAPTER 2 METHODS

THE NATIONAL ABORIGINAL AND TORRES STRAIT ISLANDER SURVEY

The National Aboriginal and Torres Strait Islander Survey (NATSIS) was conducted by the Australian Bureau of Statistics in 1994 as part of the Commonwealth Government's response to recommendations of the Royal Commission into Aboriginal Deaths in Custody. The Royal Commission recognised the need for reliable national-level statistics about Australia's Indigenous peoples.

The survey included about 15,700 Indigenous Australians living in a variety of circumstances across Australia who were selected using a multistage stratified sampling design. The response rate for the survey was high, with approximately 90% of those eligible participating. Data were collected by Indigenous interviewers who were recruited and trained especially for the survey. A range of questions was asked in the broad areas of: family and culture; health; education and training; employment and income; housing; and law and justice. People aged 13 years and over were interviewed personally. For children under 13 years old, a responsible adult (usually the child's parent) answered the questions on behalf of the child. An additional sample of adult prisoners was included in the survey, primarily to investigate law and justice issues. They only received a subset of questions, however, and they are not included in this analysis. More information on the survey methods has been published elsewhere (Australian Bureau of Statistics 1995, 1996).

MEASUREMENT OF HEIGHT AND WEIGHT

Height and weight measurements were taken by the interviewers for all survey participants aged five years or more who were available and who consented to be measured. Height was recorded to the nearest centimetre using a portable stadiometer (Model 1A25, CMS Weighing Equipment, London, UK). Weight was recorded using battery-operated digital scales (Soehnle, Germany). The value indicated on the scales' display was rounded to the nearest 0.5 kg for values up to 100 kg, and to the nearest whole kilogram for values over 100 kg. Interviewers were instructed to further round the displayed value down to the nearest whole kilogram (i.e. to ignore decimal places).

Interviewers were instructed to measure height and weight while the participant was not wearing shoes, was standing straight and looking straight ahead. If possible, a flat, hard surface was to be used. Measurements were generally taken in the participant's home, and the conditions under which such measurements were taken varied considerably from place to place. Comments from interviewers suggested that some heights and weights were guessed, not measured.

No recorded information about the quality of the measurements is available. Although measurement error is likely, there is no reason to expect a systematic bias in any particular direction, with the exception of a slight bias downward in weight due to the rounding used. It should be noted that pregnant women have not been excluded from the analysis, as they were not identified as such in the final dataset.

MEASUREMENT OF HEIGHT AND WEIGHT *continued*

Measurements of height and weight were available for 3,221 children aged 5–17 years and 5,732 adult non-prisoners aged 18 years or more. Among children and young adults aged 5–17 years, 1,974 (38%) were not measured, either because they were not available or because they or their parents refused. Children under the age of 13 years were not required to be present in order to participate in the survey, as responses were provided by a responsible adult. Because height and weight measurements were only a small component of the survey, interviewers were instructed not to spend much time calling back to homes just to record height and weight measurements for children who were not available at the time of the initial interview.

Among adults aged 18 years or more, measurements were not available for about 30% of females and 24% of males. In contrast to most studies, however, many characteristics are known about people who were not measured, and this information has been examined in some detail in chapters 3 and 4 and in the Technical Notes.

Body mass index (BMI), defined as weight in kilograms divided by the square of height in metres (kg/m^2), was calculated for all participants for whom height and weight measurements were available.

ASSESSING AND COMPARING ANTHROPOMETRIC MEASUREMENTS

Adults

BMI is commonly used to describe fatness in adults because, except in the very tall or short, it is largely independent of height (WHO 1995a). Increasing levels of BMI at the population level generally indicate increasing levels of fatness, although it is well recognised that, in individuals, high BMI may reflect high muscularity. Although the association between BMI and mortality is continuous (WHO 1995a), cutpoints are often used as a means of describing prevalence in populations and guiding advice to individuals.

The World Health Organization (WHO) and the National Health and Medical Research Council (NHMRC) are among the organisations which have published guidelines, based on BMI, for classifying adults aged 18 years or more as 'underweight', 'acceptable weight', 'overweight' or 'obese'. For example, the WHO categories were modified for use in the National Nutrition Survey as follows (Australian Bureau of Statistics & Department of Health and Family Services 1997):

- underweight—BMI less than 18.5 kg/m^2;
- acceptable weight—BMI greater than or equal to 18.5 but less than 25 kg/m^2;
- overweight—BMI greater than or equal to 25 but less than 30 kg/m^2;
- obese—BMI greater than or equal to 30 kg/m^2.

The 'obese' category represents a combination of the WHO 'grade 2 overweight' and 'grade 3 overweight' categories.

The NHMRC criteria for overweight and obesity are similar, but overweight is defined as *greater than* 25 and *less than or equal to* 30 (National Health and Medical Research Council 1984, 1985). No adult measured in the NATSIS had an unrounded BMI of exactly 30, and only three males had an unrounded BMI of exactly 25, so the differences between the WHO guidelines (as modified above) and NHMRC guidelines with respect to the overweight and obese categories are inconsequential.

Adults *continued*

Until recently, the lower limit of the acceptable range was 20.0. The shift to a cutpoint of 18.5 was based on findings that the previously described higher mortality associated with lower BMI in developed countries was due to failure to control for smoking and to early deaths during follow-up (that is, deaths of people who were underweight as a consequence of pre-existing disease) in a number of studies (WHO 1995a).

Children and adolescents

In contrast to the situation for adults, there is no single index with available reference data for children and adolescents. Adolescents have a different weight distribution from adults, even when their heights are the same (Himes & Dietz 1994), so the BMI cutpoints defined for adults are not appropriate for adolescents or children. Instead there exists a wide variety of possible indices based on height and weight, some of which have been shown to be correlated with relevant measures such as percentage of body fat, current blood pressure and blood lipids in adolescents (Himes & Dietz 1994).

Because age- and sex-specific references are needed, size descriptors for children and adolescents are based on the distribution of a reference population. Comparisons are commonly made using the mean, the 5th, 85th and 95th centiles, and 2 standard deviations. There is an expected value for each comparison. For example, 15% of a group are expected to be above the age- and sex-specific 85th centile for BMI. Therefore, if a particular population had 15% of children above the 85th centile for BMI for their age and sex, that population would not be regarded as having an excess prevalence of overweight, assuming the distribution is normal.

Up to about age 10 years, size in children is usually assessed in terms of height-for-age, weight-for-age and weight-for-height using the sex-, age- and height-specific international reference growth curves of the US National Center for Health Statistics/Centers for Disease Control (Dibley et al. 1987a). The location of a child on the curve can be expressed as either a Z–score or a centile. A Z–score can be calculated for each child by subtracting the mean value for the reference population (for the appropriate sex and age or height) from the observed value for that child, and then dividing by the standard deviation for the reference population. Thus the Z–score reflects deviation from the mean of the reference population expressed in standard deviation units. A mean Z–score for the group of interest can then be calculated. Z–scores rather than centiles are used in analyses because the centiles are not normally distributed.

While there are certain problems with the reference curves (Cole 1985; WHO 1995b), and they do not necessarily represent the ideal, they are based on a large sample of well-nourished children and seem to be a good general description of the growth of well-nourished pre-adolescent children for most races, except perhaps Asians (Habicht et al. 1974; Haas & Habicht 1990; Graciter & Gentry 1981; *A measure of agreement on growth standards (editorial)* 1984; Dibley et al. 1987a, 1987b). They have not been compared to the growth of a large group of well-nourished Aboriginal or Torres Strait Islander children, but various authors have reported that the growth profile of Aboriginal children in some locations was the same as that of non-Aboriginal children (Cockington 1980; Cheek et al. 1989; Dugdale, Muller & Alsop-Shields 1994). Hence there is no reason to think that the growth of well-nourished Aboriginal pre-adolescent children would differ substantially from that of most other races.

Children and adolescents *continued*

The international reference curves describe height-for-age and weight-for-age for all ages up to 18 years, but weight-for-height is only described up to 137 cm, or about 10 years in girls and 11.5 years in boys. As weight and height are highly correlated, an assessment of the appropriateness of an adolescent's weight can not be made simply by comparing whether an individual falls on the same weight-for-age and height-for-age centiles (Himes & Dietz 1994). This has lead various groups to conclude that BMI is the easiest index to use for adolescents, providing age- and sex-specific reference values are used.

In the United States, an Expert Committee has specified values for the 85th and 95th centiles of BMI for boys and girls aged 10–24 years using smoothed data from the first National Health and Nutrition Examination Survey conducted in the 1970s (Himes & Dietz 1994). Adolescents with a BMI at or above the 95th centile (or greater than or equal to 30, whichever is less) are categorised as overweight. Adolescents with a BMI between the 85th and 95th centiles are described as being 'at risk' of overweight and in need of further investigation (that is, this level of BMI is not in itself diagnostic of overweight) (Himes & Dietz 1994).

Researchers in Australia have questioned the appropriateness of using centiles based on American children (Lazarus et al. 1995), and two groups have analysed data from a 1985 survey conducted by the Australian Council on Health, Physical Education and Recreation on a nationally representative sample of Australian schoolchildren aged 7–15 years. Harvey and Althaus (1993) reported a range of unsmoothed centile values for BMI by age and sex, and Lazarus and colleagues (1995) calculated and reported smoothed age- and sex-specific values for the 85th and 95th centiles. Both groups commented that Australian children in 1985 had lower BMIs than their American counterparts a decade earlier.

ANALYSIS

In the analysis of NATSIS data, the distributions of height, weight and BMI were examined by single year of age for children and by age group for adults.

As there is no single index with reference data for the age range 5–17 years, the anthropometric data for children were compared to a variety of references. Mean Z–scores for height-for-age, weight-for-age and weight-for-height using an international growth reference (Dibley et al. 1987a) were calculated for children aged 5–9 years. BMI for children and young adults aged 10–24 years was compared to the smoothed 85th and 95th centiles based on American data (Himes & Dietz 1994), and BMI for those aged 7–15 years was compared to smoothed 85th and 95th centiles based on Australian data (Lazarus et al. 1995). The prevalence of underweight in children aged 7–15 years was estimated using the unsmoothed 5th and 15th centiles based on Australian data, as reported by Harvey and Althaus (1993).

Among adults, height, weight and BMI were compared to results from the 1995 National Nutrition Survey, and BMI was categorised according to the modified WHO criteria described above and used in the Nutrition Survey (Australian Bureau of Statistics & Department of Health and Family Services 1997).

ANALYSIS *continued*

Among adults and children, linear regression was used to model the level of BMI in relation to several characteristics of interest. Factors associated with non-measurement were assessed using logistic regression. Logistic regression was also used among adults to model the probability of being classified as obese (that is, BMI of 30 or more).

An assessment of the likely impact of bias due to non-measurement was performed by imputing values for BMI for people who were not measured and comparing the mean BMIs before and after the imputation procedure. It was assumed in this analysis that people with similar characteristics had similar heights and weights, regardless of whether they were measured. More information about linear regression, logistic regression and imputation is provided in the Technical Notes.

Unless otherwise specified, all estimates have been weighted to reflect the sampling design, and estimates are for all Indigenous Australians of the relevant age groups. They have not been age-adjusted to the general Australian population.

AVAILABILITY OF HEIGHT AND WEIGHT MEASUREMENTS

Overall, 3,476 males and 3,489 females aged 5–24 years were included in the National Aboriginal and Torres Strait Islander Survey (NATSIS) (table 3.1). Measurements of height and weight were available for 2,271 males (65%) and 2,279 females (65%). For about 22% of males and 20% of females aged 5–24 years, the participant was not available to be measured or the measurement was not recorded. Another 13% of males and 15% of females in this age group declined to be measured.

The proportion of children and young adults for whom height and weight measurements were available varied by age and sex. As noted earlier, participants under the age of 13 years did not need to be present to be included in the survey. Measurements were available for 56% of children aged 5–12 and 75% of those aged 13–24 years. As shown in table 3.1, being unavailable for measurement was much more common among children aged 5–12 years, while refusals were more common among those aged 13 years or more. More information about other characteristics associated with non-measurement is presented later in this chapter.

3.1 AVAILABILITY OF HEIGHT AND WEIGHT MEASUREMENTS IN THE NATSIS(a)

	MALES					FEMALES				
	Participants	*Height and weight measured*		*Not available (b)*	*Refused*	*Participants*	*Height and weight measured*		*Not available (b)*	*Refused*
Age (years)	no.	no.	%	%	%	no.	no.	%	%	%
5	265	137	52	38	10	217	141	65	29	6
6	242	121	50	39	11	222	118	53	40	7
7	219	127	58	35	7	211	120	57	36	7
8	230	126	55	37	8	224	112	50	42	8
9	231	122	53	41	6	217	125	58	34	8
10	225	126	56	37	7	223	121	54	36	9
11	207	113	55	40	5	197	126	64	30	6
12	249	151	61	32	7	189	106	56	34	10
13	170	128	75	6	19	163	126	77	2	21
14	179	136	76	6	18	177	123	69	6	25
15	189	142	75	5	20	170	122	72	9	19
16	158	116	73	4	22	157	116	74	2	24
17	142	118	83	5	12	122	102	84	1	16
18	122	95	78	2	20	135	99	73	6	21
19	95	74	78	1	21	127	96	76	4	20
20–24	553	439	79	3	18	738	526	71	5	24
Total	**3 476**	**2 271**	**65**	**22**	**13**	**3 489**	**2 279**	**65**	**20**	**15**

(a) Proportions are not weighted for the sampling design.

(b) Or not recorded.

DISTRIBUTIONS OF HEIGHT, WEIGHT AND BODY MASS INDEX

The means and standard deviations for height, weight and body mass index (BMI) by age and sex among those measured are presented in table 3.2.

Mean height increased with age until about age 16 years among females and about age 18 years among males. As would be expected, mean weight and mean BMI generally continued to increase throughout the ages examined.

3.2 HEIGHT, WEIGHT AND BODY MASS INDEX

	HEIGHT.....		WEIGHT.....		BMI.....	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
Age (years)	cm	cm	kg	kg	kg/m^2	kg/m^2
			MALES			
5	111.4	7.8	19.3	4.2	15.5	3.1
6	115.7	8.1	23.2	6.0	17.4	4.5
7	122.3	7.8	25.2	6.9	16.9	4.4
8	126.7	9.2	27.2	6.4	17.1	4.8
9	132.1	8.1	30.2	7.3	17.3	3.7
10	138.4	9.0	35.9	10.4	18.6	4.9
11	141.3	10.6	36.1	9.1	18.2	5.5
12	151.4	11.6	44.0	12.1	19.0	4.2
13	157.5	9.3	50.6	11.1	20.5	3.7
14	164.1	9.8	55.9	12.3	20.8	3.6
15	168.8	8.6	61.4	13.2	21.7	4.7
16	169.3	9.6	63.9	14.1	22.3	4.4
17	172.3	9.6	66.1	12.9	22.3	3.9
18	173.7	9.0	70.6	16.0	23.3	4.5
19	173.0	8.2	70.9	14.3	23.9	4.4
20–24	173.7	8.2	77.2	18.0	25.6	5.6
			FEMALES(a)			
5	109.8	8.9	19.8	6.4	16.4	4.7
6	115.3	7.5	20.5	4.2	15.4	2.7
7	120.6	7.8	23.7	4.7	16.4	3.2
8	126.4	7.9	27.0	7.6	16.7	4.0
9	133.9	7.4	33.4	8.6	18.6	4.7
10	139.2	9.3	35.8	8.8	18.4	3.7
11	146.5	11.5	41.1	12.1	19.1	4.5
12	149.8	9.0	45.2	10.4	20.1	4.0
13	156.4	7.0	51.6	15.7	21.0	5.5
14	158.3	7.4	55.7	16.6	22.1	6.1
15	161.5	7.7	57.1	11.2	22.0	4.2
16	163.3	9.9	56.3	10.5	21.3	4.8
17	161.0	7.0	59.2	14.3	22.9	6.0
18	159.6	7.6	61.5	19.2	24.3	7.3
19	157.1	14.6	62.1	13.4	26.0	7.6
20–24	161.2	7.7	66.2	17.4	25.5	6.2

(a) Pregnant females have not been excluded.

HEIGHT-FOR-AGE, WEIGHT-FOR-AGE AND WEIGHT-FOR-HEIGHT

Among children aged 5–9 years, height, weight and age were compared to international reference curves developed by the US National Center for Health Statistics and Centers for Disease Control (Dibley et al. 1987a). Z–scores for the indices height-for-age, weight-for-age and weight-for-height were calculated for each child by subtracting the mean value for the reference population (for the appropriate sex and age or height) from the observed value for that child and dividing by the standard deviation for the reference population. Only children up to nine years were included because reference values were not available for weight–for–height for most older children. Although reference values exist for children under five years, no height and weight measurements were available from the NATSIS for these children.

Mean Z–scores and standard deviations for height-for-age, weight-for-age and weight-for-height for children aged 5–9 years are presented in table 3.3. As indicated by the standard deviations, which are larger than 1.0, there was greater than expected variability, especially for weight-for-height, which may be a reflection of the heterogeneity of the Indigenous population.

3.3 Z–SCORES FOR CHILDREN AGED 5–9 YEARS(a)

	HEIGHT-FOR-AGE(b)		WEIGHT-FOR-AGE(b)		WEIGHT-FOR-HEIGHT(c)	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
MALES						
Overall	**–0.47**	**1.6**	**–0.03**	**1.7**	**0.54**	**2.7**
Age (years)						
5	–0.31	1.6	–0.27	1.7	–0.12	2.1
6	–0.64	1.6	0.35	1.9	1.17	2.9
7	–0.41	1.5	0.10	1.9	0.60	2.8
8	–0.54	1.7	–0.14	1.5	0.60	3.1
9	–0.46	1.4	–0.13	1.3	0.57	2.1
Place of residence						
Capital city	–0.29	1.3	0.35	1.6	0.98	2.8
Other urban	–0.54	1.7	–0.11	1.7	0.48	2.6
Rural	–0.53	1.6	–0.30	1.7	0.16	2.6
FEMALES						
Overall	**–0.38**	**1.5**	**0.00**	**1.6**	**0.42**	**2.3**
Age (years)						
5	–0.38	1.9	0.20	2.3	0.54	2.8
6	–0.43	1.4	–0.25	1.4	–0.03	1.7
7	–0.52	1.3	–0.08	1.2	0.51	1.9
8	–0.45	1.3	–0.18	1.4	0.29	2.2
9	–0.17	1.1	0.23	1.3	0.98	2.6
Place of residence						
Capital city	–0.19	1.5	0.42	1.9	0.93	2.4
Other urban	–0.41	1.4	–0.13	1.4	0.29	2.4
Rural	–0.53	1.6	–0.20	1.6	0.20	2.1

(a) Based on international reference curves (Dibley et al. 1987a).

(b) Only whole year of age was available in the NATSIS, so reference values for half-year of age were used. For example the value for 5 years and 6 months was used for all children aged 5 years.

(c) For children 77–137 cm only.

HEIGHT-FOR-AGE, WEIGHT-FOR-AGE AND WEIGHT-FOR-HEIGHT *continued*

The mean Z–score for height-for-age was consistently below 0, regardless of age, sex, or place of residence. This indicates that Indigenous children aged 5–9 years were, on average, shorter for their age than the international reference. About 20% of boys and 16% of girls fell below the 5th centile of the reference on height-for-age. Some heterogeneity by place of residence was apparent, with lower mean height-for-age among children living outside capital cities.

Mean weight-for-age Z–score was 0 for girls and close to 0 for boys, which indicates that Indigenous children on average were close to the reference mean. As with height-for-age, however, differences were apparent by place of residence. Boys and girls living in capital cities were heavier on average for their age while those in rural areas (and, to a lesser extent, those in urban areas other than capital cities) were lighter for their age than the reference population. Children in rural areas were more likely to fall below the 5th centile of weight-for-age (19% of boys and 15% of girls) than children from capital cities (7% of boys and 6% of girls).

Mean Z–scores for weight-for-height were greater than 0 among Indigenous children regardless of place of residence, but capital city residents were on average heavier for their height than residents of other urban areas, who were in turn heavier for their height than children living in rural areas. The standard deviations were quite large, which reflects a high degree of heterogeneity in weight-for-height, even after stratifying by place of residence. Capital city residents were more likely to be above the 95th centile of the international reference than their rural counterparts (22% of boys and 23% of girls versus 14% of boys and 16% of girls, respectively). Despite weight-for-height being higher than the international reference on average, about 14% of boys and 11% of girls still fell below the 5th centile for weight-for-height, although this was more common among rural children (15% of boys and 14% of girls) than children living in capital cities (8% of boys and 7% of girls).

COMPARISON OF BODY MASS INDEX WITH PUBLISHED CUTPOINTS

Although reference values for weight-for-height were not available for most children older than nine years, reference values do exist for BMI, an index which represents weight adjusted for height and so is conceptually similar to weight-for-height. Indeed, a very high correlation ($r = 0.98$) was observed between BMI and weight-for-height Z–score among children for whom both measures could be calculated.

In contrast to adults, BMI in children is strongly correlated with height (Killeen, Vanderbrug & Harlan 1978), and age- and sex-specific cutpoints are needed to interpret BMI in children. So, for example, the increase in BMI with age shown in table 3.2 should not be interpreted to mean that children are becoming fatter from the age of five years.

The distributions of BMI for children and young adults in the NATSIS have been compared to the cutpoint values based on American and Australian data in tables 3.4 and 3.5, respectively. Both tables show the proportion of Indigenous children and young adults who would be classified as overweight or at risk of overweight, based on the relevant set of reference values. Table 3.5 also shows the proportion of Indigenous children who could be classified as underweight.

3.4 OVERWEIGHT BASED ON AMERICAN BMI CUTPOINTS(a)

	CENTILE CUTPOINT.....		CATEGORY.....	
	85th	*95th(b)*	*At risk of overweight(c)*	*Overweight(d)*
Age (years)	kg/m^2	kg/m^2	%	%
		MALES		
10	20	23	12	19
11	20	24	14	9
12	21	25	18	10
13	22	26	19	7
14	23	27	9	9
15	24	28	15	7
16	24	29	13	9
17	25	29	8	6
18	26	30	23	7
19	26	30	26	7
20–24	27	30	11	22
Total	**..**	**..**	**14**	**13**
Expected	**..**	**..**	**10**	**5**
		FEMALES(e)		
10	20	23	15	8
11	21	25	14	16
12	22	26	14	9
13	23	27	19	10
14	24	28	21	10
15	24	29	11	10
16	25	29	9	6
17	25	30	16	5
18	26	30	16	12
19	26	30	15	27
20–24	26	30	16	23
Total	**..**	**..**	**15**	**15**
Expected	**..**	**..**	**10**	**5**

(a) From Himes and Dietz (1994).

(b) 95th centile or 30 kg/m^2, whichever is less.

(c) Greater than or equal to 85th centile but less than 95th centile.

(d) Greater than or equal to 95th centile.

(e) Pregnant females have not been excluded.

About 13% of Indigenous males and 15% of Indigenous females aged 10–24 years would be classified as overweight according to cutpoints based on American children and young adults (Himes & Dietz 1994). Another 14% of males and 15% of females would be classified as at risk of overweight. Thus over one in four Indigenous males and almost one in three Indigenous females aged 10–24 would be referred for further investigation if they were included in a screening program that used American cutpoints.

COMPARISON OF BODY MASS INDEX WITH PUBLISHED CUTPOINTS *continued*

Using Australian cutpoints, about 28% of Indigenous boys and girls aged 7–15 years would be identified as overweight or at risk of overweight, with a substantial proportion of these in the overweight category (table 3.5). At the other end of the distribution, a higher than expected proportion of children in this age group fell below the 5th centile for their age and sex (table 3.5). Nearly one in four boys and more than one in five girls in this age group could be considered underweight or at risk for underweight according to Australian reference values (Harvey & Althaus 1993). The proportions at or above the 85th centile and at or below the 15th centile varied according to place of residence (table 3.6).

3.5 UNDERWEIGHT AND OVERWEIGHT BASED ON AUSTRALIAN BODY MASS INDEX CUTPOINTS

	CENTILE CUTPOINT				CATEGORY			
	5th(a)	*15th(a)*	*85th(b)*	*95th(b)*	*Underweight (c)*	*At risk of underweight (d)*	*At risk of overweight (e)*	*Overweight(f)*
Age (years)	kg/m^2	kg/m^2	kg/m^2	kg/m^2	%	%	%	%
				MALES				
7	14.1	14.7	17.8	19.7	18	16	9	15
8	14.3	14.9	18.3	20.6	16	13	11	11
9	14.3	15.1	18.9	21.5	18	7	15	10
10	14.7	15.3	19.6	22.2	23	3	15	19
11	15.1	15.8	20.3	23.1	25	9	14	9
12	15.2	16.1	21.0	23.9	21	5	14	14
13	15.8	16.8	21.6	24.7	6	7	20	13
14	16.2	17.5	22.2	25.7	5	8	11	13
15	17.0	18.0	22.8	26.6	9	12	23	11
Total	. .	. .	. .	. .	**15**	**9**	**15**	**13**
Expected	. .	. .	. .	. .	**5**	**10**	**10**	**5**
				FEMALES(g)				
7	13.8	14.5	17.9	19.6	16	12	10	15
8	14.0	14.8	18.5	20.3	21	11	4	16
9	14.2	15.0	19.1	20.9	13	11	12	29
10	14.4	15.2	19.9	21.9	5	11	14	9
11	14.6	15.6	20.6	23.2	12	11	9	21
12	15.4	16.3	21.5	23.9	6	7	6	18
13	16.3	17.1	22.3	24.5	7	11	10	21
14	16.6	17.8	23.1	25.0	14	10	12	24
15	17.4	18.4	23.9	25.4	8	10	4	18
Total	. .	. .	. .	. .	**11**	**10**	**9**	**19**
Expected	. .	. .	. .	. .	**5**	**10**	**10**	**5**

(a) Unsmoothed centile values from Harvey and Althaus (1993).

(b) Smoothed centile values from Lazarus et al. (1995).

(c) Less than or equal to the 5th centile.

(d) Less than or equal to the 15th centile but greater than the 5th centile.

(e) Greater than or equal to 85th centile but less than 95th centile.

(f) Greater than or equal to 95th centile.

(g) Pregnant females have not been excluded.

3.6 UNDERWEIGHT AND OVERWEIGHT, By Place of Residence(a)

	MALES		FEMALES	
	Underweight or at risk(b)	*Overweight or at risk(c)*	*Underweight or at risk(b)*	*Overweight or at risk(c)*
	%	%	%	%
Overall	**24**	**28**	**22**	**28**
Place of residence				
Capital city	16	28	16	30
Other urban	26	31	23	29
Rural	30	24	26	25
Expected	**15**	**15**	**15**	**15**

(a) Children aged 7–15 years.

(b) Less than or equal to the 15th centile reported by Harvey and Althaus (1993).

(c) Greater than or equal to the 85th centile reported by Lazarus et al. (1995).

Although the centiles presented by Harvey and Althaus (1993) were not smoothed, they are based on the same study population used by Lazarus and colleagues (1995) to calculate their smoothed 85th and 95th centiles. Although care should be taken when combining the smoothed and unsmoothed values, the results suggest that about half of all Indigenous children aged 7–15 years were at one extreme of the BMI distribution or the other, with fewer children than expected in the middle ranges. That is, both underweight and overweight appear to be more common than would be expected, based on Australian reference values.

CHARACTERISTICS ASSOCIATED WITH MEAN BODY MASS INDEX

Indigenous children and young adults live in a wide variety of circumstances across Australia. Although a high proportion of children and young adults would be categorised as overweight according to published reference values, it is possible that such comparisons may mask important differences among sub-groups of the Indigenous population. For example, the distributions of BMI may differ in urban and rural areas (as shown in table 3.6), among Aboriginal and Torres Strait Islander peoples, and among those of different socioeconomic status. Tables 3.7 and 3.8 present mean BMI for males and females in three age groups according to a number of characteristics of interest. It should be noted that no adjustment has been made for single year of age within age groups in these tables. Care should be taken when making comparisons with data from other sources, as the age distribution within age groups may differ from those of the NATSIS. More information about age-adjusted mean BMI is available in the Technical Notes in tables T.1–T.3.

CHARACTERISTICS ASSOCIATED WITH MEAN BODY MASS INDEX *continued*

The factors associated with mean BMI varied somewhat by age group and sex. In each age group for males and females, however, mean BMI was lower among those living in a household where it was reported that someone had gone without food in the past month and higher among those who spoke English as their main language. In some age groups, reported recent illness, place of residence, household composition and number of people per bedroom were associated with mean BMI. More information about the relationship between factors of interest and level of BMI is presented in the Technical Notes. Tables T.1–T.3 present unadjusted and adjusted regression coefficients for these same factors of interest for BMI for males and females by age group.

3.7 MEAN BMI, By Age Group—Selected Characteristics: **Males**

	5–9 YEARS...		10–12 YEARS		13–17 YEARS	
	Mean kg/m^2	*SE* kg/m^2	*Mean* kg/m^2	*SE* kg/m^2	*Mean* kg/m^2	*SE* kg/m^2
Overall	**16.8**	**0.2**	**18.7**	**0.2**	**21.5**	**0.2**
Place of residence						
Capital city	17.3	0.4	19.9	0.5	21.0	0.3
Other urban	16.7	0.2	18.0	0.3	22.0	0.2
Rural	16.3	0.3	18.6	0.5	21.5	0.3
Indigenous group(a)						
Aboriginal only	16.8	0.2	18.7	0.3	21.5	0.2
Torres Strait Islander only	(b)17.1	0.5	(b)17.5	0.5	(b)22.0	0.8
Main language						
English	16.9	0.2	18.8	0.3	21.6	0.2
Not English	16.0	0.4	*17.1	0.5	20.4	0.4
Household income						
Unknown	16.4	0.4	17.4	0.4	21.2	0.4
< $20 000	16.6	0.3	18.6	0.6	22.0	0.4
$20 000–39 999	17.2	0.3	18.7	0.4	21.6	0.3
$40 000 or more	16.6	0.3	19.3	0.6	21.4	0.3
Household composition						
Indigenous only	16.4	0.2	18.5	0.3	21.8	0.2
Both Indigenous and non-Indigenous	17.3	0.3	18.9	0.4	21.1	0.3
Housing tenure						
Home owned or being purchased by its occupants	17.4	0.4	19.3	0.5	21.9	0.4
Home rented or other tenure	16.6	0.2	18.4	0.3	21.4	0.2
Whether someone in household went without food in past four weeks						
Yes	15.0	0.4	(b)16.9	0.7	(b)21.4	0.6
No	16.9	0.2	18.8	0.3	21.6	0.2
Recent illness reported						
Yes	17.0	0.3	19.0	0.3	21.4	0.2
No	16.5	0.2	18.2	0.3	21.6	0.2
Number of people per bedroom						
< 2	17.1	0.2	18.8	0.3	21.6	0.2
2–4	16.2	0.3	17.9	0.5	21.2	0.3
> 4	(b)14.9	0.7	(b)17.0	0.6	(b)20.5	0.7
No bedrooms	(b)16.3	0.9	(b)21.0	2.7	(b)21.1	0.7

(a) Children and young adults who were reported to be both Aboriginal and Torres Strait Islander are not shown because the number of people in this category was small.

(b) Mean based on fewer than 50 people.

3.8 MEAN BMI, By Age Group—Selected Characteristics: **Females**

	5–9 YEARS.		10–12 YEARS		13–17 YEARS	
	Mean	*SE*	*Mean*	*SE*	*Mean*	*SE*
	kg/m^2	kg/m^2	kg/m^2	kg/m^2	kg/m^2	kg/m^2
Overall	**16.7**	**0.2**	**19.1**	**0.2**	**21.8**	**0.2**
Place of residence						
Capital city	17.4	0.4	18.9	0.5	20.8	0.4
Other urban	16.5	0.2	19.6	0.3	23.1	0.3
Rural	16.5	0.3	18.7	0.4	20.6	0.3
Indigenous group(a)						
Aboriginal only	16.7	0.2	19.1	0.2	21.8	0.2
Torres Strait Islander only	(b)17.0	0.7	(b)19.1	1.0	(b)22.4	0.7
Main language						
English	17.0	0.2	19.3	0.2	22.0	0.2
Not English	15.3	0.4	(b)18.2	0.6	20.6	0.5
Household income						
Unknown	15.8	0.3	17.9	0.4	21.4	0.4
< $20 000	17.2	0.4	20.3	0.6	21.4	0.4
$20 000–39 999	16.9	0.3	19.4	0.4	22.4	0.4
$40 000 or more	16.6	0.4	18.9	0.4	21.8	0.5
Household composition						
Indigenous only	16.5	0.2	19.3	0.3	22.0	0.3
Both Indigenous and non-Indigenous	17.0	0.3	18.9	0.4	21.6	0.3
Housing tenure						
Home owned or being purchased by its occupants	17.0	0.4	19.3	0.5	21.3	0.5
Home rented or other tenure	16.6	0.2	19.1	0.2	22.0	0.2
Whether someone in household went without food in past four weeks						
Yes	15.2	0.5	(b)17.0	0.4	(b)20.9	0.8
No	16.8	0.2	19.3	0.2	22.0	0.2
Recent illness reported						
Yes	16.4	0.2	18.5	0.3	22.2	0.3
No	17.0	0.2	19.8	0.3	21.3	0.3
Number of people per bedroom						
< 2	17.1	0.2	19.5	0.3	21.8	0.2
2–4	15.8	0.3	18.1	0.5	22.3	0.6
> 4	(b)15.6	0.8	(b)17.1	0.6	(b)21.3	0.7
No bedrooms	(b)14.1	0.5	(b)20.7	1.1	(b)18.9	0.8

(a) Children and young adults who were reported to be both Aboriginal and Torres Strait Islander are not shown because the number of people in this category was small.

(b) Mean based on fewer than 50 people.

CHARACTERISTICS ASSOCIATED WITH NON-MEASUREMENT

The proportion of children aged 5–17 years whose height and weight were not measured varied widely among the 36 Aboriginal and Torres Strait Islander Commission (ATSIC) Regions, from about 2% not measured in the Kununurra Region to 84% not measured in the Aputula Region. However, there was no significant association between the proportion unmeasured in a region and that region's mean BMI ($p = 0.2$; $r^2 = 0.05$).

As with mean BMI, the factors associated with non-measurement varied by age group and sex. In general, however, non-measurement was more common among those who did not speak English as their main language, lived in a dwelling that was not owned or being purchased by its occupants, did not report any recent illness and/or lived in a household which included non-Indigenous members (table 3.9). More information about the characteristics associated with non-measurement is available in the Technical Notes in tables T.4 and T.5.

3.9 CHILDREN AND YOUNG ADULTS NOT MEASURED

	MALES		FEMALES	
	5–12 years	*13–17 years*	*5–12 years*	*13–17 years*
	%	%	%	%
Overall	**43**	**25**	**41**	**27**
Place of residence				
Capital city	41	16	42	11
Other urban	42	26	34	28
Rural	48	32	49	40
Indigenous group(a)				
Aboriginal	44	25	42	27
Torres Strait Islander	28	25	24	29
Main language				
English	41	19	40	23
Not English	56	57	50	46
Household income				
Unknown	48	22	44	30
< $20 000	43	20	44	11
$20 000–39 999	42	25	35	23
$40 000 or more	43	30	46	36
Household composition				
Indigenous only	47	29	45	30
Both Indigenous and non-Indigenous	37	15	33	20
Housing tenure				
Owned/being purchased by occupants	31	13	29	21
Rented or other tenure	46	28	44	28
Someone in household went without food in past four weeks				
Yes	42	36	45	22
No	44	24	40	27
Recent illness reported				
Yes	38	18	37	18
No	49	32	44	37
Number of people per bedroom				
< 2	43	22	37	24
2–4	44	30	47	32
> 4	49	53	49	46
No bedrooms	39	17	56	26

(a) Children reported to be both Aboriginal and Torres Strait Islander are not shown due to small numbers.

ASSESSMENT OF POTENTIAL BIAS DUE TO NON-MEASUREMENT

Some factors of interest, such as main language spoken and reported recent illness, were associated both with non-measurement and with mean BMI, which indicates the possibility of bias due to non-measurement in the reported BMI.

An assessment of the likely magnitude of such bias was made by imputing values for BMI for those who were not measured. It was assumed in this analysis that children with similar characteristics had similar heights and weights, regardless of whether they were measured. Among those who were measured, mean values for BMI for people with various combinations of characteristics (e.g. males aged 7 years who spoke English as their main language, etc.) were modelled using multiple linear regression (see Technical Notes for more details). These values were then assigned to people who were not measured but who had the same combination of characteristics. New means for BMI were then calculated, incorporating both the values actually measured and those imputed. These new means were then compared to means based only on actual measurement.

As shown in the Technical Notes in table T.6, the means were not very different, changing by less than 0.1 kg/m^2 for each age and sex group. In most groups, the mean was slightly lower after adding in the imputed values, which indicates that the means for BMI among those measured were biased slightly upward. That is, it appears that the measured values among children and young adults were only a fraction higher on average than what would have been observed if everyone had been measured.

DISTRIBUTIONS OF HEIGHT, WEIGHT AND BODY MASS INDEX

Analysis was limited to the 7,858 adults aged 18 years or more who were not prisoners. Body mass index (BMI) could be calculated for 5,732 adults, including 2,701 males and 3,031 females. For the remaining 839 males and 1,287 females, BMI could not be calculated because height and/or weight were not measured or not recorded.

The means for height, weight and BMI by age group are shown in table 4.1.

4.1 HEIGHT, WEIGHT AND BODY MASS INDEX(a)

		HEIGHT		WEIGHT		BMI	
	Measured	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
Age group (years)	no.	cm	cm	kg	kg	kg/m^2	kg/m^2
			MALES				
18–24	608	173.7	8.3	75.8	17.6	25.1	5.4
25–34	873	173.0	9.8	80.3	16.1	26.8	5.0
35–44	565	172.8	8.1	83.9	17.6	28.1	5.7
45–54	374	171.2	7.5	81.9	16.6	27.9	5.3
55–64	175	169.3	6.8	76.9	13.4	26.8	4.5
65 or more	106	170.9	7.4	73.9	13.1	25.3	4.2
			FEMALES				
18–24	721	160.6	8.8	65.5	17.4	25.4	6.5
25–34	952	160.7	8.0	68.3	17.6	26.5	7.0
35–44	616	160.1	7.9	71.2	16.5	27.9	6.8
45–54	383	159.7	6.6	73.3	16.2	28.8	6.3
55–64	213	159.0	6.8	77.8	18.9	30.9	7.9
65 or more	146	156.9	8.4	67.9	19.7	27.6	7.3

(a) Includes non-prisoners aged 18 years or more. Pregnant females have not been excluded.

Up to age 65 years, Indigenous males were on average about 3–4 cm shorter and Indigenous females were about 2–3 cm shorter than their all-Australian counterparts in the National Nutrition Survey (NNS) (Australian Bureau Statistics & Department of Health and Family Services 1997). Among those aged 65 years or more, there was little difference in mean height in the two surveys. However, the age distribution within the oldest age group is likely to differ in the National Aboriginal and Torres Strait Islander Survey (NATSIS) and the NNS. Since mean height was lower in older than younger age groups in both surveys, this lack of a difference in mean height in the oldest age group should be interpreted with caution. Mean weight was generally lower among Indigenous males than all-Australian males, but the opposite was true for females.

DISTRIBUTIONS OF HEIGHT, WEIGHT AND BODY MASS INDEX *continued*

The patterns for Aboriginal males and females were almost identical to those for all Indigenous people, which reflects the fact that they constitute the majority of the Indigenous group. The estimates for Torres Strait Islanders were subject to greater variability due to their relatively small numbers, but Torres Strait Islanders were on average taller and considerably heavier than Aboriginal people and had a higher mean BMI.

BODY MASS INDEX CATEGORIES

As can be seen in table 4.2, 61% of measured males and 57% of measured females were categorised as being overweight or obese according to modified World Health Organization guidelines (that is, BMI of 25 or more).

4.2 BODY MASS INDEX CATEGORY AMONG THOSE MEASURED(a)

Age group (years)	*Underweight* %	*Acceptable weight* %	*Overweight* %	*Obese* %
		MALES		
18–24	7	48	27	18
25–34	2	36	39	22
35–44	1	29	36	34
45–54	3	24	43	30
55–64	1	32	40	27
65 or more	6	41	40	14
Total	**3**	**36**	**36**	**25**
		FEMALES		
18–24	8	46	23	22
25–34	7	41	26	26
35–44	4	33	32	30
45–54	3	24	40	34
55–64	2	20	29	48
65 or more	4	38	29	29
Total	**6**	**37**	**29**	**28**

(a) Includes non-prisoners aged 18 years or more. Pregnant females have not been excluded. BMI categories are as follows: underweight—BMI less than 18.5; acceptable weight—BMI 18.5 to less than 25; overweight—BMI 25 to less than 30; obese—BMI 30 or more. No rounding was done prior to categorisation.

Indigenous adults were more likely to be classified as obese than their all-Australian counterparts. As shown in table 4.3, the differences between Indigenous people and the total Australian population were greatest among 18–24 year olds, but Indigenous people were more likely to be classified as obese in every age group among females and for all but the oldest age group among males. The differences were especially marked among Torres Strait Islanders, with 43% of males and 50% of females aged 18 years or more classified as obese.

4.3 OBESITY IN INDIGENOUS AND ALL-AUSTRALIAN ADULTS

	INDIGENOUS(a)			ALL-AUSTRALIAN(b)	
	Aboriginal (c)	*Torres Strait Islander(c)*	*Total Indigenous*	*Self-reported*	*Measured*
Age group (years)(d)	%	%	%	%	%
			MALES		
18–24(e)	17	35	18	6	10
25–44	26	49	27	12	16
45–64	28	41	29	16	26
65 or more	13	23	14	9	20
Total	**24**	**43**	**25**	**12**	**19**
			FEMALES		
18–24(e)	21	45	22	5	9
25–44	26	54	28	11	15
45–64	39	48	39	17	26
65 or more	26	55	29	13	24
Total	**27**	**50**	**29**	**12**	**19**

(a) 1994 NATSIS. Height and weight were measured. Obese is defined as BMI greater than or equal to 30.

(b) Self-reported data are from the 1995 National Health Survey (NHS). Obese was defined in the NHS as BMI greater than 30. Measured data are from the 1995 National Nutrition Survey (NNS), which was conducted on a subset of participants from the NHS. Obese was defined in the NNS as BMI greater than or equal to 30.

(c) Excludes people who said they were both Aboriginal and Torres Strait Islander as the number of people in this group was small.

(d) No adjustment for age has been made within age groups, although the age distributions within age groups may differ between surveys. For example, Indigenous people in the age group '65 or more' may be younger on average than all-Australians in this age group. Therefore, care should be taken when interpreting these comparisons, especially in the oldest age group.

(e) Data from the NNS are for adults aged 19 years or more.

CHARACTERISTICS ASSOCIATED WITH OBESITY

Factors which were associated with a higher prevalence of obesity even after adjusting for age included identifying as a Torres Strait Islander (tables 4.3 and T.8) and self-reported diabetes (tables 4.4 and T.8). A lower age-adjusted prevalence of obesity was found among smokers and recent consumers of alcohol (tables 4.4 and T.8). Among males, speaking English as a main language, working in mainstream employment (that is, not in the Community Development Employment Projects (CDEP) scheme), living in less crowded conditions and living in an urban area were all associated with a higher prevalence of obesity after adjusting for age. More information about factors associated with the probability of being classified as obese are presented in the Technical Notes, in table T.8.

4.4 OBESITY(a), By Health Risk Factors

	AGE GROUP (YEARS)				
	18–24	*25–44*	*45–64*	*65 or more*	*18 or more*
Risk factor	%	%	%	%	%
MALES					
Smokes					
Yes	13	22	19	14	19
No	25	35	40	13	33
Diabetes					
Yes	(b)23	52	35	(b)28	41
No	18	26	28	11	24
Last alcohol use					
Within past week	17	24	31	(b)14	23
Not within past week	25	26	28	20	26
Never drinks	(b)4	52	25	(b)3	33
FEMALES					
Smokes					
Yes	19	25	33	(b)31	25
No	26	33	43	28	33
Diabetes					
Yes	(b)0	47	46	(b)34	44
No	22	27	37	27	27
Last alcohol use					
Within past week	26	19	30	(b)29	23
Not within past week	21	35	39	(b)15	31
Never drinks	16	34	46	36	34

(a) Obese is defined as BMI greater than or equal to 30.

(b) Based on fewer than 50 people in the relevant category and age group.

CHARACTERISTICS ASSOCIATED WITH MEAN BODY MASS INDEX

Similar factors were associated with mean BMI. BMI was higher on average among Torres Strait Islanders and self-reported diabetics, and lower on average among smokers, recent drinkers and people living in households with more than two people per bedroom, even after adjusting for age. Among males, age-adjusted mean BMI was higher among those who spoke English as their main language and those in non-CDEP employment. More information is available in the Technical Notes in table T.7.

CHARACTERISTICS ASSOCIATED WITH NON-MEASUREMENT

The level of non-measurement varied widely among the 36 Aboriginal and Torres Strait Islander Commission (ATSIC) Regions, from less than 2% unmeasured in the Kununurra ATSIC Region to 94% unmeasured in the Aputulta ATSIC Region among females, and from less than 2% unmeasured in the Roma and Kununurra ATSIC Regions to 84% in the Aputula ATSIC Region among males. However, there was no significant association between the proportion of respondents not measured in a region and that region's mean BMI level (for males, $p = 0.8$ and $r^2 = 0.002$; for females, $p = 0.1$ and $r^2 = 0.07$).

CHARACTERISTICS ASSOCIATED WITH NON-MEASUREMENT *continued*

Tables 4.5–4.7 show the proportion of adults who were not measured according to a number of other factors of interest. People were less likely to be missing height and weight measurements if they lived in a capital city, were employed in non-CDEP scheme employment, had a higher level of education, spoke English as their main language, lived in a dwelling owned or being purchased by its occupants, lived in a household which included non-Indigenous members, identified as a Torres Strait Islander, smoked, drank alcohol and/or said they did not identify with a clan, tribal or language group. More information about the probability of being unmeasured is presented in the Technical Notes, in table T.9.

4.5 CULTURAL CHARACTERISTICS AND NON-MEASUREMENT(a)

	MALES		FEMALES	
	Participants	*Not measured*	*Participants*	*Not measured*
Variable	%	%	%	%
Indigenous group(b)				
Aboriginal only	94	23	94	29
Torres Strait Islander only	5	17	6	22
Household composition				
Indigenous members only	73	27	75	32
Both Indigenous and non-Indigenous members	27	10	25	19
Main language spoken				
English	82	19	82	25
Not English	18	35	18	44
Taken away from family as a child				
Yes	9	25	9	32
No	91	22	91	29
Identifies with a clan, tribal or language group				
Yes	63	26	60	33
No	37	16	40	23

(a) Non-prisoners aged 18 years or more.

(b) People who were reported to be both Aboriginal and Torres Strait Islander are not shown, as the number of people in this group was small.

4.6 SOCIO-DEMOGRAPHIC CHARACTERISTICS AND NON-MEASUREMENT(a)

	MALES		FEMALES	
	Participants	*Not measured*	*Participants*	*Not measured*
Variable	%	%	%	%
Age group (years)				
18–24	25	19	25	26
25–34	32	20	31	29
35–44	21	22	21	33
45–54	12	26	11	27
55–64	7	25	7	30
65 or more	4	51	5	28
Area of residence				
Capital city	27	16	27	21
Other urban	41	21	42	27
Rural	33	29	30	39
Labour force status				
Employed, non-CDEP	35	15	23	21
Employed, CDEP	14	27	6	31
Unemployed	28	22	17	25
Not in labour force	23	31	54	33
Highest year of school completed(b)				
Less than year 10	54	26	52	32
Year 10 or year 11	36	18	37	27
Year 12 or more	9	13	10	19
Dwelling owned/being purchased by occupants				
Yes	22	14	18	15
No	78	25	82	32
Number of people per bedroom				
< 2	73	19	75	26
2–4	19	27	18	32
> 4	5	36	4	45
No bedrooms	3	40	3	43
Annual household income				
< $20,000	16	27	21	28
$20,000–$39,999	32	19	30	27
$40,000 or more	32	24	27	29
Unknown	20	22	21	32
Number of children ever borne				
0	..	..	19	29
1	..	..	15	32
2–4	..	..	47	29
5 or more	..	..	20	27

(a) Non-prisoners aged 18 years or more.

(b) People still attending school are not shown.

4.7 HEALTH CHARACTERISTICS AND NON-MEASUREMENT(a)

	MALES		FEMALES	
	Participants	*Not measured*	*Participants*	*Not measured*
Variable	%	%	%	%
Smokes				
Yes	60	21	51	27
No	40	24	49	31
Most recent alcohol consumption				
Within the past week	59	20	35	26
More than 1 week ago	32	22	38	26
Never drinks	10	35	27	37
Reported long-term diabetes				
Yes	6	27	9	32
No	94	22	91	29

(a) Non-prisoners aged 18 years or more.

ASSESSMENT OF POTENTIAL BIAS DUE TO NON-MEASUREMENT

Some factors of interest, such as main language spoken, alcohol consumption and labour force status, were associated both with non-measurement and with mean BMI among males and/or females, which indicates the possibility of bias due to non-measurement.

An assessment of the likely magnitude of such a bias was made by imputing values for BMI for those who were not measured. It was assumed in this analysis that adults with similar characteristics had similar heights and weights, regardless of whether they were measured. Among those who were measured, mean values for BMI for people with various combinations of characteristics (e.g. males aged 38 years who spoke English as their main language, etc.) were modelled using multiple linear regression (see Technical Notes for more details). These values were then assigned to people who were not measured but who had the same combination of characteristics. New means for BMI were then calculated, incorporating both the values actually measured and those imputed. These new means were then compared to means based only on actual measurements.

As shown in the Technical Notes in table T.10, the means were not very different, changing by less than 0.2 kg/m^2 or less for each age, sex and Indigenous group and for capital city, other urban and rural residents. Mean BMI increased after adding imputed values in some cases and decreased in other cases. Overall, the mean after adding imputed values increased slightly among females (by 0.01 kg/m^2) but decreased slightly among males (by 0.07 kg/m^2). Thus, it appears that the measured values were a fraction lower on average among females and a fraction higher on average among males than what would have been observed if everyone had been measured.

CHAPTER 5 DISCUSSION

The results presented here highlight the considerable heterogeneity of the Indigenous population. Both underweight and overweight were more common than expected among Indigenous children, and the proportions of children in these categories varied according to place of residence. Among adults, Torres Strait Islanders were significantly heavier than Aboriginal people, and a number of socio-demographic factors were associated with mean BMI. The results do not appear to have been affected to any great degree by bias due to non-measurement.

CHILDREN

A variety of small and localised studies have examined growth in Aboriginal children in the past, but most of these have examined pre-school-aged children. Hitchcock et al. (1987) conducted a large survey of nearly 2,000 Aboriginal children aged 4–16 years in the Kimberley region in 1983. Those living in the towns were shorter and lighter than Caucasian children living in the same area, but they were taller and heavier than the Aboriginal children living in the communities. Cheek et al. (1989) also found that primary school-aged Aboriginal children living in a South Australian community were shorter and lighter than those living in a town.

These studies agree with the findings of the National Aboriginal and Torres Strait Islander Survey (NATSIS) that children in rural or remote areas were shorter and lighter than children in urban areas. However, even among Indigenous children living in capital cities, height was lower on average than the international reference.

It should be noted that the category 'other urban' includes all non-capital city locations with a population greater than 1,000. As a consequence, some of the larger remote Aboriginal communities are grouped together with cities like Newcastle and Geelong. This category reflects a wide range of potential access to affordable and adequate food, as well as to a variety of services (including medical services), so the results from 'other urban' areas should be interpreted with caution.

The standard deviations for weight-for-age and height-for-age were slightly larger than one Z–score unit (the value expected), which would suggest greater than expected variability. This may have been due in part to the use of mid-year reference data for all children of a particular age. Although reference values are provided for age in years and months, only completed year of age was available in the NATSIS.

The standard deviations for weight-for-height were even larger, but this can not be explained by the lack of detailed age information. The fact that the standard deviations were similarly high for all geographical locations, despite differences in the means, indicates that the distribution was flat and wide. That is, there were large proportions of both high values and low values compared to the reference population. This was true for body mass index (BMI) as well. For example, using the Australian references for the 7–9 year age group, 20–41% of children had a BMI above the smoothed 85th centile while 13–21% had a BMI below the unsmoothed 5th centile (table 3.5).

CHILDREN *continued*

These results provide a warning against focusing solely on the prevalence of high BMI or high weight-for-height as a way of monitoring Indigenous children in Australia. Firstly, the larger than expected number of children with values below the 5th centile of BMI would not be identified if cutpoints were limited to those at the upper end of the scale. Secondly, ensuring adequate linear growth is recognised as a major goal in child health (National Health and Medical Research Council 1997), so height-for-age of children should be monitored as well as weight-for-height and/or BMI. Since poor nutrition is one cause of failure to grow in height, it would be inappropriate, for example, to advocate a focus on weight control in a population of children who may already be suffering from an imbalanced diet. Further work is needed to determine the relative influence of nutrition and other factors such as infections on linear growth failure in particular areas. Such information would help to determine the most appropriate strategies for prevention and treatment.

Children under 5 years of age were not measured in the NATSIS, but such children are potentially the most at risk for growth failure, given their high dependence on their parents and other caregivers for providing food. Recent reports show that average weight-for-height and/or weight-for-age in Aboriginal children in this age group are still substantially below the reference mean in some parts of Australia (Dugdale, Muller & Alsop-Shields 1994; Muller, Priestly & McComb 1995; Ruben & Walker 1995; Rousham & Gracey 1997). By contrast, one small survey conducted in the Torres Strait indicated that pre-school-aged children there were not small for their age (Vlack et al. 1993). Few studies have examined the growth of Indigenous children aged 0–4 in urban areas.

A number of factors in addition to place of residence were associated with mean BMI among children, including main language, number of people per bedroom and reports of a household member going without food. Such factors may be indicators of socioeconomic disadvantage in general, as well as more specific difficulties such as lack of food security.

Separate analyses could not be done by State and Territory or for Torres Strait Islander children because the number of children in each age group was not large enough. Mean BMI was not consistently higher for Torres Strait Islander children than for Aboriginal children before the age of 18 years, however, in contrast to what was observed for adults.

ADULTS

The lower than expected heights seen in Indigenous children were reflected in the results for Indigenous adults, who were shorter on average than their all-Australian counterparts, up to the age of 65 years. By contrast, the levels of underweight seen in children were not matched in adults. The majority of adults (61% of males and 57% of females) were classified as overweight or obese, and only 3% of males and 6% of females were classified as underweight. Torres Strait Islander adults were taller and heavier than Aboriginal adults, and their mean BMI was 2–3 kg/m^2 higher, even after adjusting for a range of other factors.

It has been postulated that the BMI cutpoints defined for adults are not correct for either Aborigines or Torres Strait Islanders. Rutishauser and McKay (1986) compared the BMI of Aboriginal women and Caucasian women with the same skinfold thicknesses and found that Aboriginal women had a lower BMI by 1–2 kg/m^2. By contrast,

ADULTS *continued*

Swinburn et al. (1996) found in a small study that Polynesians were leaner than Caucasians at the same BMI and that a BMI of about 30 in Polynesians indicated the same level of adiposity as a BMI of about 25 in Caucasians. Although Torres Strait Islanders are Melanesian rather than Polynesian, it is possible that they too could be leaner for a given BMI than other groups. If so, it would be possible for the true prevalence of overweight and obesity (that is, excess adiposity) to be higher in Aboriginal adults than Torres Strait Islander adults despite the greater prevalence of BMI greater than or equal to 30 among Torres Strait Islanders. Further work in this area is needed.

It should be remembered that although there is an association between BMI and mortality, this association appears to be continuous and the cutpoints used to determine BMI categories are somewhat arbitrary (WHO 1995a). However, the results of the NATSIS indicate that the prevalence of excess adiposity is undesirably high in both Indigenous groups, as is also the case in the general Australian population (Australian Bureau of Statistics & Department of Health and Family Services 1997). Despite their limitations, the current cutpoints are useful in monitoring changes in the distribution of BMI within population groups.

A number of socioeconomic, health and cultural factors were associated with mean BMI and obesity among adults. In addition to identification as a Torres Strait Islander, age was one of the most important factors, with mean BMI increasing to a certain age and then decreasing, perhaps as a consequence of earlier mortality among obese people. As would be expected, mean BMI was higher among those who reported having diabetes and lower among smokers. Other factors, such as consumption of alcohol, main language, number of people per bedroom, employment and place of residence, were associated with mean BMI among males, females or both. These relationships are not necessarily causal, but information about such associations can help public health practitioners to target prevention programs and interventions. The analyses reported here were intended to be indicative only. Although they have provided useful information, more work could be done to characterise even more precisely the relationships between a variety of factors and BMI.

The associations between socio-demographic variables and weight observed in the NATSIS differed from those found in the 1989–90 National Health Survey (NHS) of a large representative sample of Australians. (Results from the 1995 NHS are now available, but relationships between variables have not yet been analysed in sufficient detail.) In adults aged 25–64 years in the NHS, the age-adjusted prevalence of overweight and obesity was higher in those living in non-metropolitan areas than metropolitan areas (Mathers 1994, as cited in National Health and Medical Research Council 1997). By contrast in the NATSIS, the age-adjusted prevalence of obesity was higher in those living in capital cities than in rural areas among males and not significantly different by place of residence among females. In the 1989–90 NHS, those with higher income and more education had a lower age-adjusted prevalence of overweight and obesity, and employed women were thinner than unemployed women (Mathers 1994, as cited in National Health and Medical Research Council 1997). The NATSIS results, however, showed that among Indigenous Australian males, the age-adjusted odds of being obese were higher for those in mainstream (non-Community Development Employment Project scheme) employment, those with Year 12 or

ADULTS *continued*

greater education, and those living in less-crowded conditions. Among females in the NATSIS, those living in less-crowded conditions were more likely to be obese, but the relationship between employment and obesity was weak and women with a Year 12 or greater education were less likely to be classified as obese rather than more likely. Thus the general impression is that greater economic advantage in Indigenous people was associated with a high prevalence of obesity, at least among males, whereas the reverse was true of the general Australian population.

The 1994 NATSIS was the first nationally representative survey of Indigenous Australians. Most research studies on Indigenous nutrition to date have focused on Aboriginal people living in remote northern Australia. The NATSIS provides the first opportunity to compare Indigenous people living in a wide variety of circumstances across Australia, from capital cities to rural and remote areas. Among adults, obesity was prevalent in all areas, albeit significantly lower among rural males than among their urban counterparts. Among children, both overweight and underweight were more common than expected. Although children in rural areas were relatively worse off than those living in capital cities, even urban children experienced linear growth failure, and underweight appeared to exist in at least some sub-groups as well.

The results of the NATSIS presented in this report, combined with the results of studies conducted in specific locations, indicate that there is great variability in the distributions of height, weight and BMI among Indigenous people. Moreover, a high prevalence of underweight may co-exist with a high prevalence of obesity in some groups. Thus it would be inappropriate to assume that the national prevalence applies to every location and every age group. Wherever possible, local information should be used to inform decision-making.

TECHNICAL NOTES

This section provides information about the regression techniques used in analyses of body mass index (BMI), obesity and non-measurement, as well as the results of those analyses.

THE LOGISTIC REGRESSION MODEL

The logistic regression model was used in two different sets of analyses. The dependent variable of interest in the first set of analyses was being classified as obese. Only adults aged 18 years or more were included in these analyses. The dependent variable in the second set of analyses was being unmeasured. Both children and adults were included in these analyses, but in separate models.

Because adults without measurements of height and weight were excluded from consideration in the analysis of obesity, all those included in this analysis could be assigned to one of two categories: obese (BMI greater than or equal to 30) or not obese (BMI less than 30). Similarly, in the second analysis, all those included could be assigned to one of the following categories: unmeasured (height and/or weight unavailable) or measured (height and weight, and therefore BMI, available).

In cases such as these, where the probability of falling into one of two categories is of interest, the logistic regression model is commonly used, especially in the area of health research. Logistic regression overcomes the fact that probabilities are limited in range from 0 to 1. By using a logit transformation, the dependent variable has a range from negative infinity to positive infinity, thus facilitating mathematical modelling.

In its simplest form, the logistic regression model can be described as follows:

$$\text{Logit } P_i = \log [P_i / (1-P_i)] = a + b_i X_i$$

where P_i is the probability of the outcome occurring (e.g. being classified as obese), a is an intercept term, the b_i's are coefficients and X_i's are the independent variables of interest.

Logit P_i is the natural logarithm of the 'odds ratio', which is commonly used in the field of health research as a measure of the magnitude of the relationship between two variables. More information on logistic regression is available elsewhere (e.g. Hosmer & Lemeshow 1989).

As discussed in chapters 3 and 4, several independent variables were of interest in the analysis. The relationship of a variable of interest with being classified as obese or with being unmeasured can be obscured if other factors are related both to the independent variable and to the outcome of interest. For example, as is discussed in chapter 4, age is an important predictor of BMI. Age is also associated with other variables of interest, such as labour force status, education, language spoken, etc. Thus an observed relationship between one of these factors and being classified as obese may be wholly or partly due to the effect of age. Conversely, a failure to observe any association may also be due to differences in age. The same may be true for variables other than age.

THE LOGISTIC REGRESSION MODEL *continued*

Therefore, it is important to adjust for other variables when examining the relationship between a factor of interest and being classified as obese. This is also true for the analysis of factors associated with non-measurement. In the current analyses, both unadjusted and adjusted models have been generated and compared. Only main effects models were considered in the analysis; no interaction terms were included.

In tables T.4–T.5 and T.8–T.9, odds ratios are presented for selected variables. Odds ratios have been estimated relative to an appropriate set of reference characteristics. For example, in table T.8, the reference characteristics are as follows:

- age 18–24 years;
- lives in a capital city;
- is Aboriginal only;
- does not speak English as a main language;
- lives in a dwelling that is not owned or being purchased by its occupants (i.e. rented or 'other');
- is employed in a non-Community Development Employment Project (CDEP) scheme job;
- highest year of school completed was year 10 or year 11;
- does not smoke cigarettes;
- has consumed alcohol within the past week;
- lives in a dwelling with fewer than two people per bedroom;
- does not identify with a clan, tribal or language group;
- was not taken away from family as a child;
- lives in a household with Indigenous members only;
- did not report having diabetes;
- has an annual household income of $20,000–$39,999;
- has borne 2–4 children (females only).

The reference category is not shown in the tables below for variables with only two levels (e.g. main language, smoking status). For variables with more than two levels (e.g. age group, labour force status), the reference category is shown in the tables to assist the reader. By definition, the odds ratio for the reference category (whether shown in the table or not) is 1.0, and 95% confidence intervals are not applicable.

THE LINEAR REGRESSION MODEL

In contrast to categorical variables such as whether someone can be classified as obese or not (or classified as unmeasured or not), BMI is a continuous variable. Although it is subject to whatever upper and lower boundaries are compatible with sustaining human life, in theory it can take on any value in between. (In practice, our measuring tools force us to round height and weight (and therefore BMI) to some extent, so we tend to see some clustering, but this does not alter the nature of the variable itself.)

When the dependent variable is continuous, linear regression is an appropriate modelling tool. When more than one independent variable is used, the term 'multiple linear regression' is used.

THE LINEAR REGRESSION MODEL *continued*

In its simplest form, the linear regression model can be described as follows:

$$Y = a + b_i X_i$$

where Y is the dependent variable, a is an intercept term, the b_i's are coefficients and X_i's are the independent variables of interest. The coefficients refer to a change in Y (in this case BMI) for a one unit change in the relevant X. More information on linear regression is available elsewhere (e.g. Kleinbaum, Kupper & Muller 1988).

In this paper, multiple linear regression has been used to model BMI as a function of several independent variables, such as age group, main language spoken, labour force status, educational attainment, and smoking. The relationship of a variable of interest with level of BMI can be obscured if other factors are related both to the variable and to level of BMI. Therefore, it is important to adjust for other variables when examining the relationship between a factor of interest and BMI. In the current analyses, both unadjusted and adjusted models have been generated and compared. Only main effects models were considered in the analysis; no interaction terms were included.

In tables T.1–T.3 and T.7, regression coefficients are presented for selected variables. These regression coefficients have been estimated relative to an appropriate set of reference characteristics. For example, in table T.7, the reference characteristics are the same as those presented on page 28 (e.g. age 18–24 years, lives in a capital city, etc.). The reference category is not shown in the tables below for variables with only two levels (e.g. main language, smoking status). For variables with more than two levels (e.g. age group, labour force status), the reference category is shown in the tables to assist the reader. By definition, the regression coefficient for the reference category (whether shown in the table or not) is 0, and standard errors are not applicable.

IMPUTATION OF BODY MASS INDEX VALUES FOR PEOPLE NOT MEASURED

As mentioned previously, measurements were not available for all National Aboriginal and Torres Strait Islander Survey (NATSIS) participants. If those who were not measured were more likely to have a higher (or lower) BMI than those who were measured, then bias in the estimates would result. That is, the mean BMI based on people who were measured would not accurately represent the true mean.

In contrast to most studies, many characteristics are known about those who were not measured in the NATSIS. This information can be used to assess the likely magnitude of bias in the estimates of BMI due to non-measurement. For example, as discussed in chapter 4, Torres Strait Islander adults were less likely to be unmeasured (i.e. more likely to be included) but had a higher BMI on average than Aboriginal adults. This would tend to make the observed mean for BMI for all Indigenous adults *higher* than the true mean. On the other hand, smokers were also less likely to be unmeasured, but their mean BMI was lower than that for non-smokers, and this would tend to make the observed overall mean BMI *lower* than the true mean. These two factors work in opposite directions, and it is not immediately obvious what the combined effect would be. The situation becomes even more complicated when other characteristics are considered.

IMPUTATION OF BODY MASS INDEX VALUES FOR PEOPLE NOT MEASURED *continued*

It is possible to assess the likely magnitude of bias due to non-measurement by using information from multiple linear regression models to assign BMI values to people who were not measured. The underlying assumption is that people with similar characteristics had similar heights and weights regardless of whether they were measured. Thus, people who were not measured were assigned a value for BMI based on their combination of characteristics, using the estimates from multiple regression models for those who were measured. For children, the estimates presented in tables T.1–T.3 were used, while for adults aged 18 years or more, figures from table T.7 were used. Although the values in the tables have been rounded to the nearest 0.1, unrounded values have been used in all calculations.

For example, for adult females who were not measured, BMI was imputed as follows:

BMI = 24.740765

- + 1.212930 if aged 25–34
- + 2.220724 if aged 35–44
- + 2.787857 if aged 45–54
- + 3.772463 if aged 55–64
- + 0.211147 if aged 65 and over
- + 3.098867 if Torres Strait Islander
- + 0.716696 if English is main language spoken
- + 0.386734 if works in CDEP scheme employment
- + 1.437667 if unemployed
- + 0.722361 if not in the labour force
- + 0.156896 if less than year 10 education
- – 0.919576 if finished year 12 or more
- – 0.769900 if 2–4 people per bedroom
- – 1.571646 if more than four people per bedroom
- – 1.200659 if no bedrooms in dwelling
- – 1.879695 if a smoker
- + 0.694593 if last drank alcohol more than one week ago
- + 1.119406 if never drinks
- + 1.712369 if reported diabetes

So for an adult Aboriginal female aged 30 years who smoked, did not report diabetes, said she never drinks, worked in non-CDEP employment, lived in a household with one person per bedroom, left school in year 11, spoke English as her main language and was not measured, a BMI of 25.910102 would be assigned, based on the following calculation:

BMI = 24.740765 + 0 (Aboriginal) + 1.212930 (age 30) – 1.879695 (smoker) + 0 (no diabetes) + 1.119406 (never drinks) + 0 (non-CDEP employment) + 0 (1 person per bedroom) + 0 (left school in year 11) + 0.716696 (English is main language)

A similar calculation was made for each child and adult who was not measured, and for whom the relevant characteristics were known.

IMPUTATION OF BODY MASS INDEX VALUES FOR PEOPLE NOT MEASURED *continued*

The measured values and the assigned values were then used to calculate new means. These new means were compared to the means based only on measured values (i.e. those presented in chapters 3 and 4). As can be seen in tables T.6 and T.10, the differences were very small. This indicates that any bias due to non-measurement is likely to be small and that the means based on measured values are a relatively accurate reflection of the true means insofar as they have not been affected by other sources of bias.

The figures used in the imputation procedure for adults were from a model which included only some of the variables listed in table T.7. That is, only the regression coefficients for the variables included in the 'final model' (as indicated in table T.7) were used in calculations which produced the figures presented in table T.10. However, similar results were obtained using regression coefficients from a model which included all the variables listed in table T.7.

RESULTS FOR CHILDREN

The results of analyses involving children aged 5–17 years are presented in tables T.1–T.6 and are discussed below. In the tables, 'unadjusted' refers to regression models in which only the variable of interest is included (either singly, as with main language, or as a group, as with number of people per bedroom). The estimates listed in this column are from a number of separate models. 'Adjusted for age only' refers to models which include both the variable of interest and age, although only the estimate for the variable of interest is shown. As with unadjusted models, the estimates in this column are from several separate models. The term 'adjusted for all factors listed' refers to a single model which includes all the variables shown. That is, the estimates in this column all come from the same model.

Body mass index

Even within age group, single year of age was significantly associated with BMI among boys and girls aged 5–9 years, girls aged 10–12 years and boys aged 13–17 years. This was true even after adjusting for other factors. Mean BMI was generally higher among children who spoke English as their main language and lower among those who lived in a household where someone had gone without food in the past month and/or where there were more than two people per bedroom, although these relationships were not always statistically significant. Little consistency across age and sex groups was seen for other factors, which is probably due at least in part to the small numbers of children in these groups. Although Torres Strait Islander adults had a significantly higher BMI on average than Aboriginal adults, such a difference was not seen with any consistency among children.

Non-measurement

As is shown in tables T.4 and T.5, a few factors were significantly associated with non-measurement, even after adjusting for other variables. Children who reported a recent illness were significantly less likely to be unmeasured, even after adjusting for other factors. Children who spoke English as their main language and/or who lived in homes that were owned or being purchased by their occupants were also less likely to be missed, and these relationships were usually statistically significant after adjustment for other factors. Those living in rural areas and/or in households which included only

Non-measurement *continued*

Indigenous members were more likely to be missed, but after adjustment for other factors this was not usually statistically significant. Among children aged 5–12 years, Torres Strait Islander children were significantly less likely to be missed than Aboriginal children. No significant difference was observed among children 13–17 years, however.

Imputation

As can be seen in table T.6, mean BMI changed only slightly after including imputed values, which suggests that bias due to non-measurement was minimal.

T.1 REGRESSION COEFFICIENTS FOR BODY MASS INDEX, Children Aged 5–9 Years

	MALES				FEMALES			
	Unadjusted	*Adjusted for age only*	*Adjusted for all factors listed*		*Unadjusted*	*Adjusted for age only*	*Adjusted for all factors listed*	
Variables	Beta	Beta	Beta	SE	Beta	Beta	Beta	SE
Intercept	. .	. .	14.6	1.2	. .	. .	13.4	1.1
Age (years)	**0.4	. .	**0.4	0.1	***0.6	. .	***0.6	0.1
Capital city(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Other urban area	–0.6	–0.5	–0.4	0.4	*–0.9	*–0.9	*–0.9	0.4
Rural	*–1.0	*–1.0	–0.4	0.5	–0.9	–0.8	–0.1	0.5
Torres Strait Islander only(b)	0.3	0.1	0.0	0.8	0.3	0.4	0.5	0.7
Household includes non-Indigenous members	**0.9	**1.1	*0.8	0.4	0.6	0.5	–0.3	0.4
Main language spoken is English	0.8	0.9	–0.2	0.7	**1.8	**1.6	0.6	0.7
Household member went without food in past four weeks	**–1.9	**–2.0	*–1.4	0.7	*–1.6	*–1.5	–1.0	0.8
Reported any illness in past two weeks	0.4	0.5	0.4	0.4	–0.6	–0.5	–0.6	0.3
Annual household income <$20,000	–0.5	–0.7	–0.8	0.5	0.3	0.3	0.1	0.5
Annual household income $20,000–$39,999(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Annual household income $40,000 or more	–0.5	–0.5	–0.2	0.5	–0.3	–0.5	–0.2	0.5
Annual household income unknown	–0.7	–0.8	–0.3	0.5	*–1.0	*–1.1	–1.0	0.5
Dwelling owned or being purchased by occupants	0.8	0.8	0.3	0.6	0.4	0.2	0.1	0.4
Less than 2 people per bedroom(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
2–4 people per bedroom	*–0.9	*–0.8	–0.5	0.4	**–1.3	***–1.5	**–1.4	0.5
More than 4 people per bedroom	**–2.2	**–2.1	–1.2	1.0	*–1.5	*–1.6	–1.1	0.9
No bedrooms	–0.9	–0.8	–0.2	1.2	–3.0	–2.9	–2.7	1.7

(a) The reference group. Regression coefficient is equal to 0 by definition.

(b) Children who were reported to be both Aboriginal and Torres Strait Islander have been excluded due to small numbers in this group.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.2 REGRESSION COEFFICIENTS FOR BODY MASS INDEX, Children Aged 10–12 Years

	MALES				FEMALES			
	Unadjusted	*Adjusted for age only*	*Adjusted for all factors listed*		*Unadjusted*	*Adjusted for age only*	*Adjusted for all factors listed*	
Variables	Beta	Beta	Beta	SE	Beta	Beta	Beta	SE
Intercept	. .	. .	16.9	3.5	. .	. .	10.4	3.4
Age (years)	0.3	. .	0.2	0.3	**0.8	. .	**0.9	0.3
Capital city(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Other urban area	**–1.8	**–1.9	***–2.2	0.6	0.7	0.7	0.4	0.6
Rural	–1.2	–1.3	–0.4	0.8	–0.1	–0.1	0.1	0.7
Torres Strait Islander only(b)	–1.2	–1.2	–1.9	1.3	–0.1	–0.1	0.1	1.1
Household includes non-Indigenous members	0.4	0.4	–0.3	0.6	–0.4	–0.4	–0.7	0.6
Main language spoken is English	*1.7	1.7	0.6	1.1	1.1	1.2	0.0	0.9
Household member went without food in past four weeks	*–2.0	–1.9	*–2.1	1.1	*–2.3	**–2.6	*–2.0	1.0
Reported any illness in past two weeks	0.9	0.8	*1.1	0.5	**–1.3	**–1.2	**–1.3	0.5
Annual household income <$20,000	–0.1	–0.3	–0.1	0.7	0.9	0.9	0.9	0.6
Annual household income $20,000–$39,999(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Annual household income $40,000 or more	0.6	0.6	0.7	0.7	–0.5	–0.7	–0.4	0.6
Annual household income unknown	–1.2	–1.3	–1.0	0.8	**–1.6	**–1.5	–1.2	0.7
Dwelling owned or being purchased by occupants	0.9	0.9	0.4	0.7	0.2	0.4	0.4	0.5
Less than 2 people per bedroom(a)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
2–4 people per bedroom	–0.9	–0.8	–0.8	0.7	*–1.4	*–1.3	–0.8	0.7
More than 4 people per bedroom	–1.8	–1.8	–1.4	1.2	*–2.1	–2.0	–0.7	1.3
No bedrooms	2.1	2.1	3.0	1.6	1.2	1.2	1.4	1.5

(a) The reference group. Regression coefficient is equal to 0 by definition.

(b) Children who were reported to be both Aboriginal and Torres Strait Islander have been excluded due to small numbers in this group.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.3 REGRESSION COEFFICIENTS FOR BODY MASS INDEX, Children Aged 13–17 Years

	MALES				FEMALES(a)			
	Unadjusted	*Adjusted for age only*	*Adjusted for all factors listed*		*Unadjusted*	*Adjusted for age only*	*Adjusted for all factors listed*	
Variables	Beta	Beta	Beta	SE	Beta	Beta	Beta	SE
Intercept	. .	. .	12.2	2.0	. .	. .	16.4	3.0
Age (years)	***0.5	. .	***0.5	0.1	0.3	. .	0.2	0.2
Capital city(b)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Other urban area	**1.1	**1.0	*1.0	0.4	***2.2	***2.2	***2.2	0.6
Rural	0.6	0.6	**1.3	0.5	–0.4	–0.3	–0.2	0.7
Torres Strait Islander only(c)	0.5	0.5	**2.7	0.9	0.6	0.6	–0.3	1.7
Household includes non-Indigenous members	–0.6	–0.5	**–1.1	0.4	–0.4	–0.4	–0.1	0.6
Main language spoken is English	1.2	*1.4	*1.8	0.7	1.4	1.3	0.6	1.1
Household member went without food in past four weeks	0.0	0.1	0.6	0.7	–0.8	–0.7	–0.4	1.1
Reported any illness in past two weeks	–0.3	–0.3	–0.3	0.3	*1.0	*1.0	*1.1	0.5
Annual household income <$20,000	0.4	0.4	0.7	0.6	–1.1	–1.0	–0.5	0.8
Annual household income $20,000–$39,999(b)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Annual household income $40,000 or more	–0.3	–0.4	0.0	0.4	–0.7	–0.8	–0.5	0.7
Annual household income unknown	–0.4	–0.6	–0.7	0.5	–1.1	–1.1	–0.6	0.7
Dwelling owned or being purchased by occupants	0.4	0.4	*0.9	0.4	–0.7	–0.8	–0.3	0.7
Less than 2 people per bedroom(b)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
2–4 people per bedroom	–0.5	–0.7	–0.7	0.4	0.4	0.5	0.7	0.7
More than 4 people per bedroom	–1.1	–1.2	–0.9	1.0	–0.5	–0.5	0.7	1.4
No bedrooms	–0.5	–0.9	–1.2	1.3	–2.9	–2.9	–2.6	1.9

(a) Pregnant females have not been excluded.

(b) The reference group. Regression coefficient is equal to 0 by definition.

(c) People who were reported to be both Aboriginal and Torres Strait Islander have been excluded due to small numbers in this group

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.4 RELATIVE ODDS OF BEING UNMEASURED, Children Aged 5–12 Years

	MALES			FEMALES		
	Unadjusted	*Adjusted(a)*		*Unadjusted*	*Adjusted(a)*	
Variables	Odds ratio	Odds ratio	95% CI(b)	Odds ratio	Odds ratio	95% CI(b)
Age (years)(c)	1.0	1.0	0.9–1.0	**1.1	***1.1	1.0–1.1
Capital city(d)	1.0	1.0	. .	1.0	1.0	. .
Other urban area	1.0	0.9	0.7–1.1	**0.7	***0.6	0.4–0.8
Rural	*1.3	1.0	0.7–1.3	*1.3	1.0	0.8–1.4
Torres Strait Islander only(e)	**0.5	**0.4	0.2–0.7	**0.4	**0.4	0.2–0.8
Household includes non-Indigenous members	***0.6	0.8	0.7–1.0	***0.6	*0.8	0.6–1.0
Main language spoken is English	***0.5	***0.4	0.3–0.6	**0.6	0.8	0.6–1.1
Household member went without food in past four weeks	0.9	*0.6	0.4–0.9	1.2	0.8	0.5–1.3
Reported any illness in past two weeks	***0.7	***0.7	0.6–0.8	**0.8	**0.7	0.6–0.9
Annual household income <$20,000	1.0	1.1	0.8–1.4	**1.4	*1.4	1.1–1.9
Annual household income $20,000–$39,999(d)	1.0	1.0	. .	1.0	1.0	. .
Annual household income $40,000 or more	1.1	*1.3	1.0–1.7	***1.6	*1.4	1.1–1.9
Annual household income unknown	1.3	*1.4	1.0–1.9	*1.4	1.3	0.9–1.7
Dwelling owned or being purchased by occupants	***0.5	***0.5	0.4–0.7	***0.5	***0.5	0.4–0.7
Less than 2 people per bedroom(d)	1.0	1.0	. .	1.0	1.0	. .
2–4 people per bedroom	1.0	**0.7	0.5–0.9	***1.5	1.3	1.0–1.7
More than 4 people per bedroom	1.3	*0.6	0.3–1.0	*1.7	1.0	0.6–1.6
No bedrooms	0.9	**0.4	0.2–0.8	*2.2	1.2	0.6–2.5

(a) Adjusted for all factors listed. Estimates adjusted only for age are not shown as these figures were only minimally different from unadjusted estimates.

(b) Confidence Interval.

(c) Odds ratio refers to a one year increase in age.

(d) The reference group. Odds ratio is equal to 1.0 by definition.

(e) Children who were reported to be both Aboriginal and Torres Strait Islander have been excluded due to small numbers in this group.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.5 RELATIVE ODDS OF BEING UNMEASURED, Children Aged 13–17 Years

	MALES			FEMALES		
	Unadjusted	*Adjusted(a)*		*Unadjusted*	*Adjusted(a)*	
Variables	Odds ratio	Odds ratio	95% CI(b)	Odds ratio	Odds ratio	95% CI(b)
Age (years)(c)	1.0	0.9	0.8–1.1	**0.8	*0.9	0.8–1.0
Capital city(d)	1.0	1.0	. .	1.0	1.0	. .
Other urban area	**1.8	1.2	0.7–2.0	***2.9	**2.2	1.3–3.8
Rural	***2.4	1.1	0.6–2.0	***5.2	**2.5	1.4–4.6
Torres Strait Islander only(e)	1.0	0.9	0.3–2.3	1.1	0.9	0.3–2.8
Household includes non-Indigenous members	***0.4	0.7	0.5–1.2	**0.6	0.8	0.5–1.2
Main language spoken is English	***0.2	***0.3	0.2–0.5	***0.3	**0.4	0.2–0.8
Household member went without food in past four weeks	*1.8	1.5	0.7–2.9	0.8	0.6	0.2–1.3
Reported any illness in past two weeks	***0.5	**0.6	0.4–0.8	***0.4	***0.5	0.4–0.8
Annual household income <$20,000	0.7	1.1	0.6–2.1	**0.4	0.5	0.3–1.1
Annual household income $20,000–$39,999(d)	1.0	1.0	. .	1.0	1.0	. .
Annual household income $40,000 or more	1.3	0.9	0.5–1.5	**1.8	1.5	0.9–2.4
Annual household income unknown	0.8	0.6	0.4–1.1	1.4	1.3	0.8–2.2
Dwelling owned or being purchased by occupants	***0.4	*0.6	0.3–1.0	0.7	0.8	0.5–1.3
Less than 2 people per bedroom(d)	1.0	1.0	. .	1.0	1.0	. .
2–4 people per bedroom	*1.5	1.0	0.6–1.7	*1.5	0.9	0.5–1.5
More than 4 people per bedroom	***4.0	2.0	0.9–4.5	**2.6	0.7	0.3–1.7
No bedrooms	0.7	0.3	0.1–1.5	1.1	0.8	0.2–3.2

(a) Adjusted for all factors listed. Estimates adjusted only for age are not shown as these figures were only minimally different from unadjusted estimates.

(b) Confidence Interval.

(c) Odds ratio refers to a one year increase in age.

(d) The reference group. Odds ratio is equal to 1.0 by definition.

(e) People who were reported to be both Aboriginal and Torres Strait Islander have been excluded due to small numbers in this group.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.6 MEASURED AND IMPUTED MEAN BMI VALUES, Children 5–17 Years

	MALES		FEMALES(a)	
	Measured values only(b)	*Both measured and imputed values(c)*	*Measured values only(b)*	*Both measured and imputed values(c)*
Age group (years)	Mean BMI	Mean BMI	Mean BMI	Mean BMI
5–9	16.79	16.72	16.71	16.76
10–12	18.66	18.62	19.14	19.12
13–17	21.49	21.47	21.86	21.82

(a) Pregnant females have not been excluded.

(b) Includes only those children and young adults for whom height and weight measurements were actually recorded.

(c) Includes all children and young adults, using actual or imputed values as appropriate. Imputation was done by assigning unmeasured individuals with modelled mean BMI values for their particular combination of covariates, using regression coefficients from the adjusted models presented in tables T.1–T.3. See text for more details.

RESULTS FOR ADULTS

The results of analyses involving adults aged 18 years or more are presented in tables T.7–T.10 and are discussed below. In the tables, 'unadjusted' refers to regression models in which only the variable of interest is included (either singly, as with main language, or as a group, as with number of people per bedroom). The estimates listed in this column are from a number of separate models. 'Adjusted for age only' refers to models which include both the variable of interest and age, although only the estimate for the variable of interest is shown. As with unadjusted models, the estimates in this column are from several separate models. The terms 'adjusted' and 'final adjusted model' refer to a single model which includes either all the variables shown ('adjusted') or all the variables for which estimates are presented ('final adjusted model'). That is, the estimates in this column all come from the same model.

Body mass index

Age was significantly associated with BMI among adult males and females even after adjusting for other factors (table T.7). Mean BMI was significantly higher among adults who reported they had diabetes, identified as Torres Strait Islander, said they did not drink recently or said they did not drink at all, and lower among smokers and those living in households with more than four people per bedroom. These differences were statistically significant after adjusting for other factors including age. Adults who spoke English as their main language had higher BMI on average, but this was only significant for males. Males who worked in non-CDEP employment had a higher mean BMI than other males, but the opposite was true for females. Although females who had borne five or more children had a higher mean BMI than did other women, the relationship was greatly attenuated after adjustment for age. Rural residence was associated with lower mean BMI, especially among males, but this was no longer significant after adjustment for other factors.

Obesity

The factors which were significantly associated with the probability of being classified as obese were similar to those associated with mean BMI (table T.8). Torres Strait Islanders and people with self-reported diabetes were significantly more likely, and smokers and recent drinkers were significantly less likely, to be classified as obese. People living in households with more than four people per bedroom were less likely to be classified as obese, but this was only statistically significant among males. In contrast to the results for mean BMI, labour force status was not significantly associated with being classified as obese after adjusting for other factors.

Non-measurement

As is shown in table T.9, several factors were significantly associated with non-measurement, even after adjusting for other variables. Non-measurement was significantly more likely for adults who lived in rural areas, did not drink, lived in households comprised solely of Indigenous members, identified with a clan, tribal or language group, had an annual household income of $40,000 or more, and/or lived in a dwelling that was not owned or being purchased by its occupants. After adjusting for other factors, people in non-CDEP employment were the least likely and those not in the labour force were the most likely to be unmeasured.

Non-measurement *continued*

Torres Strait Islanders were significantly less likely than Aboriginal people to be missing measurements. Smokers were less likely to be unmeasured than non-smokers, but after adjusting for other factors this was only significant among males. People who spoke English as their main language and/or those who finished year 12 or more were less likely to be unmeasured, but after adjusting for other factors these associations were only significant among females. Compared to females who had borne 2–4 children, non-measurement was significantly more likely for those who had borne no children or one child and significantly less likely among those who had borne five or more children, even after adjusting for other factors.

Imputation

As can be seen in table T.10, mean BMI changed only slightly after including imputed values, which suggests that bias due to non-measurement was minimal. Even for the category with the largest change (females aged 55–64), the difference was less than 0.6%.

T.7 REGRESSION COEFFICIENTS FOR BODY MASS INDEX, Adults(a)

	MALES				FEMALES			
	Unadjusted	*Adjusted for age only*	*Final adjusted model(b)*		*Unadjusted*	*Adjusted for age only*	*Final adjusted model(b)*	
Variable	Beta	Beta	Beta	SE	Beta	Beta	Beta	SE
Intercept	. .	. .	25.7	0.5	. .	. .	24.7	0.6
Age group								
18–24(c)	0.0	. .	0.0	. .	0.0	. .	0.0	. .
25–34	***1.8	. .	***1.7	0.3	**1.0	. .	***1.2	0.3
35–44	***3.0	. .	***2.7	0.3	***2.4	. .	***2.2	0.4
45–54	***2.8	. .	***2.4	0.4	***3.4	. .	***2.8	0.5
55–64	***1.8	. .	**1.4	0.5	***5.5	. .	***3.8	0.6
65 or more	0.3	. .	0.0	0.7	**1.9	. .	0.2	0.7
Torres Strait Islander	***2.3	***2.1	***2.3	0.5	***3.2	***3.0	***3.1	0.6
Main language spoken is English	***1.6	***1.7	***1.1	0.3	0.1	0.2	0.7	0.4
Labour force status								
Employed, non-CDEP(c)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Employed, CDEP	***–2.0	***–1.6	**–1.1	0.4	–0.1	0.0	0.4	0.6
Unemployed	***–1.8	***–1.5	***–0.9	0.3	0.4	**1.1	***1.4	0.4
Not in labour force	***–1.2	***–1.3	*–0.7	0.3	*0.7	0.4	*0.7	0.3
Highest year of school completed								
Less than year 10	–0.3	***–0.9	–0.4	0.2	***1.2	0.0	0.2	0.3
Year 10 or year 11(c)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
Year 12 or more	–0.3	0.5	–0.2	0.4	–0.6	–0.2	*–0.9	0.4
Number of people per bedroom								
< 2(c)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
2–4	***–1.4	***–1.3	–0.5	0.3	**–1.1	*–0.7	*–0.8	0.4
> 4	***–3.8	***–3.8	***–2.4	0.6	*–1.8	*–1.7	*–1.6	0.8
No bedrooms	–0.5	–0.7	–0.1	0.7	–0.4	–0.7	–1.2	0.9
Smokes	***–1.9	***–1.9	***–1.4	0.2	***–2.1	***–1.8	***–1.9	0.3
Most recent alcohol consumption								
Within the past week(c)	0.0	0.0	0.0	. .	0.0	0.0	0.0	. .
More than 1 week ago	0.4	0.3	*0.5	0.2	***1.2	***1.1	*0.7	0.3
Never drinks	***1.4	**1.2	**1.1	0.4	***2.1	***1.4	**1.1	0.4
Reported long-term diabetes	***2.1	***1.5	**1.4	0.4	***3.3	***1.9	***1.7	0.5
Area of residence(d)								
Capital city(c)	0.0	0.0	. .	. .	0.0	0.0	. .	. .
Other urban	0.0	0.0	. .	. .	0.2	0.1	. .	. .
Rural	***–1.0	***–1.0	. .	. .	–0.1	–0.1	. .	. .
Dwelling owned or being purchased by occupants(d)	*0.5	0.3	. .	. .	–0.2	–0.5	. .	. .
Annual household income(d)								
< $20,000	–0.5	–0.5	. .	. .	0.1	–0.3	. .	. .
$20,000–$39,999(c)	0.0	0.0	. .	. .	0.0	0.0	. .	. .
$40,000 or more	–0.1	0.1	. .	. .	–0.3	–0.2	. .	. .
Unknown	***–1.0	**–0.8	. .	. .	0.3	0.1	. .	. .
Household includes non-Indigenous members(d)	0.1	0.2	. .	. .	0.0	0.0	. .	. .
Taken away from family as a child(d)	0.2	0.0	. .	. .	0.3	0.1	. .	. .
Identifies with a clan, tribal or language group(d)	0.1	0.0	. .	. .	0.2	0.1	. .	. .
Number of children ever borne(d)								
0	. .	. .	. .	. .	*–0.7	0.3	. .	. .
1	. .	. .	. .	. .	**–1.1	–0.3	. .	. .
2–4(c)	. .	. .	. .	. .	0.0	0.0	. .	. .
5 or more	. .	. .	. .	. .	***1.3	0.3	. .	. .

(a) Non-prisoners aged 18 years or more. Excludes those still attending school and those who reported they were both Aboriginal and Torres Strait Islander. Pregnant females have not been excluded.

(b) Adjusted for all variables for which values are shown.

(c) The reference group. Regression coefficient equals 0 by definition.

(d) Not included in final model.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.8 RELATIVE ODDS OF BEING OBESE, Adults(a)

	MALES				FEMALES			
	Unadjusted	*Adjusted for age only*	*Final adjusted model(b)*		*Unadjusted*	*Adjusted for age only*	*Final adjusted model(b)*	
Variable	Odds ratio	Odds ratio	Odds ratio	95% CI(c)	Odds ratio	Odds ratio	Odds ratio	95% CI(c)
Age group								
18–24(d)	1.0	. .	1.0	. .	1.0	. .	1.0	. .
25–34	*1.3	. .	*1.4	1.1–1.8	*1.3	. .	*1.3	1.0–1.7
35–44	***2.3	. .	***2.2	1.7–3.0	***1.5	. .	**1.5	1.1–2.0
45–54	***2.0	. .	**1.8	1.2–2.6	***1.9	. .	**1.6	1.2–2.3
55–64	**1.7	. .	1.4	0.9–2.2	***3.4	. .	***2.5	1.7–3.8
65 or more	0.8	. .	0.6	0.3–1.4	1.4	. .	1.0	0.7–1.7
Torres Strait Islander	***2.4	***2.3	***2.6	1.7–4.0	***2.7	***2.7	***2.7	1.9–3.8
Main language spoken is English	**1.5	**1.6	*1.5	1.0–2.1	1.0	1.0	1.1	0.9–1.5
Labour force status								
Employed, non-CDEP(d)	1.0	1.0	1.0	. .	1.0	1.0	1.0	. .
Employed, CDEP	*0.7	*0.7	1.0	0.7–1.4	0.7	0.8	0.8	0.5–1.3
Unemployed	***0.6	***0.6	0.8	0.6–1.0	0.9	1.0	1.1	0.8–1.4
Not in labour force	*0.7	*0.7	0.9	0.7–1.2	1.0	0.9	1.0	0.8–1.2
Highest year of school completed								
Less than year 10	1.0	0.8	0.9	0.7–1.2	1.1	*0.8	0.9	0.7–1.1
Year 10 or year 11(d)	1.0	1.0	1.0	. .	1.0	1.0	1.0	. .
Year 12 or more	1.1	1.3	1.0	0.7–1.5	0.8	0.9	**0.6	0.5–0.9
Number of people per bedroom								
< 2(d)	1.0	1.0	1.0	. .	1.0	1.0	1.0	. .
2–4	***0.6	***0.6	*0.7	0.5–1.0	0.8	0.9	0.9	0.7–1.1
> 4	***0.2	***0.2	**0.2	0.1–0.6	0.6	0.7	0.7	0.4–1.2
No bedrooms	0.9	0.9	0.8	0.4–1.6	0.7	0.7	0.6	0.3–1.1
Smokes	***0.5	***0.5	***0.5	0.4–0.7	***0.7	***0.7	***0.7	0.6–0.9
Most recent alcohol consumption								
Within the past week(d)	1.0	1.0	1.0	. .	1.0	1.0	1.0	. .
More than 1 week ago	1.2	1.2	1.2	0.9–1.4	***1.5	***1.5	**1.3	1.1–1.6
Never drinks	***1.7	**1.7	*1.4	1.0–2.0	***1.8	***1.6	***1.6	1.2–2.0
Reported long-term diabetes	***2.3	***1.9	**1.8	1.3–2.6	***2.1	***1.6	**1.6	1.2–2.2
Area of residence(e)								
Capital city(d)	1.0	1.0	. .	. .	1.0	1.0	. .	. .
Other urban	1.0	1.0	. .	. .	1.0	1.0	. .	. .
Rural	*0.8	*0.8	. .	. .	1.0	1.0	. .	. .
Dwelling owned or being purchased by occupants(e)	1.2	1.2	. .	. .	0.9	*0.8	. .	. .
Annual household income(e)								
< $20,000	0.8	0.8	. .	. .	1.0	0.9	. .	. .
$20,000–$39,999(d)	1.0	1.0	. .	. .	1.0	1.0	. .	. .
$40,000 or more	0.9	0.9	. .	. .	1.0	1.0	. .	. .
Unknown	***0.6	**0.6	. .	. .	1.2	1.2	. .	. .
Household includes non-Indigenous members(e)	0.9	0.9	. .	. .	1.1	1.1	. .	. .
Taken away from family as a child(e)	0.8	0.8	. .	. .	1.2	1.1	. .	. .
Identifies with a clan, tribal or language group(e)	*1.2	1.2	. .	. .	1.1	1.0	. .	. .
Number of children ever borne(e)								
0	. .	. .	. .	. .	0.9	1.1	. .	. .
1	. .	. .	. .	. .	0.9	1.1	. .	. .
2–4(d)	. .	. .	. .	. .	1.0	1.0	. .	. .
5 or more	. .	. .	. .	. .	***1.5	1.2	. .	. .

(a) Non-prisoners aged 18 years or more. Excludes those still attending school and those who reported they were both Aboriginal and Torres Strait Islander. Pregnant females have not been excluded.

(b) Adjusted for all variables for which values are shown.

(c) Confidence Interval.

(d) The reference group. Odds ratio is equal to 1.0 by definition.

(e) Not included in final model.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.9 RELATIVE ODDS OF BEING UNMEASURED, Adults(a)

	MALES			FEMALES		
	Unadjusted	*Adjusted(b)*		*Unadjusted*	*Adjusted(b)*	
Variable	Odds ratio	Odds ratio	95% CI(c)	Odds ratio	Odds ratio	95% CI(c)
Age group						
18–24(d)	1.0	1.0	. .	1.0	1.0	. .
25–34	1.1	1.1	0.8–1.4	1.2	**1.4	1.1–1.7
35–44	1.2	1.3	1.0–1.7	**1.4	***1.8	1.4–2.3
45–54	*1.4	1.4	1.0–1.9	1.0	1.1	0.8–1.5
55–64	1.4	1.1	0.7–1.7	1.2	1.0	0.7–1.5
65 or more	***4.4	***2.6	1.6–4.1	1.1	0.9	0.6–1.3
Torres Strait Islander	0.7	*0.6	0.4–1.0	**0.6	***0.3	0.2–0.5
Main language spoken is English	***0.4	0.8	0.6–1.0	***0.4	***0.6	0.5–0.8
Labour force status						
Employed, non-CDEP(d)	1.0	1.0	. .	1.0	1.0	. .
Employed, CDEP	***2.1	1.3	1.0–1.8	**1.6	1.1	0.8–1.6
Unemployed	***1.6	**1.5	1.1–1.9	*1.3	1.3	1.0–1.7
Not in labour force	***2.7	***1.7	1.3–2.2	***1.9	***2.1	1.7–2.6
Highest year of school completed						
Less than year 10	***1.6	1.1	0.9–1.4	***1.3	1.2	1.0–1.4
Year 10 or year 11(d)	1.0	1.0	. .	1.0	1.0	. .
Year 12 or more	*0.7	0.7	0.5–1.1	**0.6	**0.6	0.5–0.9
Number of people per bedroom						
< 2(d)	1.0	1.0	. .	1.0	1.0	. .
2–4	***1.6	1.0	0.8–1.2	**1.3	**0.7	0.6–0.9
> 4	***2.5	1.2	0.8–1.9	***2.3	0.8	0.6–1.2
No bedrooms	***2.7	1.3	0.8–2.1	***2.1	0.9	0.6–1.4
Smokes	0.9	**0.7	0.6–0.9	**0.8	0.9	0.7–1.0
Most recent alcohol consumption						
Within the past week(d)	1.0	1.0	. .	1.0	1.0	. .
More than 1 week ago	1.1	0.8	0.7–1.0	1.0	1.0	0.9–1.2
Never drinks	***2.1	*1.4	1.0–1.8	***1.7	**1.3	1.1–1.6
Reported long-term diabetes	1.3	0.8	0.6–1.2	1.1	0.8	0.6–1.1
Area of residence						
Capital city(d)	1.0	1.0	. .	1.0	1.0	. .
Other urban	***1.5	1.1	0.9–1.4	***1.3	*1.3	1.1–1.6
Rural	***2.3	*1.3	1.0–1.8	***2.3	***1.8	1.4–2.2
Dwelling owned or being purchased by occupants	***0.5	*0.7	0.5–0.9	***0.4	***0.5	0.4–0.6
Annual household income						
< $20,000	***1.6	1.2	0.9–1.6	1.0	0.9	0.8–1.2
$20,000–$39,999(d)	1.0	1.0	. .	1.0	1.0	. .
$40,000 or more	***1.4	**1.4	1.1–1.8	1.1	*1.3	1.0–1.6
Unknown	1.2	1.0	0.8–1.3	*1.2	1.2	0.9–1.4
Household includes non-Indigenous members	***0.3	***0.5	0.4–0.6	***0.5	**0.7	0.6–0.9
Taken away from family as a child	1.2	1.1	0.8–1.5	1.2	1.1	0.9–1.5
Identifies with a clan, tribal or language group	***1.8	*1.2	1.0–1.5	***1.6	*1.2	1.0–1.4
Number of children ever borne						
0	. .	. .	. .	1.0	*1.3	1.0–1.6
1	. .	. .	. .	1.1	*1.3	1.0–1.6
2–4(d)	. .	. .	. .	1.0	1.0	. .
5 or more	. .	. .	. .	0.9	***0.7	0.6–0.9

(a) Non-prisoners aged 18 years or more. Excludes those still attending school and those who reported they were both Aboriginal and Torres Strait Islander. Pregnant women have not been excluded.

(b) Adjusted for all factors listed.

(c) Confidence Interval.

(d) The reference group. Odds ratio is equal to 1.0 by definition.

Statistical significance is indicated as follows:

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

T.10 MEASURED AND IMPUTED MEAN BMI VALUES, Adults(a)

	MALES		FEMALES	
	Measured values only(b)	*Both measured and imputed values (c)*	*Measured values only(b)*	*Both measured and imputed values(c)*
	Mean BMI	Mean BMI	Mean BMI	Mean BMI
Overall	**26.74**	**26.67**	**27.12**	**27.13**
Age group (years)				
18–24	25.10	25.01	25.45	25.42
25–34	26.86	26.76	26.50	26.55
35–44	28.10	28.05	27.83	27.83
45–54	27.87	27.86	28.83	28.83
55–64	26.90	26.84	30.98	30.80
65 or more	25.42	25.43	27.40	27.26
Area of residence				
Capital city	27.06	27.13	27.04	27.07
Other urban	27.01	26.89	27.25	27.24
Rural	26.05	26.02	26.98	27.02
Indigenous group				
Aboriginal	26.62	26.56	26.92	26.96
Torres Strait Islander	28.90	28.82	30.10	30.06

(a) Non-prisoners aged 18 years and over, excluding those who were still attending school and those who reported they were both Aboriginal and Torres Strait Islander. Pregnant females have not been excluded.

(b) Includes only those adults for whom height and weight measurements were actually recorded.

(c) Includes all adults, subject to the exclusions in (a), using actual or imputed values as appropriate. Imputation was done by assigning to unmeasured individuals the mean BMI values for their particular combination of covariates, using regression coefficients from the adjusted models presented in table T7.

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