NSW Food and Nutrition Monitoring Project

NSW Centre for Public Health Nutrition

Recommendations for monitoring overweight and obesity in NSW

The University of Sydney

NSW HEALTH
Better Health *Good Health Care*

Health
Working as a Team
The Way Forward

State Health Publication No (HP) 000028
ISBN: 0 7347 31434

This publication is available from the NSW HealthNet/Web.
www.health.nsw.gov.au

Suggested citation: (2000) Recommendations for Monitoring Overweight and Obesity in NSW. NSW Department of Health, State Publication No (HP) 000028.

Abbreviations

ABS	Australian Bureau of Statistics
ACHPER	Australian Council for Health, Physical Education and Recreation
AGPS	Australian Government Publishing Service
AHFS	Australian Health and Fitness Survey
AIHW	Australian Institute of Health and Welfare
ASCO	Australian Standard Classification of Occupations
ATSI	Aboriginal and Torres Strait Islander
BMI	Body Mass Index
CCLO	Classification and Classified List of Occupations
CHDEWG	Coronary Heart Disease Expert Working Group
CVD	Cardiovascular disease
HPS	Health Promotion Survey
MONICA	Multinational Monitoring of trends and determinants in Cardiovascular disease
NATSIS	National Aboriginal and Torres Strait Islander Survey
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHF RFPS	National Heart Foundation Risk Factor Prevalence Study
NNS	National Nutrition Survey
RFPS	Risk Factor Prevalence Survey
WHR	Waist to hip ratio

Contextual Note - Links with the Australian Food and Nutrition Monitoring Unit

The work undertaken in the development of this document preceded the establishment of the Australian Food and Nutrition Monitoring Unit. The Unit was established at the University of Queensland in 1999 by the Commonwealth Department of Health and Aged Care to develop an ongoing nationally coordinated food and nutrition monitoring system for Australia.

Many of the modules and recommendations contained in this document are still current and relevant to NSW. However, since the writing of this document, the Australian Food and Nutrition Monitoring Unit has begun work on several key areas which will contribute to and enable better food and nutrition monitoring at the State and Area level in NSW.

Key projects of the Australian Food and Nutrition Monitoring Unit include:

Compendia of data sources, Methodological Guidelines, and Indicators

- a food and nutrition data sources catalogue, and a framework for its use;
- guidelines for the use and interpretation of dietary data from the 1995 national nutrition survey;
- guidelines for using and comparing existing national dietary survey data;
- specifications of standard questions and guidelines for measuring selected food habits in the Australian population (including the prevalence of breastfeeding);
- a set of nationally agreed indicators for monitoring the nutrition situation in Australia

Reports on the food and nutrition situation in Australia

- a comprehensive report on the food and nutrition intake trends of Australians
- a status report on the diet and health of the Australian population
- an interim evaluation of the effects of folate fortification, and
- collation of data on food and nutrition status of population subgroups.

It is within this context that the information and recommendations contained herein should be considered. Further work in nutrition monitoring in NSW will need to be undertaken in collaboration with AFNMU, and focus on those monitoring activities which are best undertaken at State and Area levels.

Further information about the Australian Food and Nutrition Unit can be found at the website address http://www.acithn.uq.au/nutrition/monitoring
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Executive Summary

What is the purpose of this report?

The recommendations outlined in this document suggest future directions for food and nutrition monitoring in NSW and will be used by NSW Health to guide the development of the Food and Nutrition Monitoring system in NSW.

The report recommends standard methods for the collection, measurement and analysis of data related to the monitoring of overweight and obesity in NSW.

Why is it important to monitor overweight and obesity?

1. To provide information on prevalence and trends.
2. To provide information for policy makers and field workers, who when consulted, identified overweight and obesity as a priority issue for nutrition monitoring.
3. To assess progress towards State cardiovascular disease goals and targets and Area Performance Contracts.
4. To contribute to the overall information required for national monitoring of this significant problem.

Who is this report for?

1. **NSW Health Department** – including the Food and Nutrition Unit, the Centre for Clinical Policy and Practice, the Epidemiology and Surveillance Branch, and the Centre for Disease Prevention and Health Promotion.
2. **NSW Area Health personnel** – including Health Promotion and Public Health Unit personnel, Community Nutritionists, and Health Outcomes Councils.
3. **Others** interested in monitoring overweight and obesity, for example, the NHMRC and AIHW who are considering standardised methods for monitoring weight status and weight related beliefs and practices.

What does this report contain?

It includes a review of the literature, current views about measurement, and **recommendations** regarding:

1. What target groups to monitor
2. What and how to measure overweight and obesity
3. Standards for classifying people as overweight or obese
4. How to sample a population to give a representative picture
5. Options for obtaining NSW information

Summary of recommendations

1. Recommended target groups: (Section 2, p.17)

- men aged 25–40 years
- menopausal women
- Aboriginals
- children and adolescents
- older people
- people from low socio-economic groups
- people from non-English speaking backgrounds

2. Recommended measures: (Section 3, pp. 27-35)

- weight
- height
- abdominal circumference – in the adult population
- socio-demographic information
- attitudes and practices related to weight management

3. Recommended indices derived from measurements: (Section 3, p.27)

- BMI – compare to cut-points for children and adults
- z-scores – compare to reference population for young children

***4. How to measure overweight and obesity*:** (Section 4.1, p.39-42)

The recommended methods for measuring weight, height and abdominal circumference are described in the protocols herein, adapted from the World Health Organization (WHO) recommended protocols.

5. Recommended questions to obtain self-reported data: (Section 4.2, p.42)

1. How tall are you without shoes?
   ________ centimetres

   or
   ________ feet _______inches

2. How much do you weigh without clothes or shoes?
   ________ kilograms

   or
   ________ stones _______ pounds

6. *The validation of self-reported data:* (Section 4.3, p.42)

The validity of self-reported data needs to be assessed at regular intervals by measuring weights and heights. Those who are overweight are more likely to under report their weight and over report their height. It also appears likely that the way people self-report their heights and weights may vary over time. Validation of the NSW Health Survey data on heights and weights will provide information on the accuracy of self-reported data using telephone methodology.

7. *Self-reported data in children and adolescents:* (Section 4.4, p.44)

Until more information is available about the validity of self-reported heights and weights in this group, it is recommended that surveys of children and adolescents should **not** rely on self-reported weight and height as a means to determine weight status.

8. *Measuring heights and weights in children and adolescents:* (Section 4.4, p.44-45)

Priority should be given to surveying weights and heights of children and adolescents on a routine basis, and disseminating results and planning actions to address problems identified.

9. *Measured or self-reported abdominal circumferences:* (Section 4.5, p.45)

Until more information is available about the validity of self-reported abdominal measurements, only measured or self-measured (with clear instructions and tape provided) abdominal measurements should be conducted on the adult population.

10. *Standards for classifying overweight and obesity in the general population* (Section 5.1, pp.47-49)

Commonly used categories for comparisons with past surveys are grouped as: 'underweight', 'acceptable weight', 'overweight' and 'obese'.

Underweight	BMI <20
Acceptable weight	20 ≤ BMI <25
Overweight	25 ≤ BMI < 30
Obese	BMI ≥ 30

To maintain consistency with the National Nutrition Survey, a further refined breakdown of categories is recommended (using a modified version of the latest recommendations by WHO).

Underweight	BMI <18.5	(WHO grade 1,2 and 3 thinness)
Normal weight	(report the two categories of cut-points separately to allow comparison with past data sets)	
	18.5 ≤ BMI < 20	(WHO normal range 18.5–24.99)
	20 ≤ BMI < 25	
Overweight	25 ≤ BMI < 30	(WHO grade 1 overweight)
Obese	BMI ≥ 30	(WHO grade 2 overweight 30.0–39.99, WHO grade 2 overweight ≥ 40.00)

Example of interpretation of BMI category: 25 ≤ BMI < 30 = 25.00–29.99
Combine the 'thin' categories and 18.5–< 20 of the normal category to provide an 'underweight' category for comparisons with past surveys.

11. *Weight status categories for use with the Aboriginal population:* (Section 5.2, p.49)

Until more information is available about the distribution of fat and its relationship with BMI in the Aboriginal population, the BMI categories recommended for the general adult population should be used for interpreting information about the Aboriginal population. Acknowledging the limitations of this weight classification, this information still provides a means of tracking change over time.

12. *Weight status categories for people from different ethnic backgrounds:* (Section 5.3, p.51-52)

There are no definitive BMI categories for use with people from different ethnic populations (though these are currently being researched). For the present, the BMI categories recommended for the general adult population should be used for people from different ethnic populations. Acknowledging the limitations of the weight classification for ethnic groups, the information still provides a means of tracking change over time. If different BMI categories are eventually recommended, they are likely to vary between these groups.

13. *Standards for classifying weights of children 0–8 years:* (Section 5.4.1, pp.53-55)

Use the z-score definitions for classifying the weight status of children aged 0–8 years. Compare these to the National Center for Health Statistics/WHO reference population until improved international reference population data exists. The z-scores are:
For children of low weight:

- low weight for height: < -2 z-score of the sex specific reference value for age (Represents degree of thinness or wasting)
- low weight for age : < -2 z-scores of the sex specific reference value for age (Represents degree of lightness or underweight)

For children overweight:

- high weight for age: > +2 z-scores of the sex specific reference value for age (Represents degree of heaviness or overweight)
- high weight for height:> +2 z-scores of the sex specific reference value for age (Represents degree of heaviness or overweight)

Based on the normal distribution of a population, the expected values for each of these -2 and +2 z-scores is 2.3%. If the z-score exceeds this amount then there is cause for concern.

14. *Classifying weights of children 9–15 years:* (Section 5.4.2, p.55-57)

Reference data recommended for use:

1. Australian data derived from the Australian Health and Fitness Survey (Lazarus et al 1995). This provides a reference data set from an Australian population of children.
2. US reference data (National Health and Nutrition Examination Survey-1) (Must et al 1991) for comparisons to the National Nutrition Survey and international data.

‘At risk of overweight’: ≥ 85th percentile BMI and < 95th percentile BMI (when BMI ≤ 30) for age and sex of reference population (see above).
Overweight: ≥ 95th percentile for age and sex or BMI >30.
To indicate **thinness**: < 5th percentile BMI.

15. Classifying weights of 16–24 year olds (Section 5.4.3, p.57)

Given the similarity of the US cutpoints in this age range to the adult recommended cutpoints, and the common use of 18–24 year old age group using adult cutpoints, it is recommended that weight classification for this age group be consistent with the general **adult weight classification.**

This recommendation should be reviewed as more population-based survey data becomes available, especially for the 16–17 year old age group.

16. Possible options to obtain weight status information about the NSW general population: (Section 6.1, p.61)

- National Nutrition Survey
- New survey that measures weights and heights
- Self-reported data from the NSW Health Survey
- Measure weights and heights from a subsample of the NSW Health Survey
- Women's Health Study – longitudinal survey, 1996– 2016
- Blue Mountains Eye Study

17. Possible options to obtain weight status information about NSW children: (Section 6.2, p.62)

- Include measured weights and heights in the Drug and Alcohol Survey
- Repeat the School Survey of Fitness and Physical Activity
- Regularly collect weights and heights of all schoolchildren to monitor overweight, obesity and growth

18. Presentation and analysis of data: (Section 7, p. 65-69)

Descriptive statistics:
For population / sample data report the following:
- mean
- median
- standard deviation
- standard error of mean
- 95% confidence intervals
- centile distribution

In adults:
- Report the above information by sex and 5-year age groups (where the sample permits).
- Report proportion of population classified as:
  Underweight
  Acceptable weight
  Overweight
  Obese

In adolescents:
- Report the above descriptive statistics by sex and year of age for BMI
- Report frequency of adolescents with BMI > 30.
- Report frequency of those considered at risk of overweight (≥ 85th percentile) relative to the reference data.
- Report frequency of those considered overweight (≥95th percentile) relative to the reference data.
- Report frequency of thinness (<5th percentile) relative to the reference data.

Section 1: Introduction

1.1: The context of this report

This report forms part of the *Recommendations for Food and Nutrition Monitoring in NSW* document (NSW HD 2000) which aims to:

1. Provide, timely, high-quality, accessible, appropriate data for decision-making about nutrition in NSW.
2. Complement relevant national, State and local initiatives relevant to nutrition monitoring.
3. Take particular account of measurement and interpretation issues of any nutritionally vulnerable groups such as Aboriginal communities and lower socioeconomic groups.

Overweight and obesity is an important issue for monitoring and is identified in:

1. State and National cardiovascular disease goals and targets
2. National documents, such as the *Acting on Australia's Weight* (NHMRC 1997)
3. Consultations conducted with workers in nutrition and public health, as part of the NSW Food and Nutrition Monitoring Project
4. Area Performance Contracts

1.2: The purpose of this report

The aim of this report is to standardise methods used for the collection, measurement, analysis and interpretation of data related to the monitoring of overweight and obesity in NSW.

In the past, surveys in NSW which have included weight and height assessment, have used a variety of measurement methods and criteria for classifying weight status, making it difficult to compare results. For the purposes of monitoring, it is vital to be able to compare new data to past data collections in order to establish trends.

1.3: Who is this report for?

This report is suitable for use by:

1. **NSW Health Department**, particularly useful for the Food and Nutrition Unit, the Centre for Clinical Policy and Practice, the Epidemiology and Health Surveillance Branch, and the Centre for Disease Prevention and Health Promotion. The information in this report can be used at the State level by those planning surveys of the general population and target groups which require the assessment of weight status. The report outlines what types of data needs to be collected and standards used for classifying the weight status of the population.

2. **NSW Area health personnel**: such as, Health Promotion and Public Health Unit personnel, Community Nutritionists, and Health Outcomes Councils. The report provides information on monitoring the general population and specific target groups, including information about sampling issues, methods for data collection and standards used for classifying the weight status of the population.

3. Interest at the **national level**: the National Health and Medical Research Council (NHMRC) and the Australian Institute of Health and Welfare (AIHW) are currently considering standardised methods to monitor weight status and weight related practices. At the commencement of this project, The *National Health Data Dictionary* which describes data standard for anthropometric body composition measurement for Australian adults, had not been published. However, towards the conclusion of this project the draft became available (AIHW 1997), and was cross-checked with our report to ensure comparability of recommended standards and practices. The NSW report may require review once national initiatives for monitoring overweight and obesity have been finalised.

4. Interest at the **international level**: data produced from a standardised system of monitoring overweight and obesity contributes to information on this issue at the international level. Currently, the Rowett Research Institute, Aberdeen, United Kingdom is compiling international data sets on the prevalence of overweight and obesity. In addition, UNICEF requires all countries to report the prevalence of children 0-5 years, with weight and height for age below z-scores of -2 (refer tosection 5.4).

1.4: The importance of monitoring overweight and obesity

Monitoring overweight and obesity in Australia provides information about its prevalence and trends. It can be used by policy makers and field workers to highlight an area or group of concern for intervention, and/or to assess the effectiveness of intervention.

1.4.1: The prevalence of overweight and obesity in Australia

The prevalence of overweight and obesity, its associated health consequences and the economic costs attributable to it combine to make overweight and obesity a significant public health problem in Australia (Crawford 1995). Overweight and obesity are risk factors for a number of diseases, including hypertension, hyperlipidaemia, non-insulin dependent diabetes mellitus, gall bladder disease and cardiovascular disease (Burton, Hirsh and Van Itallie 1985). The Centre for Health Program Evaluation (CHPE) and the Australian Institute of Health and Welfare (AIHW) (Crowley et al 1993) have estimated the cost of obesity as $810 million per year (in 1992–93 dollar terms), 63% of which are direct costs. It has also been estimated that 300,000 consumers spend a further $500 million for weight control programs each year in Australia.

The most recently available estimates of the prevalence of overweight and obesity based on measured height and weight come from the 1989 National Heart Foundation Risk Factor Prevalence Survey (RFPS), where 48 % men and 34% of women aged 20–69 years were overweight or obese (RFPSMC 1990). The 1980, 1983 and 1989 NHF RFPSs are also the main sources of data used to give an indication of secular trend in overweight and obesity over that time. The trend in the data from these surveys was analysed by Bennett and Magnus (Bennett and Magnus 1980–89), adjusted for age and survey design factors, to show an increase in prevalence of overweight and obesity in men and women, aged 25 to 64 years, from 1980 to 1989 (see Table 1.1a and 1.1b). These surveys were conducted only in capital cities, and do not include any rural participants and were restricted to catchment areas within 16 km of the NHF centres.

Table 1.1a: Weight status of adults from 1980, 1983, 1989 NHF RFPS, males

Weight Status	1980 (%)	1983 (%)	1989 (%)
Underweight	4.8	4.7	3.1
Acceptable	45.4	46.2	41.3
Overweight	40.6	40.0	44.1
Obese	9.3	9.1	11.5
Overweight or obese	49.8	49.1	55.6

Source: Bennett and Magnus 1994

Table 1.1b: Weight status of adults from 1980, 1983, 1989 NHF RFPS, females

Weight Status	1980 (%)	1983 (%)	1989 (%)
Underweight	16.7	14.1	11.8
Acceptable	55.0	53.4	49.8
Overweight	20.2	22.0	25.1
Obese	8.0	10.5	13.2
Overweight or obese	28.3	32.5	38.3

Source: Bennett and Magnus, 1994

Other data based on self-reported weights and heights from the 1989–90 National Health Survey (NHS) and from the ABS Household Monitoring Survey also indicate that the prevalence of overweight and obesity is increasing. The 1989–90 NHS reported the prevalence of overweight or obesity as 44 % among males and 30% among females (ABS 1995); the 1995 ABS Population Survey Monitor reported overweight or obesity prevalence as 50% among males and 34% among females (AIHW 1995).

Information in NSW from the 1994 NSW Health Promotion Survey, based on self-reported data, showed the prevalence of overweight and obesity as 48% for males and 31% for females (NSWHD 1995).

1.4.2: Australian and NSW Goals and Targets

In response to the high prevalence of overweight and obesity and the trend of increasing weight levels, Australian health authorities have identified health goals for obesity. The goals and targets that have been set for the year 2000 are based within the overall strategy for reducing cardiovascular disease (CDHSH 1994).

At the NSW State level, reducing the prevalence of overweight and obesity is a goal within the *Coronary Heart Disease NSW Goals and Targets and Strategies for Health Gain* (NSW CHDEWG 1995). These goals and targets are shown in Table 1.2.

Table 1.2: NSW health goals and targets relating to obesity

Health goals for adults	Year 2000 target	Baseline Data
Increase proportion with an acceptable body weight	Men 60% Women 60%	Men 48.8% Women 51.0% (Source: 1989–90 ABS National Health Survey)
Reduce the prevalence of overweight	Men 40% Women 25%	Men 44.2% Women 30.6% (Source: 1989–90 ABS National Health Survey)
Reduce the prevalence of abdominal obesity	Men 38% Women 18%	Men 41.8% Women 21.3% (Source: 1989 NHF RFPS)

Source: NSW CHDEWG 1995 and Commonwealth Department of Human Services and Health, 1994

Another important development has been the recent formation of the Working Party of National Health and Medical Research Council (NHMRC) to develop a strategy for the prevention of overweight and obesity *Acting on Australia's Weight* (NHMRC 1997). This stresses the significance of obesity as a public health problem and highlights the need for action. The document lists as one of its strategies, the monitoring of overweight and obesity, emphasising the need to monitor:

1. weight and waist measurements using standardised methods,
2. physical activity, and
3. dietary intake and diet-related weight control practices.

Crawford (Crawford and Owen 1994: 162) also emphasises the importance of obtaining a more "detailed understanding of the nature, extent and distribution of weight control concerns and of the behaviours associated with them" while attempting to develop initiatives to reduce the prevalence of overweight (Crawford 1995).

1.4.3: The use of overweight and obesity data provided by a monitoring system

The purpose of monitoring overweight and obesity is not simply to improve the data available about this problem, but more importantly, to improve the use of the information for public health professionals to find solutions. Such information should help with planning, programs, problem-solving and evaluation.

In the United States, experience with state-level and community-based nutrition monitoring has shown that often, data are accumulated, but that improved access to data does not necessarily lead to use of the information to improve decision-promoting abilities of nutrition professionals (Pelletier 1994). The reasons for this are many but include a lack of relevance or perceived importance of the information to the priorities of health professionals, lack of interpretation and effective dissemination of the data, and limited knowledge and skills among health professionals about how to use the data appropriately to plan interventions.

In order to avoid these problems, consultations were conducted with field workers in nutrition and public health to ensure that data recommended for collection was identified as useful to public health professionals. Overweight and obesity was highlighted as an important nutrition issue: **'the weight status of adults'** and **'the growth and weight status of children'** were commonly identified in the top 10 issues by various groups. Consultants reported using (or wanting to use) information on overweight and obesity to:

1. identify factors affecting problems (for example, monitoring physical activity),
2. assess the effectiveness of interventions, and
3. support initiatives to prevent overweight and obesity.

In recent years, local Area Health Services in NSW have directed some of their attention to nutrition. Area Performance agreements with the NSW Health Department now include strategic activities and performance indicators relating to diet, overweight and obesity, and physical activity.

1.5: What about underweight?

This report concentrates on the health issue of overweight and obesity. It is well known that underweight is also a significant health problem in some groups, for example, growth stunting and wasting amongst some Aboriginal children, anorexia nervosa amongst some adolescent girls and under nutrition amongst some older people.

The emphasis of this report is to monitor overweight and obesity and therefore the target groups differ from those of most concern for underweight monitoring. However, some of the standards developed in the document may also be useful for monitoring underweight, such as the recommended techniques used for measurements and the standards for classifying underweight in the population.

It may be useful to monitor underweight in order to check for potential harmful side-effects that may result from an over zealous approach to decreasing overweight and obesity. Included in the *Recommendations for Food and Nutrition Monitoring in NSW* (NSW HD 2000) is a recommendation that a plan for growth monitoring be developed, to monitor growth in any children in vulnerable population groups, such as Aborigines and those of low socioeconomic status.

1.6: What this report contains

The following sections on overweight and obesity present a review of the literature and current views, and make recommendations regarding:

- what target groups to monitor
- what and how to measure overweight and obesity
- standards for classifying individuals and populations as overweight and obese
- how to sample a population
- how to present and analyse data about overweight and obesity
- options for obtaining NSW information

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Section 2: Who to monitor

2.1: Criteria

Information from the 1989 NHF RFPS, the 1989–90 National Health Survey and the more recent 1995 ABS Population Survey Monitor indicates that **five out of ten Australian men and three out of ten Australian women are overweight or obese.** However, certain groups within the Australian population are of particular concern because they meet one or more of the following criteria:

1. they have a greater prevalence of overweight and obesity than the general population;
2. they have a prevalence of overweight or obesity increasing at a faster rate than the general population;
3. they are at an age or stage of life susceptible to putting on weight;
4. there is limited information about the group but we suspect a problem of overweight or obesity because of life circumstances or the stage of life.

2.2: Target groups

Recommendation 1: Target groups
In *Acting on Australia's Weight* (NHMRC 1997) the target groups for the strategic plan are:

- men aged 25–40 years;
- menopausal women;
- Aboriginal and Torres Strait Islander peoples;
- and children and adolescents.

In addition to these target groups, *Recommendations for Food and Nutrition Monitoring in NSW* (NSW HD 2000) also recommends targeting:

- older people;
- people with low socio-economic status;
- and people from non-English speaking backgrounds (NESB).

2.2.1: Men aged 25–40 years

Estimates of the prevalence of overweight and obesity based on measured heights and weights from the 1989 NHF RFPS, were 48% for men and 34% for women, aged 20–69 years (RFPSMC 1990). The prevalence of overweight and obesity was lowest amongst the 20–24 year olds and increased with age. The greatest differences in the proportion of overweight and obesity occurred between the ages of 25 and 40 years in men (NHMRC 1997a) (see Table 2.1). The prevalence of overweight and obesity from age category 20–24 years to aged category 35–39 years doubled, increasing from 25% to 51%.

From the same survey abdominal obesity was estimated using the waist-to-hip ratio, derived from the measurement of waist and hip circumference. The proportion of men with a high waist-to-hip ratio (≥0.9) increased steadily with age, up to age group 45–49 years and then remained fairly stable at around 60%.

Table 2.1: Prevalence of overweight and obesity based on measured height and weight for men and women aged 20–69 years in Australian capital cities, 1989

BMI	20-24 years %	25-29 years %	30-34 years %	35-39 years %	40-44 years %	45-49 years %	50-54 years %	55-59 years %	60-64 years %	65-69 years %	All (20-69)
Men											
Ovwt	19	30	36	43	43	46	45	45	49	50	39
Obese	6	6	6	8	9	12	15	16	11	11	9
Ovwt or obese	25	36	42	51	52	58	60	61	60	61	48
Women											
Ovwt	13	13	14	21	23	29	30	29	37	36	22
Obese	4	8	8	8	7	15	19	23	15	21	11
Ovwt or obese	17	21	22	29	30	44	49	52	52	57	33

Excludes pregnant women
Source: Risk Factor Prevalence Study Management Committee 1990

2.2.2: Menopausal women (45–55 years)

The greatest increases for women were at age 45–54 years, increasing from 30% at age category 40–44 years to 49% at age category 50–54 years (see Table 2.1).

For women, the proportion with a high waist-to-hip ratio (≥0.8) rose slowly up to age group 40–44 years and then increased sharply, up to approximately 50%.

2.2.3: Older people

The prevalence of overweight and obesity increases with age. For men the prevalence of overweight and obesity reaches a peak of approximately 60% at age 50–54 years and then maintains a plateau. In women there is a continual increase in weight until the mid 60's, when it reaches a reported high of 57% in the age category 65–69 years.

2.2.4: Children and adolescents

The Australian Council for Health, Physical Education and Recreation (ACHPER) conducted a national survey of schoolchildren, aged 7–15 years, in 1985, known as the Australian Health and Fitness Survey. This survey was the first nationally representative anthropometric survey of Australian children and established 'baseline' reference data. The survey included measured weights and heights, skinfold thickness, and physical activity levels of school children. Lazarus et al. (1995) used the data from this survey to derive Australian BMI cutoffs for age and sex. For example, at age 12, boys have a BMI cut-off of 21.0 at the 85th percentile ('at risk for overweight') and a BMI cut-off of 23.9 at the 95th percentile ('overweight') (see Section 5 for further explanation of use of BMI in children and adolescents). These BMI cut-offs tend to be lower than the US recommended cut-off points, indicating the Australian children are lighter than US children (US 12 year old boy 85th percentile BMI = 21.3; 95th percentile BMI = 25.0) (Himes and Dietz 1994).

The 1995 National Nutrition Survey will provide measured weights and heights on children aged 2 years and over. The *Plan for national food and nutrition monitoring program* (Coles-Rutishauser and Lester 1995) recommends the regular collection and collation of child health data for the purpose of growth monitoring, and to indicate trends in the weight status of children. As yet, despite the existence of the 1995 National Nutrition Survey, there is no plan for regular data collection of measured weights and heights of children.

2.2.5: Aboriginal and Torres Strait Islander peoples

In 1994 the ABS conducted *The National Aboriginal and Torres Strait Islander Survey* (NATSIS) (ABS 1994) which included the measurements of heights and weights of participants 5 years and over. Of the people 18 years and over, in NSW, 60 % of males and 61% of females were classified as overweight or obese. The prevalence of overweight or obesity for males is similar to the national figure from this survey, however the prevalence of overweight or obesity is higher in females in NSW than the national figure (see Table 2.2a and 2.2b) (compare 61% to 57%). These results do not include those who did not agree to be measured. In NSW 19% of males, and 28% females were not measured.

Information is limited about the measured weights and heights of children and adolescents from the NATSI survey. What has been reported to date is from adolescents aged 13–18 years and uses adult BMI cut-off points to categorise weight status. It is also difficult to obtain other data on the growth of children in Aboriginal groups. Included in the *Recommendations for Food and Nutrition Monitoring in NSW* (NSW HD 2000) is a recommendation that a plan for growth monitoring be developed, to monitor the growth of any children in vulnerable population groups, such as Aborigines and those of low socioeconomic status.

Table 2.2a: Weight status among indigenous people aged 18 years and over of those who were measured, males

Weight Status	NSW %	Total Australia %
Underweight (BMI < 20)	6.5	7.8
Acceptable weight (BMI 20–25)	33.3	32.6
Overweight (BMI>25, ≤30)	34.7	35.6
Obese (BMI>30)	25.4	24.0
Overweight or obese	60.1	59.6

Source: derived from ABS NATSIS

Table 2.2b: Weight status among indigenous people aged 18 years and over of those who were measured, females

Weight Status	NSW %	Total Australia %
Underweight (BMI <20)	13.5	12.9
Acceptable weight (BMI 20–25)	25.5	29.8
Overweight (BMI>25, ≤30)	32.0	28.7
Obese (BMI >30)	29.0	28.6
Overweight or obese	61.0	57.3

Source: derived from the ABS NATSIS

Several NSW Better Health Program projects have measured the prevalence of overweight and obesity among Aboriginals. However, the body mass index cut-offs used to define overweight and obesity varied among projects, making it difficult to compare the data. Table 2.3 summarises these surveys (Boyle and Dobson 1992) . The Aboriginal population of Wilcannia had the highest proportion of overweight or obesity in women (64%) . The non-Aboriginal population of Wilcannia was also measured, and the prevalence of overweight and obesity in non-Aboriginal men was higher than Aboriginal men (compare 58% to 46%) but the prevalence in Aboriginal women was higher than non-Aboriginal women (compare 64% to 56%).

Table 2.3: Prevalence of overweight and obesity based on measured weight and height among Aboriginals in project of the NSW Better Health Program

Region	Project	Age range	Sample size	Males (%)*	Females (%)*
Orana/Far West	CVD RF Screening Wilcannia, 1989	20–70 years	209	46 (BMI > 26 kg/m^2)	64 (BMI >25 kg/m^2)
New England	Purfleet, Forster Aboriginal Diabetes Study 1985	18+ years	118	27 (BMI ≥27 kg/m^2)	53 (BMI > 25 kg/m^2)
Orana/Far West	Bourke Enngonia – Aboriginal Diabetes Study 1982–83	20+ years	294	30 (BMI > 27.5 kg/m^2)	42 (BMI >27 kg/m^2)

* Proportion overweight or obese (%)
Source: Boyle and Dobson 1992

Guest et al (1993) found that the prevalence of abdominal obesity (waist-to-hip ratio >0.9) among Aboriginal males and non-Aboriginal males was similar. However, Aboriginal females were significantly more likely to be abdominally obese (waist-to-hip ratio >0.8) than non-Aboriginal females. For example, 75% of Aboriginal females aged 20–49 years were abdominally obese, compared with 43% of non-Aboriginal females of the same age (NHMRC 1997). (See section 5.2 for further discussion of fat distribution in the Aboriginal population).

2.2.6: People from non-English speaking backgrounds

Results from the 1989 NHF RFPS show that the odds of being overweight or obese were 2 to 3 times greater for men and women born in Southern Europe than their Australian-born counterparts (see Table 2.4)(AIHW 1989). In contrast the odds were lower for Asian-born migrants to Australia, particularly men. Similar results have been reported by Mathers (1994) based on self-reported data from the NHS 1989–90.

In a more detailed analysis of data from the NHF RFPS 1980,1983,1989, Bennett (1993) found that men and women from Southern European countries or from the Middle East had significantly higher BMI levels than Australian-born men and women. Increasing length of residence in Australia was associated with statistically significant increases only for men and women from Asia (+0.9 BMI, $P < 0.01$; +1.0 BMI, $P < 0.05$, respectively). Period of residence was not associated with significant differences in body mass index for any other immigrant groups.

Immigrants to Australia from Southern Europe had significantly higher mean WHR in 1989 than Australian-born men and women. Asian born women had a relatively high mean waist-to-hip ratio despite having the lowest mean BMI. In a study in the US where the BMI and percent body fat of Asians and whites were compared (Wang et al 1994), although Asians had a lower BMI, Asians had more upper-body subcutaneous fat than whites.

Since the 1989 NHF RFPS there has been changes in the migrant population in Australia. More regular data collection is required to reflect the changing pattern in the group, in particular the increasing number of Asians immigrants.

It will be possible to obtain more up-to-date information on the immigrant population from the 1995 National Nutrition Survey when further analysis are conducted on the data (but not at the Area Health Service level).

Table 2.4: Prevalence of overweight and obesity, according to region of birth, based on measured weights and heights for men and women aged 20–69 years in Australian capital cities, 1989

Region of birth	Sample size	Proportion overweight or obese (%)	Adjusted[a] odds ratio for proportion overweight or obese	99% confidence interval for adjusted odds ratio
Males:				
Australasia	3265	49.0	1.00	
United Kingdom	490	44.7	0.70	0.54 – 0.90
Northern Europe	214	67.4	1.52	1.02 – 2.26
Southern Europe	249	68.5	1.96	1.33 – 2.88
Asia	202	34.5	0.52	0.35 – 0.77
Other	77	40.8	0.84	0.46 – 1.54
Women:				
Australasia	3452	31.4	1.00	
United Kingdom	426	34.3	1.02	0.78–1.34
Northern Europe	192	42.2	1.14	0.77 – 1.69
Southern Europe	246	56.4	3.00	2.08–4.34
Asia	189	30.4	0.84	0.54–1.31
Other	69	36.6	1.63	0.85–3.12

a. adjusted for age and city
Source: AIHW derived from 1989 RFPS

2.2.7: Socioeconomic characteristics

Results from the NHF RFP surveys were examined for trends in socioeconomic inequalities in cardiovascular disease risk factors (Bennett 1995). Educational attainment was used to indicate socioeconomic status. Other indicators of socioeconomic status include occupation and income, however education has been found to be more closely associated with cardiovascular disease (Winkleby et al 1992). Bennett also notes that as the level of educational attainment of Australians generally increases, the usefulness of educational attainment may be reduced as a marker of socioeconomic status.

Bennett found that each survey showed an inverse relationship between BMI and educational attainment. This was strongest in women aged 25–44 years, where the odds of being overweight or obese were twice as high as for women of low education (primary school or some high school) compared to women of high education (post-secondary).

The 1989 RFPS also showed that managers or administrators and men in ‘blue’ collar positions were more likely to be overweight or obese compared to professionals. Women in sales or labouring occupations, or women managing homes were more likely to be overweight compared to professional women. Also, women living in areas of greatest socioeconomic disadvantage compared to women living in areas of least socioeconomic disadvantage were more likely to be overweight or obese.

The majority of this information on socioeconomic factors is based on an urban population from data collected 8 years ago, and does not include rural areas. It will be possible to obtain more up-to-date information on socioeconomic status and weight status from the 1995 NNS, when further analyses are conducted on the data. The information will be limited to National and State levels, and is not disaggregated to Area Health Service level. Tracking changes in the prevalence of overweight and obesity in sentinel sites with low socio-economic groups would thus be useful for identifying key points of intervention.

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Section 3: What to measure

3.1: Weights and Heights

For population monitoring, simple techniques are needed to indicate the degree of obesity. Measurement of weight and height is a simple, unobtrusive and relatively inexpensive method used to estimate weight status.

3.1.1: Indices used to interpret measurements

The index **Body Mass Index** (BMI) can be calculated from the measurements of weight and height to allow interpretation of the anthropometric data.

BMI = (body weight in kilograms)/(height in metres, squared)

BMI is also known as the Quetelet's index. This index does not measure body fat or fat percentage, but cut-offs for BMI are used to indicate the degree of overweight. BMI can be calculated for data from adults and children (aged 9+ years) (see Section 5 for further discussion of BMI and the use of standards for classifying weight status).

Alternatively, weights and heights can be compared to reference data and reported as **Z-scores** (or standard deviation (SD) score), **percentiles**, or **percent of median**.

$$\text{Z-score} = \frac{\text{(observed value) - (median reference value of a population)}}{\text{standard deviation of reference population}}$$

(Armitage and Berry 1987).

This index is commonly used to interpret data from populations of young children (see Section 5.4.1 and 7.4.1 for further information on the use and interpretation of z-scores).

Percentile – the rank position of an individual on a given reference distribution, stated in terms of what percentage of the group the individual equals or exceeds. For example, only about 5% of all children are shorter than a child at the 5th percentile for height - meaning that a child at the 5th percentile for height is unusually short.

Percent of median – the ratio of a measured value in the individual, for instance weight, to the median value of the reference data for the same age and height, expressed as a percentage. This system is not recommended as percent points do not correspond across age or height status. For example, depending on a child's age, 80% of the median weight-for-age might be above or below -2 z scores (WHO 1995), therefore prevalences among different ages can not be compared.

3.2: Body fat distribution

3.2.1: Waist-hip ratio

Body fat distribution has emerged as an important predictor of obesity-related morbidity and mortality. Abdominal obesity is associated with conditions such as coronary heart disease (CHD), stroke, non-insulin diabetes mellitus and high blood pressure (NHMRC 1997). In epidemiological studies, body fat distribution has been assessed using a variety of methods including skinfold thickness (Rice et al 1992) and the ratio of waist circumference to hip circumference (waist to hip ratio or WHR).

WHR = waist circumference (cm) / hip circumference (cm)

In prospective studies in which fat distribution was assessed by skinfolds or circumferences, abdominal fatness was a significant risk factor for CHD independent of BMI (Larsson 1988). Abdominal fatness is associated with increased levels of insulin and triglycerides and decreased levels of HDL-cholesterol (Despres 1990). Cutoff points commonly used for WHR that may indicate increased risk of cardiovascular disease have been >0.9 for males and >0.8 for females. These cutpoints have been used for the interpretation of waist and hip data for the National Nutrition Survey. Unfortunately, researchers have varied the measurement site for waist, so that comparisons between data and with cut-points are limited (Alexander and Dugdale 1990). This problem highlights the need for standardisation of measurement protocols (see Section 4.1.7 on standard protocol for measurement of abdominal circumference).

Waist and hip circumferences are relatively quick measures used to indicate abdominal obesity using simple equipment. However, there is some extra time and effort required to conduct accurate measures, such as the time to mark identifying points on subjects. Subjects need to be wearing light clothing and for some cultures and age groups this is not acceptable.

3.2.2: Skinfold measurements

Skinfold measurements are useful for clinical and research work, but in general are not recommended for population monitoring. The time required to accurately conduct these measurements is long, making them generally impractical for use in population based studies. Furthermore, it is particularly difficult to conduct accurate measurements of overweight and obese people as the skinfold is difficult to pinch (i.e., difficulty in opening calliper wide enough) and tends to move easily.

3.2.3: Waist circumference only or waist circumference : height measures

Recently, there has been a movement to adopt waist only measurements as a method of assessing abdominal obesity. The use of waist only measurements would be a simple way that most members of the public could use to evaluate their own abdominal obesity (Lean et al 1995). Waist circumference has also been identified as the best indicator of changes in intra-abdominal fat during weight loss (Van der Kooy et al 1993). In 1995, Lean et al reported on a study conducted in Glasgow of 1900 randomly recruited men and women aged 25–74 years. This study found that waist circumference ≥94 cm for men and ≥80 cm for women identified subjects with high BMI (≥25) and those with lower BMI but high waist:hip ratio (≥0.95 for men, ≥ 0.8 for women) with a sensitivity of >96% and specificity >97.5%. Waist circumference ≥ 102 cm for men or ≥ 88 cm for women identified subjects with BMI ≥30 and those with lower body mass index but high waist:hip ratio with a sensitivity of >96% and specificity of 98%. About 2% of the sample was misclassified. This study recommends the use of these two cut-points for two action levels:

1. Waist circumference 94–<102 cm in men and 80–<88 cm in women – should be accompanied by a warning not to gain weight.

2. Waist circumference ≥ 102 cm in men and ≥ 88 cm in women – should be urged to lose weight. This upper action level corresponds with the point at which symptoms of breathlessness and arthritis begin to develop from overweight (Lean et al 1995).

Subsequent to the work by Lean et al, other investigators have evaluated waist-only measures. Cho et al (1996) investigated the use of waist only measurements in 1500 Hong Kong Chinese. When the cut-points of ≥94 cm in men and ≥80 cm in women were used the sensitivity was only 16% in men and 30% in women with a specificity of 100%. When the cutpoints were reduced to 85 cm for men and 75 cm for women the sensitivity improved to 79%(men) and 56 %(women) and the specificity reduced to 93% and 99% respectively. The authors of this study concluded that waist only measurements were not a good assessment tool for use in Chinese subjects.

Cox and Whichelow (1996) conducted a prospective study of British adults who had weight, height, waist and hip circumferences measured in the 1984–85 *Health and Lifestyle Survey*. They compared the anthropometric variables of 7000 men and women aged 18–97 years to causes of mortality. No consistent trend was observed for BMI, but there was a linear trend with the ratio of waist circumference to height for cardiovascular disease in both men and women. Waist circumference only was a good predictor of death in women but was not good at predicting cardiovascular death in men. The authors conclude that the waist circumference to height ratio should be used in the public health context for both men and women.

Ashwell et al (1996) compared intra-abdominal fat (measured by computed tomography) to weight, height and waist circumference. The study was conducted on a small group: 31 women and 16 men, aged 18–73 years, with BMI's ranging from 20–48. The ratio of waist circumference to height had the highest correlation with intra-abdominal fat (r=0.83, P<0.001). The correlations for other measures were: waist circumference (r=0.75), body mass index (r=0.69), and the ratio of waist to hip circumference (r=0.54). The authors concluded that waist circumference to height is the best simple anthropometric measure to use.

Recommendation 2: Waist circumference

Given the controversy surrounding the use of various measures to determine abdominal obesity, it is recommended that at least waist circumferences are collected by self-measurement or investigators when weight and height measurements are conducted. This will allow waist measures to be interpreted as waist only circumferences or as waist circumference to height ratio.

3.3: WHR in children and adolescents

Central body fat in childhood is associated with greater risk of hyperlipidaemia, cardiovascular risk factors, hyperinsulaemia and hypertension (Freedman et al 1989, Williams et al 1992 and Sangi et al 1992).

In a study in which total body fat and fat free mass was measured by bioelectrical resistance, and compared to skinfolds and waist to hip ratio, skinfold measurements provided a better estimate of central body fat compared to WHR (Goran, Kaskoun and Shuman 1995). However, this study was done on a small group of children (n=16) aged 4–8 years, and the findings would need to be confirmed on a larger sample size. Another study in adolescents showed no significant correlation between waist circumference, waist:hip ratio or trunk: extremity skinfold ratio and intra-abdominal adipose tissue area as measured by magnetic resonance imaging (de Ridder et al 1992).

Recommendation 3: Measurement of waist and hip circumferences in children and adolescents

Although research indicates that the determination of central body fat in children and adolescents is useful information, at this stage, routine measurements of waist and hip circumferences of children and adolescents are not recommended, given:

a) the uncertainty surrounding the usefulness of waist and hip measurements as a means of determining abdominal fat distribution in children and adolescents; and

b) the time and cost to conduct waist and hip measurements.

However this recommendation should be reviewed, as more information becomes available on the usefulness of this data for children and adolescents.

3.4: Socio-demographic information required to interpret anthropometric data and monitor trends in at-risk groups

3.4.1: Age

Participants should first be asked their age in years: (as asked in the NSW Health Survey):

24. How old were you on your last birthday?

    ________ years

If a respondent does not want to answer this question ask:

25. To which age category do you belong?
    1. 15–19 years
    2. 20–24 years
    3. 25–29 years
    4. 30–34 years
    5. 35–39 years
    6. 40–44 years
    7. 45–49 years
    8. 50–54 years
    9. 55–59 years
    10. 60–64 years
    11. 65– 69 years
    12. 70 – 74 years
    13. 75+ years

Age has been broken down into five year age categories for comparison with other surveys, for example, these age categories can be used to compare with ten year age categories, such as 20–29 years or 25–34 years. For the purposes of nutrition monitoring and recording changes in the prevalence of overweight and obesity, more changes are likely to start occurring as a person reaches their mid-20's, so it would be more useful to break the ten year age categories into: 25–34 years, 35–44 years, etc. (See Table 2.1 for an example of age categorisation from the NHF RFPS).

3.4.2: Ethnicity

Recording ethnicity allows identification of target groups. Immigrants should also indicate the numbers of years of residence in Australia by stating the year of immigration to Australia. This information is useful for the purposes of monitoring obesity because increasing years of residence may lead to an increased prevalence of obesity in some ethnic groups (refer to section 2.2.6 for further discussion on years of residency).

3.4.3: Socio-economic status

A variety of measures have been used to assess socio-economic status in health research, and have been based mainly on **occupation, education** and **income**.

Occupation-based measures:
The most commonly used measures in Australian health research are based on occupational categories, which can be grouped into:

1. Industry or skill-based occupational classifications; and
2. Measures of occupational prestige.

The industry-based occupational measure (known as Classification and Classified List of Occupations (CCLO)) has significant misclassification problems. For example, people in the same industry but at different levels of qualification, skill and responsibility are placed in similar occupational categories (Najman, 1988: 32). The CCLO has now been superseded by a skill-based occupational classification known as the Australian Standard Classification of Occupations (ASCO) which is currently used by the Australian Bureau of Statistics for census data collections. The ASCO system groups together occupations which require similar levels of education, training and experience (see Table 3.1). Although the ASCO system is much better than the CCLO system, this system is not ideal, for example, managers (1) in the ASCO system may range from managers of large multinational corporate organisations to the managers at a local retail outlet. Studies using skill-based occupational classifications have produced inconsistent findings (Turrell, Western and Najman 1994).

Table 3.1: CCLO and ASCO occupational classifications

CCLO	ASCO
0 Professional, technical and related	1 Managers and administrators
1 Administrative, executive and managerial workers	2 Professionals
2 Clerical workers	3 Para-professionals
3 Sales workers	4 Tradespersons
4 Farmers, fishermen, hunters, timber getters and related workers	5 Clerks
5 Miners, quarrymen and related work	6 Salespersons and personal service
6 Workers in transport and communication	7 Plant and machine operators and drivers
7/8 Tradespersons, production process workers and labourers	8 Labourers and related workers
9 Service, sport and recreation workers	
10 Members of the armed services	
11/12 Occupation inadequately stated	

Measures of occupational prestige have been developed by measuring how the general public ranks occupations according to the level of esteem they perceive each occupation has in the wider society. The two most widely used measures of occupational prestige in Australia are:

1. Congalton (1969)
2. Daniel (1983) (preferred measure since based on more recent public perceptions)

Both of these measures rank occupation on a scale of 1 to 7, with the lower scores denoting high status occupations (professionals, managers, senior civil servants, etc.) and the higher scores denoting lower status occupations (clerks, sale staff, drivers, labourers). A small number of studies using occupational prestige have shown that people from prestigious occupations have eating patterns more in line with recommendations for the prevention of cancer (Baghurst et al 1990) and have higher levels of knowledge about health, nutrition and fitness (Simons et al 1982).

In recent years, measures of occupational prestige have been criticised because they were generated using subjective assessments made by people of the public who may or may not be familiar with the occupation (Turrell, Western and Najman 1994). These criticisms suggest that prestige measures fail to consider a person's objective position in society. However, studies have shown that occupational prestige is positively associated with income, education and employment status.

A fundamental problem to this system has been determining how to assign a class position to people outside the workforce, especially women. Traditionally, the social class of women has been determined by their partner's or father's occupation, income or education.

Education-based measures:
Educational attainment is usually grouped into:

1. Number of years of study completed, or
2. Discrete categories, such as 'completed primary school', 'completed high school' and 'tertiary studies'.

Health researchers, have mainly used the latter approach in Australia, and have shown that a higher level of educational attainment is associated with lower systolic and diastolic blood pressure (Simons et al 1986) and a lower body mass index (English and Bennett 1985).

Despite the relative success of using education-based measures to determine socio-economic status, there are likely to be increasing problems with this system in the future as the population becomes more homogeneous in terms of educational attainment (Liberatos et al 1988). Also, higher levels of educational attainment do not necessarily lead to well paid, high status occupations (Liberatos et al 1988).

Income-based measures:
Income measures use categorical variables to place income into groupings. In the study by Broadhead (1985) of the 1978 Australian Health Survey, income was adjusted for family size and standardized for age. There was a strong relationship between the measures of affluence and rates of morbidity.

Research conducted in the United States investigated the effect of income inequality as a predictor of mortality (Fiscella and Franks 1997). Wilkinson (1997) comments that this research highlights that it is relative poverty and not absolute poverty that affects health. The effect of inequality of income depends on a person's income relative to the wider society. This interpretation implies it is important to redistribute income in order to improve health, reducing the psychological burden of relative disadvantage (and not to simply redistribute 'health producing goods') (Wilkinson 1997).

Using income as a means to determine socio-economic status has a number of advantages:

1. Relatively straightforward single question required (eg. respondents can choose from income groupings);
2. Allows groups such as the unemployed to be assessed;
3. Provides a relatively unambiguous and easy to understand estimate of inequality.

However, a major disadvantage of income-based measures is the intrusive nature of the question which can affect the willingness of a participant to answer and, therefore the response rate.

Area-based measures:
Area-based measures of class usually involve ranking geographic regions in terms of their mean score on variables such as income, education and occupation. Studies involving area-based measures have demonstrated that socially disadvantaged regions have a disproportionally high rate of infant mortality (Siskind et al 1987a), adult mortality (Siskind et al 1987b) and morbidity (National Health Strategy 1992).

Despite their predictive value, there are a number of problems with area-based measures: (Turrell et al 1994)

1. Area-based correlations are likened to individual-based characteristics or persons and of course, there are variations within an area;
2. When there is a significant association between an area and a health outcome, interpretation of the finding is very broad;
3. Studies at the individual level have produced different patterns of results (Pukkala and Teppo 1986) which raises questions about what area based measures are actually measuring, for example, there is a low level of association between the prestige of a person's occupation and the prestige of the suburb in which the person lives (Quine and Lancaster 1989:515).

Composite indices of socioeconomic status, based on an aggregate of several variables, have also been suggested (Najman 1988). However, once an association has been found, it can obscure important differences between the component measures that make up the index, making interpretation difficult (Wiggers et al 1995).

Recommendation 4: Measures to assess socio-economic status
The measures most commonly used and recommended for use are:

1. Education – total years of previous education.
2. Occupational prestige, using the more recent Daniel scale (preferred system to ASCO).
3. Income – adjusted for the number of persons in a household.
4. ASCO system of skill-based occupation.

Using a combination of indicators allows research to be directly compared with other work. The results of all SES measures should be discussed and presented so that any clear associations can be interpreted correctly.

3.5: Weight-related attitudes and practices

Monitoring weight-related attitudes and practices may assist in planning more effective policies and programs to promote healthy weight control in the population and to reduce the prevalence of obesity. By monitoring these variables, it is possible to identify areas for intervention to improve the likelihood of success.

What areas to monitor?

The following are important topic areas for the development of population-based questions:

1. Self perception of body weight
2. Weight loss behaviours and intentions
3. Weight goals (not necessarily loss only)
4. Actions pursued for weight maintenance, loss or gain
5. Barriers to healthy weight management

How to monitor weight-related attitudes and practices?

Methods for measuring weight-related attitudes and practices in a clinical setting have not been widely adapted to population-based surveys. Some methods for measuring weight related behaviours in a population already exist (Paxton et al 1994, Crawford et al, in press), however attitudinal measures require further development.

An addendum to this report, 'A validation study of S&R weights and heights' (Flood et al 1999) includes the analysis of some questions related to weight-related attitudes and practices. In this study of 227 people in Western Sydney, individuals were asked to classify themselves as underweight, acceptable weight, overweight or obese. 64% of men and 61% of women accurately classified their weight status, when comparing these self-reported perceptions to measured data. However, this study was based on a small sample, with a poor response rate (52%) in one Area Health Service, and therefore further work on the interpretation of questions about weight-related views and practices should be conducted.

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Section 4: How to measure overweight and obesity

Data that is used to determine the weight status of individuals in a population can be based on measured weight and height, self-reported weight and height, abdominal and hip circumferences, and abdominal only circumferences.

4.1: Measurement protocols for weight and height, waist and hip circumferences

Protocols for measuring weight, height, length, abdominal circumference and hip circumference are described below. These are adapted from the WHO recommended protocols (WHO 1995) based on the standardization manual by Lohmann et al (1988). To achieve consistency between the measurement of standards, the data collection form should have the capacity to record up to three measures for each measurement described.

4.1.1: Weight measurement in individuals able to stand without support

- use a level platform scale placed on a flat, hard surface
- regularly calibrate the scales, using standard weights close to the approximate weight of participants, eg. use 3 x 20 kg weights
- measure clients in light indoor clothing only without shoes, coats, or cardigans
- if heavy clothing must be worn because of cultural constraints, adjustments should be made before weight measurements are interpreted
- stand the client in the centre of the platform, with the body weight evenly distributed between both feet
- record weight in kilograms to the nearest 0.1 kg
- repeat the measurement and record
- if the two measurements disagree by more than 0.5 kg, then take a third measurement
- the subject's weight is calculated as the mean of the two observations, or the mean of the two closest measurements.

4.1.2: Weight measurement in infancy

- the preferred scale is a level pan scale with a beam and movable weights
- other types of scales may be used when pan scales are unavailable
- calibrate all types of scales regularly using standard weights
- measure infants with or without a nappy but with all clothing removed
- place the infant on the scale so that the weight is distributed equally about the centre
- record the weight when the infant is lying or suspended quietly (this may require patience)
- record the weight to the nearest 10 g
- if a nappy is worn, subtract its weight from the observed weight (reference data for infants are based on nude weights)
- if the infant is restless, weigh the parent while he or she is holding the infant and again without the infant; this procedure is less reliable partly because the parent's weight will usually be recorded to the nearest 100g.

4.1.3: Weight measurement for a person who can sit but is unable to stand

- use a movable wheelchair scale
- the individual should sit upright in the centre of the chair
- chair scales are expensive, however if a large number of elderly or disabled people are to be weighed such scales are recommended

4.1.4: Height measurement

- use a vertical board with an attached metric rule and a moveable horizontal headboard
- clients should be barefoot or in thin socks and wearing little clothing so that positioning of the body can be seen
- the client should stand on a flat surface with weight distributed evenly on both feet, heels together and the head positioned so that the line of vision is perpendicular to the body
- the arms hang freely and the head, back, buttock and heels are in contact with the vertical board
- if a person can not stand straight in this position, only the buttocks and heels or head are in contact with the vertical board
- ask the client to inhale deeply and maintain a fully erect position
- move the headboard down to the top of the head so that the hair is compressed
- record height to the nearest 0.1 cm
- record two measurements and if they differ by more than 0.5 cm, then a third measurement should be taken

4.1.5: Height measurement in young children

- for children 2–3 years of age use two measurers and the process described in 4.1.4
- one measurer places a hand on the child's feet (to prevent lifting of the heels and keep heels on the vertical board) and makes sure the knees are extended with the other hand
- the second measurer lowers the board and observes the height reading

4.1.6: Measuring length (suitable for use in infants and young children)

- two observers are required to measure length
- the subject lies down on a length table or measuring board
- the crown of the head should touch the stationary, vertical board
- the head should be held with the line of vision perpendicular to the measuring surface
- the shoulders and buttocks should be flat on the table, and the shoulders and hips should be aligned at right angles to the long axis of the body
- extend the legs at the hips and knees so that they lie flat against the table top with the arms against the sides of the trunk (extend the legs gently in infants)
- the measurer should ensure that the legs remain flat against the table
- shift the moveable board against the heels
- record length to the nearest 0.1 cm

4.1.7: Abdominal circumference

- use a flexible but inelastic (non-stretchable) graduated tape measure
- the subject stands comfortably with feet about 25–30 cm apart with weight evenly distributed on both feet
- take the measurement midway between the inferior margin of the last rib and the crest of the ilium, in a horizontal plane
- palpate and mark each body point and determine the midpoint with a tape measure and mark
- sit by the side of the subject and fit the tape snugly but not so tightly to compress underlying soft tissue
- measure to the nearest 0.1 cm at the end of normal expiration
- record two measures and if they differ by more than 0.5 cm, then take a third measurement
- the subject's abdominal circumference is calculated as the mean of the two measures, or the mean of the two closest measurements if a third is taken

4.1.8: Hip circumference

- use a flexible but inelastic (non-stretchable) graduated tape measure
- the subject should wear light clothing with nonrestrictive underwear
- the subject stands erect with arms at the side and feet together
- the measurer sits at the side of the subject so that the level of maximum extension of the buttocks can be seen
- place the tape measure around the maximum extension of the buttocks in a horizontal plane
- an assistant may be needed to help position the tape on the opposite side of the subject's body
- the tape should be snug against the skin but not compressing soft tissue
- record measurement to the nearest 0.1 cm
- record two measures and if they differ by more than 0.5 cm, then take a third measurement
- the subject's hip circumference is calculated as the mean of the two measurements, or the mean of the two closest measurements if a third is taken

Recommendation 5: Anthropometric measures
The recommended method for measuring weight and height is described in the protocols herein, adapted from the WHO recommended protocols.

4.2: The use of self-reported weights and heights

Self-reported weights and heights have been used as surrogate measures of actual weights and heights in surveys in Australia and NSW. These measures can be included in self-administered questionnaires and used in telephone surveys. Self-reported weights and heights require no equipment or training, and are therefore less costly than measured weights and heights. Recent surveys that have included self-reported weights and heights include the National Health Survey (NHS) 1988–89 and 1995, National Heart Foundation Risk Factor Prevalence Survey 1989 (which also included measured weights and heights), NSW Health Promotion Survey 1994, and the ABS Population Survey Monitor 1994–95.

The NSW Health Survey, an annual telephone survey which commenced in 1997, includes self-reported weights and heights of adults.

Recommendation 6: The recommended way to ask self-reported data:

1. How tall are you without shoes?

   ________ centimetres

   or

   ________*feet*________ inches

2. How much do you weigh without clothes or shoes?

   ________ kilograms

   or

   ________ stones _______ pounds

4.3: The validation of self-reported weights and heights

Waters (1993) evaluated measures of self-reported weight and height and their use in the determination of body mass index in population surveys. The evaluation was based on a secondary analysis of data on measured weights and heights compared with self reported (SR) weights and heights, from the 1989 NHF Risk Factor Prevalence Survey. The results showed that both men and women tended to over-report their height; men overestimated by an average of 1.1 cm, and women overestimated by an average of 0.5 cm. Both men and women tended to underestimate their weight; women by an average of 0.4 kg and men by an average of 0.2 kg.

The reporting error in this study was defined as the self-reported BMI minus the measured BMI. The reporting error is below zero in most age groups, implying that on average, the measured BMI is consistently underestimated by self-reported BMI.

Furthermore, misclassification of weight status by age group for men and women was quite extensive (refer to Appendix 1). As men get older, particularly after age 40–44 years, self-reported BMI misclassifies overweight and obesity. This also occurs in women, particularly from age 50–54 years.

Two models for statistically adjusting BMI calculated from self-reported data were derived to provide closer approximations to measured BMI. The recommended models varied with the sex and age of the participant. However, the author has questioned the current applicability of these formulae since the release of initial results from the National Health Survey 1995 (NHS) (based on self-reported weight and height). These results show an unexpected decrease in the prevalence of overweight and obesity. The observed trends in measured weights and heights from the NHF RFPS (1980, 1983, 1989) indicate an increasing trend (prevalence of overweight and obesity increased from 50% to 56% in men and from 28% to 38% in women (see Tables 1.1a and 1.1b.). Also measured data collected on school children in Victoria in 1994 showed that the proportion of children classified as overweight has doubled, to more than 10%, since the previous survey of 1985 (Harvey 1997).

Results from the National Health Survey compared to results from the National Nutrition Survey 1995 (which measured the height and weight of a subsample of the HNS) report that although mean differences for height and weight were relatively small, there are significantly different results for BMI classifications. BMI based on measured weights and heights, classified 64% of males and 47% of females as overweight or obese, compared with 52% and 36%, respectively, from self-reported data (ABS Cat. No 4359.0).

In addition, a study conducted as part of the recommendations from the NSW Food and Nutrition Monitoring Plan (NSW HD 2000), on the validity of self-reported weight and height data from the NSW Health Survey (a telephone survey), found that self-reported weight and height leads to considerable misclassification of relative weight status. BMI based on measured weights and heights, classified 62% of males and 47% of females as overweight or obese, compared with 38% and 32% respectively, from the self-reported data (Flood et al 1999). However, further research on the validation of telephone surveys is required as these results were based on a small sample (n=227), with a poor response rate (52%), in one Area Health Service in NSW.

The error in self-reported weight and height compared with measured weight and height was evaluated in a nationally representative US sample of 11,284 adults, aged 20 –74 years from the NHANES-II (Rowland 1990). Although weight and height were reported with small errors on average, self-reported weight and height were unreliable in important population subgroups, including:

- heavier people under-reported their weight more than lighter people
- more than twice as many severely overweight women as men under-reported their weight by ≥4.5 kg (31% vs. 14%)
- 45% of people aged 65–74 years over-reported their height by > 2.5 cm.

It is important to validate self-reported data based on the methodology used in each survey. It is highly likely that self-reported data from respondents who know they will have measured weights and heights taken (as occurred in the NHS RFPS) will differ from self-reported data where there is no imminent collection of measured weights and heights (Waters 1993). Also, self-reported data from a face-to-face interview (the methodology used in the National Health Surveys) are likely to be different from telephone surveys or self-administered questionnaires where there is no expectation of assessment and where the participant can not be viewed by the interviewer (Rowland 1990).

Recommendation 7: The validation of self-reported data
The validity of self-reported data needs to be assessed at regular intervals by measuring weights and heights. Those who are overweight are more likely to under report their weight and over report their height. It also appears likely that the way people self-report their heights and weights may vary over time. Regular validation of the NSW Health Survey data on heights and weights will provide information on the accuracy of self-reported data using telephone methodology.

4.4: Self-reported weight and height in children and adolescents

Compared with adults there has been little information about the validity of self reported weight and height in adolescents. A study of 204 adolescents in Victoria, aged 14–15 years, compared the self-reported and measured weight and height in a sample of adolescents and their parents (Tienboon et al 1992). On average, the adolescents' self-reported weight and height did not differ to a greater extent from the measured values of their parents for their own weight and height but differences for individuals were more variable. The adolescents underestimated their weight by an average 0.8 kg and overestimated their height by 1.1 cm. However, the magnitude of the standard deviation of the differences between measured and reported weight and height was 4–6 kg and 4–6 cm (compared to 2–3 kg and 1 cm in Stewart et al's study in the US in 1982). This indicates that the Australian adolescent population in this study had a lower reliability for self-reported weight and height.

In a study from the US (Himes, Story 1992) 69 American Indian youth, aged 12–69 years were studied to determine the validity of self-reported weights and height. Self-reported weight was significantly less than measured weight by 2.64 kg for boys and 2.76 kg for girls, but they did not significantly misreport their stature. Because of this BMI based on self-reported data was significantly less than measured BMI by about 1 kg/m^2 in both sexes. The authors concluded that on this sample size that this information could not be used to adjust reported data but suggested larger studies were required to investigate this further.

In a British study of teenagers it was found tall, thin individuals were more likely to under-report their height and short, fatter individuals to overestimate their height and underestimate their weight. When the self-reported data was used to calculate BMI this resulted in a lower estimate of overweight teenagers. The authors of this study said self-reported height and weight data from a teenage population should be used with caution particularly when classifying individuals by BMI. This could especially influence estimates of the prevalence of overweight (Crawley et al, 1995).

Recommendation 8: Self-reported data in children and adolescents
Until more information is available about the validity of self-reported weights and heights in this group, it is recommended that surveys of children and adolescents should **not** rely on self-reported weight and height as a means of determining weight status.

4.5: The use of self-reported measures of fat distribution

There have been a few studies that have attempted to quantify the accuracy of self-reported or self-measured waist and hip circumferences. Kushi et al (1988) reported that 87 women aged 55–67 years who were sent tape measures, measured themselves, and were subsequently

> **Recommendation 9: Measuring heights and weights in children and adolescents**
> Priority should be given to surveying the weights and heights of children and adolescents on a routine basis, and disseminating these results and planning activities to address problems identified *(see Section 6 for a discussion on possible options to obtain data for children).*

remeasured by trained technicians, tended to underestimate their hip measurement and overestimate their waist measurement. Freudenhaim and Darrow (1991) observed that women aged 19–45 y (n= 227) tended to underestimate their waist, hip and thigh circumferences. In a study conducted by Weaver et al (33) conducted on 66 women aged 40–81 years participants were sent an inelastic measuring tape, and specific instructions (including diagrams) on how to measure themselves (with the help of a friend). Participants recorded measurements of their waist, hips, chest, bust, weight and height and then measurements were conducted by trained technicians. Overall, there was good correlation between the technician and self-measured values (Pearson's correlation co-efficients: for weight (0.99), waist and bust (0.96), height (0.95), hips (0.93). Where differences occurred most of the errors were unrelated to whether the individual was at the low, middle or high end of the distribution of technician-measured values. Overall, these results indicate that self-measured data can be fairly accurate.

A study in Tasmania, conducted by the Menzies Centre for Population Health, is including a question on a mail-out survey on waist circumference, which is subsequently measured. This will give some more information on the accuracy of self-reported (no tape sent for measuring) waist measures.

> **Recommendation 10: Measured or self-reported abdominal circumferences**
> Until more information is available about the validity of self-reported abdominal circumferences, only measured or self-measured (with clear instructions and tape provided) abdominal circumferences should be conducted on the adult population.

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Section 5: Standards for classifying individuals and populations as overweight and obese

Body mass index appears to be a good measure of overweight and obesity in adult white men and women from Europe and North America (WHO EC 1995). Increasing BMI in these populations are associated strongly with mortality. However, since BMI does not distinguish between weight due to muscle and that due to fat, its relationship with obesity is likely to differ in individuals and populations who differ in body build (eg. highly muscular individuals) and body proportions (for example, individuals with unusually long or short legs).

5.1: Classifying the weight status of individuals in the general population

In Australia, BMI has been commonly grouped into weight categories set by the NHMRC:

Underweight	BMI<20
Acceptable weight	20≤BMI≤25
Overweight	25<BMI ≤30
Obese	BMI >30

Other cut-off points have also been used in surveys in Australia (refer to Appendix 3, Tables 2.1 and 2.2). Harvey et al (1991) highlighted problems that can occur when data from different surveys are compared using different cut-points. Data initially published from the 1989–90 National Health Survey used a cut-off point of greater than 26 to define overweight and obesity. The survey reported overweight and obesity prevalence as 33.2% in men and 23.7% in women. When a cut-off point of greater than 25 was used, the estimated prevalence was 44.6% for men and 31.0% in women.

An Expert Committee for WHO has recently recommended another classification of BMI. The Committee states that since BMI does not measure fat mass or fat percentage and because there are no clearly established cut-off points for fat mass or fat percentage that can be translated in to cut-points for BMI, the Committee has expressed different levels of high BMI in terms of degree of overweight rather than degrees of obesity.

These new categories for BMI are:

Grade 3 thinness	<16
Grade 2 thinness	16.0–16.99
Grade 1 thinness	17.0–18.49
Normal range	18.5–24.99
Grade 1 overweight	25.0–29.99
Grade 2 overweight	30.0–39.99
Grade 3 overweight	≥40.00

This classification is based principally on the association between BMI and mortality. These recommended cut-off points are appropriate for identifying the extent of overweight in individuals and populations, however they should not be interpreted in isolation but in combination with other determinants of morbidity and mortality (disease, smoking, blood pressure, serum lipids, glucose intolerance, type of fat distribution, etc.) (WHO 1995: 312).[1]

The 1995 National Nutrition Survey has adopted a modified version of the WHO's recommendations for classifying individuals in terms of weight categories. They use these categories for adults 19 years and over:

Underweight	<18.5	(WHO grade 1,2, and 3 thinness)
Acceptable weight	18.5–<20	
	20–<25	
Overweight	25–<30	(WHO grade 1 overweight)
Obesity	30+	(WHO grade 2 and 3 overweight)

Example of interpretation on the use of these BMI categories:

BMI 25–<30 = 25.00 – 29.99

(see Section 8 for further discussion on the interpretation of BMI cut-points).

By dividing the WHO acceptable weight category into two sections, comparisons with past surveys will be possible.

[1] A report from a WHO consultation on obesity (1998) proposes endorsing the existing WHO classification of BMI with some minor modifications: the category of overweight (BMI >= 25) is subdivided into 'pre-obese' (BMI 25-29.9) and 'obese' (BMI >= 30). The category of obese is further subdivided into 3 categories: obese class I (BMI 30-34.9), obese class II (BMI 35.0-39.9) and obese class III (BMI >=40). The additional category of BMI 35.0 - 39.9 is recommended in recognition of the fact that management options for dealing with obesity differ above a BMI of 35 (WHO: Report of a WHO Consultation on Obesity. *Obesity: preventing and managing the global epidemic.* Geneva: WHO. 1998).

Recommendation 11: Standards for classifying overweight and obesity in the general population

Commonly used categories for comparisons with past surveys are grouped as: ' underweight', 'acceptable weight', 'overweight' and 'obese'.

Underweight	BMI <18.5 (WHO grade 1, 2 and 3 thinness)
Acceptable weight	20 ≤ BMI <25
Overweight	25 ≤ BMI < 30
Obese	BMI ≥ 30

To maintain consistency with the National Nutrition Survey, a further refined breakdown of categories is recommended (using a modified version of the latest recommendations by WHO).

Underweight	< 18.5	(WHO grade 1,2, and 3 thinness)
Normal weight	(report the two categories of cut-points separately to allow comparison with past data sets)	
	18.5 ≤ BMI < 20	(WHO normal range 18.5–24.99)
	20 ≤ BMI < 25	
Overweight	25 ≤ BMI < 30	(WHO grade 1 overweight)
Obese	BMI ≥ 30	(WHO grade 2 overweight 30.0–39.99, WHO grade 2 overweight ≥ 40.00)

Example of interpretation of BMI category: 25 ≤ BMI < 30 = 25.00 – 29.99

Combine the 'thin' categories and 18.5 – < 20 of the normal category to provide an 'underweight' category for comparisons with past surveys.

5.2: Classifying the weight status of the Aboriginal population

In NSW the Aboriginal population is 94,000 (1.5% of the NSW population). The Torres Strait Islander population consists of 5000 (0.08% of the NSW population). This section of the report addresses the classification of weight status of Aboriginal people since they make up the great majority of the indigenous population in NSW. However, it should be noted that Torres Strait Islander people have a different body composition to Aboriginal people, and it is likely that this group of people will require specific cutpoints relevant to their ethnicity.

In a study by Coles-Rutishauser (1987). The relationship between BMI and subcutaneous fat was examined by comparing the sum of skinfolds of Australian Aboriginal women with Australian women of European origin (see Table 5.1).

Table 5.1: 95% confidence intervals for BMI in Australian and Caucasian women according to skinfold thickness

Sum of skinfolds (mm)	CI for BMI Aboriginals (n=114)	CI for BMI Caucasians (n=88)
40	16.8–18.2	19.7–20.6
60	20.2–21.3	22.4–23.1
80	23.5–24.5	25.0–26.0

Source: Coles-Rutishauser, 1987

On average Australian Aboriginal women with the same level of subcutaneous fat were found to have a BMI which was one to two units lower than Australian women of European origin.

Prediction equations of body fat from BMI based on data from populations of Caucasian origin predicts zero body fat in adult women at BMI <15.5 (Womersley and Durnin, 1977). However in the study by Rutishauser Aboriginal women with a BMI of 15.5 kg/m^2 were observed to have measurable amounts of subcutaneous fat, to be fertile and able to breastfeed their infants successfully.

In this group of Aboriginal women not only did the relationship between BMI and subcutaneous fat differ but the distribution of subcutaneous fat also differed between the two groups (see Table 5.2).In the Aboriginal women a much higher proportion of subcutaneous fat was found on the trunk compared to the limbs.

Table 5.2: Differences in the distribution of subcutaneous fat between Aboriginal women and Australian women of European origin.

Group	No.	BMI	Skinfold limb (mm)	Skinfold trunk (mm)
Aboriginal	23	26.1	28.5	49.5
European	91	24.5	30.3	35.7

Source: Rutishauser, 1996

These studies indicate that at least in Aboriginal women there is a different relationship between BMI and subcutaneous fat than women of European origin. The reason for this appears to be primarily associated with a much lower level of limb fat in this group, compared to women of European origin.

This leads us to question the appropriateness of using BMI categories based on data from Caucasian populations, at least for the female Aboriginal population. However, studies on larger samples of both sexes in the Aboriginal population would be needed to give more information on a suitable BMI category to use. In this case it would be useful to have a cohort study to consider mortality with BMI and not merely cross-sectional data that compares BMI and skinfold thickness, though this is useful to provide some guidance.

Recommendation 12: Weight status categories in the Aboriginal population
Until more information is known about the distribution of fat and its relationship with BMI in the Aboriginal population, the BMI categories recommended for the general adult population should be used for interpreting information about the Aboriginal population. Acknowledging the limitations of this weight classification, this information still provides a means of tracking change over time.

5.3: Classifying the weight status of people from different ethnic backgrounds

Various studies have examined the relationship of BMI and body composition for different ethnic populations, other than the Caucasian population that BMI categories were originally based on. The ethnic populations considered include: Africans, Asians, Indo-Mediterranean and Pacific groups.

In a study by Wang et al. (1994) the correlations between BMI and percent body fat (fat %) measured by dual-photon absorptiometry in 445 white and 242 Asian adults aged 18–94 years were studied. Comparisons were also made to six body circumferences and eight skinfold measurements. Although Asians had lower BMI, they were fatter than whites of both sexes. Asians had more upper-body subcutaneous fat, especially females (see Table 5.3)

By contrast, in a study by Swinburn, Craig et al. (1996) where differences between the body composition of Polynesians and Caucasians were assessed by bioelectrical impedance, Polynesians were found to be significantly leaner than Caucasians for the same BMI. However, bioelectrical impedance has potential errors, though it can be a good community-based measure if it has been validated in the specific population. The authors of this study recommend that this area should be further researched using other reference methods for measuring body composition. Pippa Craig (personal communication) is currently conducting further research on the body composition of Tongan and Singaporian populations, using DEXA (dual energy x-ray absorptiometry), to assess the relationship between percent body fat and BMI. This will be further analysed in a cross-sectional study, where body fat will be compared to some health outcome measures for known diseases. This will provide evidence-based information to determine the most appropriate BMI to use for these particular populations.

Table 5.3: Comparisons of mean BMI, circumference measurements, and skinfold-thickness between whites and Asians.

Variable	Males Whites	Males Asians	Females Whites	Females Asians
BMI	25	23	24	22
Percent body fat(a)	19	21	30	32
Waist circumference (mm)	878	831	734	731
Supriliac skinfold (mm)	11	13	13	18
Subscapular skinfold (mm)	15	17	14	19

(a) measured by dual-photon absorptiometry
Source: Wang et al., 1994

By contrast, in a study by Swinburn, Craig et al. (1996) where differences between the body composition of Polynesians and Caucasians were assessed by bioelectrical impedance, Polynesians were found to be significantly leaner than Caucasians for the same BMI. However, bioelectrical impedance has potential errors, particularly with using different machines (Swinburn et al 1996: 892). The authors of this study recommend that this area should be further researched using other reference methods for measuring body composition. Currently the South Pacific Commission has BMI charts with the following ranges:

- acceptable weight 22–27
- overweight 27–32
- obese >32

These BMI categories were derived without an analysis of their association with mortality (Swinburn, Craig et al 1996). However, other population studies show that increasing BMI is associated with higher mortality.

Recommendation 13: Weight status categories for people from different ethnic backgrounds
There are no definitive BMI categories for use with people from different ethnic backgrounds (though these are currently being researched). For the present, the BMI categories recommended for the general adult population should be used for people from different ethnic populations. Acknowledging the limitations of the weight classification for ethnic groups, the information still provides a means of tracking change over time. If different BMI categories are eventually recommended, they are likely to vary between ethnic groups.

5.4: Criteria for classifying weight status of children and adolescents

This section deals with classifying the weight status of children in population studies. Using a system to classify diagnostic and clinical measures is not addressed here. The tools can be used for the individual but should be accompanied by more in-depth assessments to determine the existence of obesity or under nutrition in the individual. For example:

1. Stage of sexual maturation.
2. Additional anthropometry to identify excess body fat, such as skinfold thickness at the triceps and subscapular sites.
3. Lipoprotein fractions, including high-density lipoprotein cholesterol (HDL), total triglyceride concentrations, and low-density-lipoprotein cholesterol (LDL). (Himes and Dietz 1994).

The following sections cover the following age groups:

Children 0–8 years
Adolescents 9–15 years
Youth: older adolescents and young adults 16–24 years.

These categories have been chosen to reflect maturation stages and categories represented in the literature:

- The National Nutrition Survey reports anthropometric data of children and youth: 2–8 years; 9–18 years.
- The US report on guidelines for surveillance of overweight is aimed at 10–24 years.
- The WHO considers 'adolescents' as 10–19 years.
- The United Nations defines 'youth' as 15–24 years.
- Australian reference data are available on schoolchildren aged 7–15 years Australian Health and Fitness Survey (AHFS) conducted in 1985 by Australian Council for Health, Physical Education and Recreation (ACHPER).

Clearly there is no consistent approach to classifying weight status by age. We have chosen age categories most comparable to others used in Australia. However, it may also be useful to use z-scores up to age 10 and age and sex specific BMI cutpoints down to age 7, to allow some overlap of method for comparison. It should be noted, however, that percentiles of BMI in young children do not track well into adulthood.

5.4.1: Children aged 0–8 years

UNICEF indicators for international reporting of weight status for children 0–5 years were recommended after the World Summit for Children, using z-scores.

Where the z-score = $\frac{\text{(observed value) - (median reference value)}}{\text{Standard deviation of reference population}}$

Examples of the calculation of the z-score, using weight for height, are shown in Table 5.5.

Table 5.5: Examples of calculation of z-scores

Height of subject (boys) (cm)	Weight of subject (kg)	Median weight for height (kg)	±1.00 SD (kg)	Subjects' z-score
60	5.1	5.8	-0.643	-1.1
70	9.3	8.5	+0.841	+1.0
90	15.1	13.0	+1.069	+2.0
110	15.3	18.7	-1.610	-2.1

Waterlow et al 1977
SD Standard deviation

Similar calculations to determine the z-score for height or weight for age can be made by substituting the age of the subject, the height or weight of the subject, the median height or weight for age, and the appropriate standard deviation as required (Waterlow et al 1977).

The concept of a z-score is useful because:

i. a population can be described statistically; and
ii. z-scores can be used as cut-points.

The National Nutrition Survey uses z-scores for children aged 2–8 years, in the following groupings:

- low height-for-age defined as a height < -2 z-score units of the sex-specific reference value for age (representing degree of shortness or stunting)
- low weight-for-age defined as a weight < -2 z-score units of the sex-specific reference value for age (representing degree of lightness or underweight)
- low weight-for-height defined as < -2 z-score units of the sex-specific reference value (representing degree of thinness or wasting).
- high height for age defined as > +2 z-score units of the sex-specific reference value for age (representing degree of tallness)
- high weight for age defined as > +2 z-score units of the sex-specific reference value for age (representing degree of heaviness)
- high weight for height defined as >+2 z-score units of the sex-specific reference value (representing degree of heaviness or overweight).

For children overweight, WHO also has the following definitions:

- high weight-for-age defined as weight > +2 z-score units of the sex-specific reference value for age (representing degree heaviness or overweight)
- high weight-for-height defined as > +2 z-score units of the sex-specific reference value (representing degree of heaviness or overweight).

Based on the normal distribution of a population, the expected values for each of these -2 and +2 Z-scores is 2.3%. If the z-score exceeds this amount then there is cause for concern (see Section 7 for further discussion on the interpretation of z-scores) (WHO1995: 165).

The main problem when using z-scores is determining a suitable reference population. The common reference data used in Australia are from the National Centre for Health Statistics NCHS/WHO reference data which were originally based from four data sources from the US in 1975. A revision of the original data sets was conducted in 1990 to further improve the data but inadequacies of this reference data set still remain (WHO 1995: 249 ff.). The data for the infants were based on data of bottle-fed children. Studies since then of 'breast-fed' infants report differences in the growth curves.

To rely solely on a reference population from the US could result in falsely underestimating the extent of obesity, as children from the US show a shift towards increasing weight. Such a shift should not be viewed as normal.

The latest WHO recommendation is to develop a new international reference tool based on breast fed infants living in healthy environments. Meanwhile until we have this new reference tool the NCHS/WHO reference growth curves should be used (WHO 1983).

Recommendation 14: Classifying weight for children 0-8 years
Use the z-score definitions for classifying the weight status of children aged 0–8 years. Compare these to the NCHS/ WHO reference population until improved international reference population data exist. The z-scores are:
For children of low weight:

- low height-for-age was defined as a height < -2 z-score units of the sex-specific reference value for age (representing degree of shortness or stunting)
- low weight-for-age was defined as a weight < - 2 z-score units of the sex-specific reference value for age (representing degree of lightness or underweight)
- low weight-for-height was defined as < -2 z-score units of the sex-specific reference value (representing degree of thinness or wasting).

For children overweight:

- high weight-for-age defined as weight > +2 z-score units of the sex-specific reference value for age (representing degree heaviness or overweight)
- high weight-for-height defined as > + 2 z-score units of the sex-specific reference value (representing degree of heaviness or overweight).

Based on the normal distribution of a population, the expected values for each of these -2 and +2 z-scores is 2.3%. If the z-score exceeds this amount then there is cause for concern.

5.4.2: Adolescents aged 9–15 years

In 1994, in the USA, an Expert Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services was established to propose specific criteria for overweight or obesity in adolescents (Himes and Dietz 1994). The Committee recommended the use of age and sex specific percentiles of Body Mass Index (BMI; weight/height^2), using the BMI cutoffs from the first United States National Health and Nutrition Examination Survey (NHANES-I) (Must and Dallal 1991a and 1991b) to routinely indicate overweight in adolescents. Age and sex specific BMI cutpoints are required in children and young adolescents due to the wide variability of their height compared to adults, since they are still growing.

Children above the 95th percentile for age and sex, or >30 BMI are classified as 'overweight'. Adolescents with BMIs ≥ 85th percentile but <95th percentile or ≤ 30 BMI are considered 'at risk of overweight'.

BMI (kg/m^2) is significantly correlated with subcutaneous and total body fatness in adolescents (Roche et al 1981, Duerenberg et al 1991) and is specific for those with the greatest amount of body fat (Himes and Bouchard 1989, Marshall et al 1990).
A further evaluation of the use of BMI cut points was conducted by Lazarus et al (1996) which reported reasonable true-positive (0.71, 95% CI: 0.53, 0.85) and low false negative (0.05, 95% CI: 0.02, 0.09) rates at the 85th percentile cutpoint for BMI. At the 95th percentile cutpoint for BMI, both true-positive (0.29, 95% CI: 0.15, 0.47) and false positive (0.01, 95% CI: 0.00, 0.03) rates were lower. The 95th percentile cutoff for 'overweight' provides low sensitivity but very few false positive rates. This means that the risk of wrongly labelling a child as 'overweight' is very small, but that some truly obese subjects could be missed. However, the sensitivity improves by using the 85th percentile (Lazarus et al 1996).

Recommendation 15: Classifying weight in adolescents 9-15 years
'At risk of overweight': ≥ 85th percentile BMI and < 95th percentile BMI for age and sex (when BMI ≤ 30).
Overweight: ≥ 95th percentile for age and sex or BMI >30.
To indicate thinness: < 5th percentile BMI (WHO 1995)

Once again, determining an appropriate reference data poses some difficulties. The NHANES-I reference data used for the US determination of cut-points results in an under estimation of overweight in adolescents in Australia**,** since US adolescents are bigger. Lazarus et al (1996) considered the extent of misclassification of Australian children using US values compared to Australian cut-points (calculated from weight and height data from Australian Health and Fitness Survey (AHFS) of 8492 schoolchildren 7–15 years). For example , using the US cut point at the 85th percentile of BMI 23 for 14 year old boys, 5% of Australian boys would have false negative results, ie. would be wrongly placed outside the category of 'at risk for overweight'. By contrast the Australian derived cut point for 14 year old boys at the 85th percentile is 22.2.

The use of BMI cut-points derived from NHANES-I and AHFS may not be suitable for use with children from different ethnic backgrounds and Aboriginal children. Ideally, if a large enough data set were available, reference data based on these populations would be used to develop appropriate cut-points specific to the ethnicity.

For the purposes of determining trend data, it is useful to use Australian derived cut-points as the reference data. This data is available from ages 7–15 years. The US NHANES-I data are an alternative reference data which would allow comparisons at an international level. The use of this reference data set is also available for 9–24 year olds. (See Appendix 2 for cutpoints from NHANES-I and AHFS). The NHANES-I cutpoints are planned for use for the analysis of the NNS.

Recommendation 16: Reference data recommended for 9-15 year olds
Reference data recommended for use:

1. Australian data derived from the Australian Health and Fitness Survey (Lazarus et al 1995). This provides a reference data set from an Australian population of children.
2. US reference data (NHANES-I) (Must el al 1991) for comparisons to the National Nutrition Survey and international data.

5.4.3: Older adolescents and young adults (16–17 years; 18–24 years)

Human growth and maturation are continuous processes, and transitions from childhood and into adulthood are not abrupt (WHO 1995: 263).

This age group has been included in the US reference data with the varying cut-points for age and sex as in other adolescent age groups. These BMI cut points for 85th percentile range from 24 to 27; and 95th percentile range from 29–30. Given that our Australian population is less overweight than the US population, if we had data on these age groups to develop cutpoints at these centiles they would probably be 1–2 BMI points below these. These figures closely resemble the adult recommended cut-points of 25 and 30 for overweight and obesity.

Past Australian studies have tended to include these age categories into the general adult recommended cut points, in particular 18 years and over (surveys using general population data include National Health Survey, ABS Health Monitor Surveys, NHF Risk Factor Prevalence Studies, NSW Health Promotion Survey).

Recommendation 17: Classifying weight in 16-24 year olds:

Given the similarity of the US cutpoints in this age range to adult recommended cutpoints, and the common use of 18–24 year old age group using adult cutpoints, it is recommended that weight classification for this age group be consistent with the general adult weight classification.

This recommendation should be reviewed as more population-based survey data becomes available, especially for the 16–17 year old age group.

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Section 6: Options for obtaining information about the weight status of the NSW population

6. 1. Possible options to obtain data about the NSW general population

6.1.1 Use data from the National Nutrition Survey. There is however no assurance that this survey will be repeated.

Pros:
- 1995 data already paid for
- collects information on wide range of ages
- allows estimates at State, capital city, other urban and rural levels (n= approx. 2800 for NSW; n=1700 for Sydney; n=1100 for remainder of state)
- data can be used to validate self-reported weights and heights from NHS

Cons:
- does not provide information at Area Health Service level
- will not provide enough data for ATSI population
- information only updated occasionally; gives trend data but not suitable to assess particular intervention programs since too irregular
- uncertainty regarding future validation of NHS data

6.1.2 Conduct a new survey which includes measures of weights and heights; based on similar method to NHF RFPS*,* with an improved sampling frame (for example, including rural areas and more representative samples of urban areas).

Pros:
- provides more extensive information on all target groups,
- provides information for Area Health Service level, suitable to assess performance agreements
- it may be possible to conduct this via the blood sample survey (that may be conducted by the National CVD planning group)

Cons:
- expensive to set up and continue, unless funded by another organisation, eg. NHF

6.1.3 Use the self-reported data from the NSW Health Survey

Pros:
- survey already in place and self-reported weights and heights included
- provides regular data at AHS level

Cons:
- limitation of self-reported data (as discussed in Section 4.3)
- age limited to 16 + years (SR data for adolescents less reliable)

6.1.4 Measure weights and heights on a subsample of the respondents from NSW Health Survey

Pros:

- measured data would provide the means to validate self-reported weights and heights from a survey using telephone methodology, indicating the level of error
- would indicate if self–reported data were varying over time
- could provide information on measured weights and heights for some selected Area Health Services (depending on numbers)
- would be less costly then setting up complete new survey

Cons:

- limited age range 16 + years
- size of sample will influence usefulness (but more costly as increase sample size)
- will involve some costs and requires seeking permission from participants in the telephone survey .

6.1.5 Women's Health Study – National longitudinal study of more than 40,000 women, includes weight, exercise and health baseline data, includes age ranges 18–22 years, 45–49 years and 70–74 years. Baseline data collected in 1996, follow-up to be collected over 20 years, at three-yearly intervals.

Pros:

- provides data on a large cohort followed over 20 years
- survey already in place and methods established

Cons:

- limited to reporting on a few specific age groups

6.2. Possible options to obtain data about NSW children

6.2.1 Include measured weights and heights in the Drug and Alcohol Survey, conducted by the NSW Health Department every 3–4 years in Years 7–11(ages 12–17years).

Pros:

- Data available at State and Area level possible (total n = 10,000) (Over-samples rural areas)
- sampling already conducted as part of existing survey
- same survey already has some short questions on food intake (fruit and veg, bread and cereal, milk), which can be compared to weight status
- includes some questions on physical activity and TV watching; could compare to weight status

Cons:

- the survey may not be repeated at regular intervals
- limited to high school students
- requires funding for training field workers and resources for measurement

6.2.2 Repeat survey of School Survey of Fitness and Physical Activity. (A survey conducted in NSW in 1997), on children, aged 7–15 years. The survey included measures of weights and heights, and on a sample of skinfolds (3: biceps, triceps, subscapular) and waist: hip circumferences (n=approx 6000)

Pros:

- provided data for the State and Area Health Services, including sampling in urban and rural areas
- can compare weight status to physical activity and TV watching habits

Cons:

- no assurance that a repeat of the survey will occur
- did not include any questions on food habits; not able to compare to weight status (it is better to be able to compare within the one survey).

6.2.3 Regularly collect weights and heights of all school children to monitor growth and overweight and obesity

Pros:

- provides comprehensive system to allow analysis of data, providing prevalence of overweight and obesity (and underweight), trends, and growth at State wide level
- provides information for Area Health Services on an annual basis

Cons:

- who would keep the data and report the information? NSW Health? – costly
- extra data collection required by School Nurses. Would they be willing?

6.3. Possible options to obtain data about NSW Aboriginals

6.3.1 Analyse the unreported data of children from the NATSI survey to provide baseline data

Pros:

- Data already collected
- Useful source of information of this subpopulation using measured data

Cons:

- Need to ensure applicability of analysis method to the age group and subpopulation
- limited to use of reference data based on Caucasian population, however still useful for comparisons to future surveys

6.3.2 Repeat NATSI survey**,** including measured weights and heights of people 0 years and over (rather than 5 years and over only)

Pros:

- likely to be repeated in 1999, and ABS consultant reports aims to repeat every five years
- provides information about this target group at State and Area Health Service level
- little cost or organising required by NSW Health

Cons:

- short questions on nutrition (fat and sugar) provide limited knowledge of diet (suitability of comparing with weight status limited)

6.3.3 Analyse the population from the NATSI survey in appropriate age categories for adults and children. Ensure appropriate uses of age categories and analysis of weight status in appropriate age categories.

6.4: Other existing data options for the NSW population

Select existing surveys from population-based samples, that track longitudinal data.

6.4.1 MONICA – Hunter Area, represents large proportion of people with low SES. May be repeated depending on funding.

6.4.2 Blue Mountains Eye Study, Stage 1 conducted 1992–1994, repeat Stage 2 1997–1999. Conducted on people aged over 50 years (n=3500); suitable for target groups – menopausal women and older people. Measures weights and heights and will allow comparison between dietary intake and weight status.

6.4.3 Asthma study – tracking 600–800 babies 0–5 years from the Liverpool, Westmead district.

6.4.4 Nepean Cohort Study of 800–1000 children – measured weights and heights as infants, 7 years, and repeat measure planned for future date.

Section 7: Presentation and analysis of data

7.1: Descriptive Statistics

For each set of data on weight, height, abdominal circumference and BMI report:

1. Mean
2. Median
3. Standard deviation
4. Standard error of mean
5. 95% confidence intervals
6. Distribution: 5th centile
   10th centile
   15th centile
   25th centile
   50th centile
   75th centile
   85th centile
   90th centile
   95th centile (depending on adequate sample size-refer to note 7.2)
7. For BMI, proportion classified in standard weight categories (as appropriate).

For most purposes it is adequate to report the above for BMI and abdominal circumference only. Reporting the weights and heights is useful for comparisons to international data sets or if further analyses of the data are likely, such as, interpreting the data by another means other than kg/m^2.

7.11: Measured weight and height

- For measured heights report values to xxx.x cm (ie. one decimal place)
- For measured weights report values to xxx.x kg (ie. one decimal place)
- For BMI calculated from measured weight and height present BMI as xx.xx (ie. two decimal places). BMI should not be rounded before categorisation to the classification below.

7.12: Self-reported weight and height

- For self-reported heights report values to xxx cm
- For self-reported weights report values to xxx kg
- For BMI calculated from self reported weight and height present BMI as xx.x (ie. to one decimal place). BMI should not be rounded before categorisation to the classification below.
- To convert imperial units to metric, use the conversion factors:
  2.54 cm = 1 inch
  0.454 kg = 1 pound

7.2: In adults

1. Ideally report the descriptive statistics by sex and 5-year age groups (where the sample size permits): 20–24 years, 25–29 years, 30–34 years, etc. For most purposes report the basic data set outlined for BMI. This may not include the centile distributions for adults.

   For 16–19 year olds, ideally report by year of age: 16, 17, 18, 19 years (if the sample size is sufficient). A sample size of least 200 in each age and sex group is recommended by WHO (1995).

   Since it is likely that there is insufficient data to report by year of age, alternatively report as 16–17 and 18–19 years or 16–19 years.

   Alternatively, report adults in 10-year age groups. The age groups chosen need to reflect which past data sets they will be compared to. For comparison to the NSW Health Promotion Survey use data groups: 16–17, 18–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70+ years. For comparisons to the National Nutrition Survey use:19 - 24, 25 - 44, 45 - 64 and 65 years and over.

2. Report the proportion (%) of population classified into the following categories

Underweight	BMI < 18.5	(WHO grade 1,2,and 3 thinness)
Normal weight	(report the two categories of cut-points separately to allow comparison with past data sets): BMI 18.50 – 19.99 BMI 20.00 – 24.99	
Overweight	BMI 25.00 – 29.99	(Grade 1 overweight)
Obese	BMI ≥ 30.00	(Grade 2 overweight is 30.00 – 39.99) and Grade 3 overweight is ≥ 40.00)

BMI should be derived after the data entry of weight and height. It should be stored as a continuous variable and should not be rounded before categorisation to the above classification, however the data set should be truncated to two decimal places, to avoid misinterpretation of the above categories. For example a BMI stored in the computer as 29.999 will be truncated as 29.99 and categorised as overweight (this allows the data to be truly categorised as 25–<30 so that all data points are categorised appropriately).

For ease of viewing the data (see Table 7.1) and for comparisons with past surveys an alternative categorisation method is the following simplification of categories:

Underweight	BMI <20.00
Normal weight	BMI 20.00 – 24.99
Overweight	BMI 25.00 – 29.99
Obese	BMI ≥ 30.00

Table 7.1: Body mass index based on self reported weight and height from the NSW Health Survey
(Comparable to the NSW Health Promotion Survey)

Age (years)	Underweight BMI <20.00 (%)	Normal weight BMI 20.00 – 24.99 (%)	Overweight BMI 25.00 – 29.99 (%)	Obese BMI ≥ 30.00 (%)
Males				
16–17				
18–19				
20–29				
30–39				
40–49				
50–59				
60–69				
70 +				
Females				
(as above)				

In a separate table record:
- mean
- median
- standard deviation
- standard error of mean
- 95% confidence intervals
- centile distribution as required (eg. for comparison to international data sets)

Report the centile distribution of BMI: round to two decimal places for BMI calculated from measured weight and height, and round to one decimal place for BMI calculated from self-reported weight and height (see 7.11 and 7.12 above).

7.3: In adolescents: (9–15 years)

1. Report the descriptive statistics by sex and year of age, ie. 9, 10, 11, 12, 13, 14, 15 years.
   Since the distribution of BMI within adolescent groups may be skewed towards higher values, the median provides a better estimate of central tendency than the mean (WHO 1995).
2. Report frequency and percentage (%) of adolescents with BMI > 30.
3. Report percentage (%) of those considered at risk of overweight (≥ 85th percentile) relative to the reference data[2] (see section 5.4.2 for detailed discussion of reference data).
4. Report percentage (%) of those considered overweight (≥95th percentile) relative to the reference data.
5. Report % of thinness (<5th percentile) relative to the reference data.
6. As required, compare proportion of sample to whole distribution for BMI cutpoints of reference BMI population, eg. 40% of the sample may fall into less than the 10^{th} percentile of the reference population.

7.4: In younger children: (0–8 years)

1. Report the descriptive statistics by sex and year of age.
2. Report proportion (%) of children at z-score points (see Section 5.4.1 for further description of z-score and reference data):
   - < -2
   - ≥ -2 to < -1
   - ≥ -1 to $< +1$
   - $\geq +1$ to $\leq +2$
   - $> +2$

   Where z-scores = $\dfrac{\text{(observed value) - (median reference of a population)}}{\text{standard deviation of reference population}}$[3]

[2] Reference data recommended for children 9-15 years;
1. Australian data derived from the Australian health and Fitness Survey 1985 (Lazarus et al 1995).
2. US reference data derived from the National health and Nutrition Examination Survey - 1 (Must et al 1991).

[3] Reference data recommended for children 0-8 years:
NCHS/WHO reference data (1983) (until a new international reference tool is available).

7.4.1: Interpretation of z-scores

1. Compare the above z-scores values to the expected values of:

< -2	2.3%
≥ -2 to < -1	13.6%
≥ -1 to < +1	68.3%
≥+1 to ≤ +2	13.6%
> +2	2.3%

2. If the sample is greater than 2.3% at z-score +2 this shows the sample is more overweight than the reference population.

3. Document trends over time to evaluate changes in the population. If a shift to the right (ie. more towards the +2 z-score) occurs then the population is increasing in weight. If a shift to the left occurs (ie. more towards the -2 z-score) then the population is decreasing in weight. Increases in either end of the distribution are a concern.

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Section 8: How to sample from the population to give a representative picture

8.1: Why sample?

It is usually necessary to take a **sample** of a subset of a **population** as normally it is not feasible to survey a whole population. Sampling has several advantages:

- samples can be studied more quickly than whole populations;
- a study of a sample is less expensive than a study of an entire population ;
- potentially, it increases the accuracy of the data collected if a greater proportion of the project budget can be allocated to training research staff in data collection methods.

8.2: Methods of sampling

A sample should be selected in such a way that it is representative of the larger population. The best way to ensure that a sample will lead to reliable and valid inferences is to use **probability samples** in which the probability of being included in the sample is known for each subject in the population (Dawson-Saunders, Trapp, 1990: 70). The four commonly used probability sampling methods are:

- simple random sampling
- systematic sampling
- stratified sampling
- cluster sampling

Any work that involves selecting a sample should seek advice from an epidemiologist and/or a statistician, especially if stratified and cluster samples are used, to determine a suitable sample size and analysis strategies.

8.2.1: Simple random sampling

A simple random sample is one in which every subject has an equal probability of being selected for the study. Each subject is assigned a number and then a random sample is taken using a random number table or a computer-generated list of random numbers.

8.2.2: Systematic sampling

A systematic random sample is one which every *n*th person is selected, for example every third person on a list or every tenth caller to a hotline. The number between 1 and *n* should be selected randomly, for example if every tenth caller is to be surveyed, you should randomly select a number between 1 and 10. If 7 was chosen, then the systematic sample consists of callers with ID numbers 7, 17, 27, 37, 47, etc.

Systematic sampling should **not** be used if there is something peculiar about the method for identifying the subjects, such as, choosing to sample each 7th person which results in sampling on a certain day of the week. This could cause bias as the type of people that attend on that day may be different from another day.

Systematic sampling was used in the NSW Health Promotion Survey (1994) to simplify the database after the 16 geographic strata had been identified. In each of the 16 databases (based on telephone numbers listed in the white pages), every *x*th record was selected from each database, and stored on a new database to reduce the size of the database to a more manageable size.

8.2.3: Stratified sampling

A stratified sample is one in which the population is first divided into relevant strata (subgroups), and a random sample is then selected from each stratum. Commonly used strata types are age and gender. In the NSW Health Survey strata are defined by Health Areas. In this case, weights will need to be applied to each Area proportional to its size (in terms of population) to provide combined estimates for the whole state of NSW.

8.2.4: Cluster sampling

A cluster random sample results from a two-stage process in which the population is divided into clusters and a subset of the clusters is randomly selected. Clusters are commonly based on geographical areas. An example includes the NSW Health Survey where a cluster is defined by the available private telephone numbers within each Health Area. In this survey, each number also represents a cluster containing a varying number of individuals. The NSW Health Survey can therefore be described as a stratified two stage cluster sample (NSW Health Department 1997).

Cluster sampling is usually more feasible and less costly than other methods. For example, it is not usually feasible in terms of times and resources to compile a list of households for any sizeable population, but lists of blocks can be compiled relatively easily.

A major disadvantage of cluster sampling is that standard errors of estimates are usually high and the data analysis required to estimate the standard error is more complicated and time-consuming. Estimates are high since there can be a lot of homogeneity amongst subjects in a cluster (eg. choosing all those subjects in one household). People within a cluster are more alike than those between clusters.

8.2.5: Other sampling methods

Another type of sample is the **'convenience sample'** which are the people who can be sampled easily. For example, they may be the people approached in a shopping centre or the person who answers a telephone call (the person selected will depend on the time of day of the call). In such a sample each subject has an unknown probability of selection. The type of people 'captured' by this method are very unlikely to represent the whole population about which you wish to make inferences.

Another method for sampling sometimes used is known as a **'snow-ball sample'**. This is where subjects for a survey are located by asking existing subjects to nominate someone from their own network. It is frequently used in surveys of hard-to-get-to populations such as homeless youth. It may also be a useful means of accessing very obese people. This method is extremely likely to result in a biased sample. However, for some groups of people there would be no data unless this method was used. Proponents argue, that in these cases, some data is better than none at all (Hawe et al 1990: 135)

8.3: Sampling frame

The **sampling frame** is a list used from which the sample is selected. Commonly used sampling frames in Australia are (Smith 1997):

- the electoral roll
- the telephone directory
- geographic areas eg. ABS Census Collectors Districts (CCD)
- school student registers

8.3.1: The electoral roll

The electoral roll is a convenient frame from which to choose random samples for surveys and is available from the Electoral Commission. The electoral roll will provide the names of all registered voters over the age of 18 years. However, the electoral roll will inevitably be slightly out of date because of deaths and people moving to other locations, as well as others who have only recently turned 18 (Commonwealth Dept of Health 1985). Some people choose not to register for the electoral roll. In a study by Smith et al (1997) conducted with 2500 people aged over 49 years in the Blue Mountains, different sampling frames were compared. The electoral roll contained only 84.3% of the subjects they had recruited from a door-to-door census. Younger subjects, subjects who do not own their own home, subjects born outside of Australia, unmarried persons and males were less likely to be registered on the electoral roll.

When using the electoral roll as a sampling frame researchers should be aware of the potential selection bias and need to take care when generalising about findings to the wider community (Smith et al 1997).

8.3.2: Telephone directory

The telephone directory is available as a computerised version of the white pages which is updated six-monthly.

Some households do not have a telephone connected, or choose not to be listed in the telephone directory. In 1991 NSW had 89% of its population listed in the telephone book (ABS 1992). In 1994 (at the time of the NSW Health Promotion Survey) 93% of households identified in the 1991 census were listed in the Telecom White Pages. Studies have also found that between 7 to 10 percent of listed telephone numbers are no longer connected at any given time (Smith et al 1995, Williamson et al 1994). Thus, between 80 to 83 % of households would be expected to have a telephone number correctly listed in the telephone book (Smith et al 1997). In the study by Smith et al (1997), described above, 82 % of individuals (about 81% of households) with telephone numbers listed in the white pages were in the census of people recruited from the door-to-door census. 5% of households had no telephone connection. 5.5% of the subjects in this study could not be found in either the telephone or the electoral roll.

People who are less likely to be included in the telephone directory sampling frame are:

- younger subjects (less likely to be listed)
- older subjects (less likely to have a telephone connected)
- subjects who do not own their own home
- subjects born outside Australia
- subjects with a higher occupational prestige (measured using the Daniels Scale).
- homeless people.

8.3.3: All households with a telephone:

An alternative sampling frame from telephone numbers is to include all households with a telephone, those listed and unlisted. Telstra is able to provide active or assigned numbers within Telephone Exchanges across the state, also showing the proportion of numbers in each Exchange that lies within a Statistical Local Area (SLA). Note that this includes business numbers which will need to be removed from the sampling frame. Business numbers are usually removed during the calling process which adds to the time and cost of the survey.

Approximately 5% of people do not have a telephone connected (Smith et al 1997).
People who do not have a telephone connected are more likely:

- to be older
- to be born outside Australia
- to not own their own home
- to be unmarried.

This form of telephone sampling frame represents a greater proportion of the population than relying solely on the numbers listed in the white page directory, however it is more expensive to obtain.

This sampling frame is being used by the NSW Health Survey.

8.3.4: Geographic area – households

The Australian Bureau of Statistics (ABS) cluster households into areas for the purposes of data collection, such as the census or the Health Monitor Surveys. Geographic areas are divided into:

- Statistical Divisions (SD)
- Statistical Local Areas (SLAs)
- Collectors' Districts (CDs)
- residential blocks

The sampling frame is then made up of the households in that geographical area.

These household sampling frames are comprehensive as the households in each area are approached door-to-door for survey work. However, this method is expensive and involves a lot of resources.

In some surveys all members of the household are surveyed, such as in the Census collections. At other times individuals within a household need to be randomly selected
This is done by assigning a number to each member of the household and then randomly selecting a member. Weighting factors are required to compensate for varying household

sizes. This all adds to the complication and time of the method (NSW Health Department 1997).

Alternatively a Kish Grid can be used to randomly select an individual however this system requires an assumed maximum size in each household.

Selection based on individual characteristics, such as selecting the person with a birthday nearest the date of contact is not random. For the selection to be truly random, the survey day must be chosen at random, and the underlying distribution of birthdays across the community must be uniform. Since this does not occur this method of selecting individuals is not recommended.

Note that the selection of individuals within a household is also necessary when using telephone numbers as the sampling frame.

8.3.5: Schools

Using schools as a sampling frame can be a useful way to obtain information about school - aged children, since they are a captive audience. However, it mainly addresses the age groups between 5 and 15 years. Ages outside this are difficult to sample as they do not necessarily attend any common institutions or work settings and are not enrolled on the electoral roll.

When schools are used as a sampling frame careful attention must be given to the random selection of age categories. The sampling frame can consist of:

1. All children of each age (allocating an ID number to each child and then randomly selecting the sample required).

2. Children in each grade at school. It should be noted that this method can be problematic as each grade does not contain a randomly representative sample of ages. This can bias a sample if every grade is not selected to participate; for example, only choosing every second grade, as there will be a biased representation of children at a given age.
3. All schools where there is a minimum number of children in each school age and sex category. This technique was used by the Australian Health and Fitness Survey (AHFS), 1985 (in which school children had fitness tests and measurements for weight and height taken) where the sampling frame consisted of schools in Australia able to provide groups of 10 children in each age and sex category. This type of sampling frame excludes small schools, in particular schools from rural areas. In the AHFS 10% of primary schools and 3% of secondary schools were excluded.

8.4: Interview modes

8.4.1: Face-to-face interviews

This mode of questioning allows for more probing questions and allows the interviewer to listen and watch the respondent. In the case of self-reported weight and height data this method probably encourages reporting accuracy (Rowland 1990: 1126) since the interviewer can actually see the respondent.

8.4.2: Telephone interviews

The use of telephone interviews for health surveys has increased in the past 10 years, especially with the development of computer-assisted telephone interviewing systems. Telephone interviewing is attractive because of lower costs and easier administration and supervision than face-to-face interviewing.

The study in Perth that compared face-to-face household interviews verses telephone interviews (Donovan et al 1997) discussed some variations in responses between the two modes. The telephone sample was:

- significantly higher in residential social status;
- had significantly lower reporting of smoking and lower unsafe alcohol consumption;
- had significantly greater recall of health messages.

These researchers conclude that comparisons of data collected using different survey modes should be treated with caution. For example, self reported weight and height data collected from the National Health Survey (a face-to-face interview) should be compared with considerable caution with self reported weight and height data from the NSW Health Survey (a telephone survey).

8.4.3: Self-completed questionnaires (mail out)

Mail out surveys are cheaper and can reach a widely scattered sample. In the case of weight and height information, data is limited to self reported information. However this mode of delivery allows more privacy for asking sensitive questions, such as weight related attitudes and behaviours or food security questions. This method requires the respondent to be literate and allows no observation.

Since people have the opportunity to report on this at their leisure in their own home, questions asking about weight, height , and waist circumference may be measured by the respondent. This possibility further reduces the ability to compare this method with other interview methods, which have no opportunity at all for self measurement. A survey conducted in Tasmania in 1997-1998, asked people to complete a mail out survey in which they self-reported their waist circumference. Early analysis of this data indicates that people are commonly using waist sizes shown on their clothes (personal communication Malcolm Riley, Tasmanian Food and Nutrition Study).

8.5: Response rate

A major problem with survey research can be obtaining an adequate response rate. If response rates are low, or if there are systematic differences between responders and non-responders, then there is reason to question the representativeness of the sample obtained (Commonwealth Dept of Health 1985: 44).

The people who respond to invitations to cooperate with a survey are generally different from those people who refuse. Waters (1993) compared the measurements of 2119 respondents who had missing self-reported data for weight and height from the 1989 RFPS and found that there was a significant association for men and women ($p<0.001$) between BMI category and whether or not self-reported weight and height data were missing. A greater proportion of men with missing self-reported weight or height were obese compared to men with both self-reported heights and weight data available (cf. 14.6% to 10.4%). For women a greater proportion with missing self-reported height or weight were overweight or obese than women for whom self reports were available.

Response rates tend to vary with the mode of delivery of the survey. Response rates are usually better in face-to-face interviews than telephone surveys, and these two methods are both better than mail-out surveys. Responses can also vary with interview mode. A recently published study in Perth (Donovan 1997) compared the responses for two interview modes: face-to-face household interviews and telephone interviews. The response rate in the telephone survey was 46% compared to 66% in the household survey.

The 1994 NSW Health Promotion Survey (HPS) (a telephone survey) had a response rate of 72.6%. The response rate was higher for: those who completed the interview in English; older people; and people with tertiary education. Consequently, the NSW HPS was weighted to provide a similar age, gender and ethnic distribution as the 1991 Census data (NSW Health Dept 1995).

There are methods used to improve response rates, and these include:

- differential call back procedures, used in telephone surveys, where respondents approached in a different way to encourage response, such as calling back at a more convenient time, or by a more senior interviewer.
- using follow-up procedures, such as a reminder letter or phone call.
- including a stamp, self-addressed return envelope with a mail out survey.

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Appendix 1

Table A1.1: Distribution of BMI categories by measure and self-report, women

Age group	Measure-ment status	Under-weight %	Acceptable weight %	Overweight %	Obese %
20–24 years	Measured Self-report	26.6 24.0	56.4 57.3	14.6 15.0	2.4 3.8
25–29 years	Measured Self-report	23.7 25.7	52.9 52.7	15.2 15.4	8.1 6.2
30–34 years	Measured Self-report	22.9 22.8	55.6 54.6	15.5 16.7	6.0 5.9
35–39 years	Measured Self-report	16.0 19.2	55.5 55.0	20.9 18.9	7.7 6.9
40–44 years	Measured Self-report	14.9 14.8	60.9 61.8	19.9 20.3	4.3 3.2
45–49 years	Measured Self-report	7.3 9.7	48.6 49.7	28.0 27.9	16.2 12.7
50–54 years	Measured Self-report	6.2 7.2	46.1 51.8	27.8 24.1	19.9 16.9
55–59 years	Measured Self-report	8.5 8.7	47.1 54.2	29.0 24.3	15.4 12.9
60–64 years	Measured Self-report	4.7 9.2	46.9 50.2	35.1 29.3	13.3 11.3
65–69 years	Measured Self-report	6.2 6.2	38.4 47.7	37.1 37.3	18.3 8.9
all ages	Measured Self-report	15.7 16.7	52.3 54.1	22.2 21.2	9.7 8.0

Source: Waters, 1993

Table A1.2: Distribution of BMI categories by measure and self-report, men

Age group	Measure-ment status	Underwt %	Acceptable weight %	Overweight %	Obese %
20–24 years	Measured Self-report	8.9 10.2	64.0 67.3	21.7 18.8	5.4 3.7
25–29 years	Measured Self-report	6.9 6.4	55.3 58.2	32.3 30.9	5.5 4.5
30–34 years	Measured Self-report	3.8 6.3	54.5 55.1	36.8 34.0	4.9 4.6
35–39 years	Measured Self-report	4.7 3.8	43.9 49.4	43.5 40.4	7.9 6.4
40–44 years	Measured Self-report	3.1 2.2	42.7 52.1	45.4 38.7	8.9 7.0
45–49 years	Measured Self-report	0.9 1.0	36.9 43.6	48.6 46.6	13.7 8.5
50–54 years	Measured Self-report	1.5 2.5	37.8 41.3	44.8 44.2	15.9 11.9
55–59 years	Measured Self-report	0.8 2.5	37.7 44.5	46.1 39.3	15.4 13.7
60–64 years	Measured Self-report	2.5 1.3	33.7 43.5	53.9 48.6	10.0 6.6
65–69 years	Measured Self-report	2.0 2.9	34.7 48.3	51.4 41.8	11.9 7.0
All ages	Measured Self-report	4.1 4.4	46.5 52.0	40.5 36.8	9.0 6.8

Source: Waters, 1993

Appendix 2:

Table A2.1: Smoothed BMI cutpoints (percentiles) for age, based on US data (NHANES-I), (Whites) males.

Age (y)	*n*	5th	15th	50th	85th	95th
9	121	14.04	14.75	16.24	18.88	21.45
10	146	14.42	15.19	16.79	19.67	22.66
11	122	14.81	15.64	17.35	20.47	23.87
12	153	15.21	16.11	17.93	21.28	25.01
13	134	15.69	16.65	18.57	22.12	26.06
14	131	16.16	17.22	19.25	22.97	27.02
15	128	16.57	17.79	19.94	23.82	27.86
16	131	17.00	18.35	20.63	24.63	28.69
17	133	17.29	18.72	21.13	25.44	29.50
18	91	17.50	18.95	21.46	26.08	29.89
19	108	17.77	19.25	21.88	26.53	29.98
20–24	423	18.62	20.26	23.09	27.02	31.43

Must et al 1991

Table A2.2: Smoothed BMI cutpoints (percentiles) for age, based on US data (NHANES-I), (Whites), females.

Age (y)	*n*	5th	15th	50th	85th	95th
9	125	13.96	14.72	16.35	19.21	21.78
10	152	14.36	15.18	17.02	20.33	23.15
11	117	14.76	15.64	17.69	21.24	24.48
12	129	15.17	16.11	18.36	22.25	25.53
13	151	15.59	16.55	18.91	23.13	26.46
14	141	15.89	16.89	19.29	23.87	27.31
15	117	16.21	17.23	19.69	24.28	27.89
16	142	16.55	17.59	20.11	26.68	28.45
17	114	16.76	17.84	20.39	25.07	28.95
18	109	16.87	18.01	20.58	25.34	29.23
19	104	17.00	18.20	20.80	25.58	29.37
20–24	956	17.47	18.61	21.38	25.78	31.25

Must et al 1991

Table A2.3: Smoothed BMI cut-points for age and sex based on Australian data (AHFS), males

Age (y)	***n***	**85th**	**95th**
9	480	18.9	21.5
10	492	19.6	22.2
11	484	20.3	23.1
12	495	21.0	23.9
13	473	21.6	24.7
14	468	22.2	25.7
15	468	22.8	26.6

Lazarus et al 1995
AHFS (Australian Health and Fitness Survey)

Table A2.4: Smoothed BMI cut-points for age and sex, based on Australian data (AHFS), females

Age (y)	***n***	**85th percentile**	**95th percentile**
9	489	91.1	20.9
10	498	19.9	21.9
11	480	20.6	23.2
12	492	21.5	23.9
13	438	22.3	24.5
14	405	23.1	25.0
15	413	23.9	25.4

Lazarus et al 1995
AHFS (Australian Health and Fitness Survey)

Appendix 3

Table A3.1: Summary of school surveys conducted in NSW that include dietary intakes, anthropometry and physical activity

Survey title Who conducted (Year)	Method of sampling	Sample size boys:girls (response rate, where available)	Age/ Year at school	Variables measured (relevant to project)	Comments
Australian Health & Fitness Survey, Australian Council for Health, Physical Education and Recreation Inc. (ACHPER) (1985)	Sampling frame: schools in Aust able to provide groups of 10 children in each age, sex cat. Sampling design: 2 stage random probability: S.1. schools S.2: 15 children in each age, sex category	Aust.:8484 Response rate schools: 90% Response rate of students: 67.5%.	7 – 15 years	i. ht & wt (m); ii.W:H circ's; iii.skinfolds; iv.Phy.fitness v. S.R. report of phy act.	i.means and percentiles, difficult to compare to goals and targets. ii.exclude smaller schools, therefore rural pop. less represented. (Excludes 10% primary, 3% sec schools).
National Dietary Survey of Schoolchildren (1985)	Conducted as part of ACHPER. 65% of children from fitness survey had usable dietary data.	Total (Aust)5224 2631 boys; 2593 girls NSW: 1768 892 boys; 876 girls (rural & urban)	10 – 15 years (approx. equal numbers from each age group)	24 hour record of food & drink. Completed & checked by individual interviews.	i. % consuming various foods, mean & distribution of foods & nutrients. ii. No assessment of under-reporting.

Survey title Who conducted (Year)	Method of sampling	Sample size boys:girls (response rate, where available)	Age/ Year at school	Variables measured (relevant to project)	Comments
					iii. No information on within person variation (based on one 24 hour rep).
High School Drug & Alcohol Survey. Drug & Alcohol Directorate, NSW Health. Contacts: Chriss Rissel, Roberto Ferraro (1996)	High school students;10000 randomly sampled. Oversampled rural areas. Conducted every 2–3 years	5000 students received survey 2 with nutrition questions.	Year 7 – 12 (aged approx.12– 18 years)	*Supplementary 2:* i. 6 q's on usual intake, breakfast, vegetables, fruit, breads & cereals, milk. ii. phys. act.; hours a day watching T.V. iii. *In general survey:* No. of alcoholic drinks.	i. Repeat likely in 3–4 years. ii. Interested in wt/ht (M) in future surveys.
Health Behaviour Survey of Children (HBSC). Contact: Adrian Bauman (1996)	Random sample (no oversampling of sub-populations)	4000	Years 5, 7,9 School students	i.Wt & ht (SR). ii.Food frequency of 14 foods; iii. Perception of body image; weight loss diet.	i. How will SR wt & ht be analysed?

Survey title Who conducted (Year)	**Method of sampling**	**Sample size boys:girls (response rate, where available)**	**Age/ Year at school**	**Variables measured (relevant to project)**	**Comments**
School Survey of Fitness and Physical Activity Contact: Michael Booth (1997)	Rural/ urban sampling across NSW.	6100. Supplementary survey of 400 ATSI youth likely.	7 – 15 years (every second school year)	i. Wt&ht (M & SR) ii. 3 skinfolds (on sample) iii. WH circ's. iv.Phys act .	No funding available for food habits questions.
Auburn/ Holroyd Survey. Contact: Fiona Blyth, Kate Loni. (1995)	Telephone survey; asked questions for children <17 years by proxy (used parents); and adults.	Total 152 children (<17 years); Auburn 811 (17 + years); Holburn 762 (17 + years) (total: 64.3%)	<17 years; 17 + years	i.Perception & concern of weight status of child; ii. TV watching habits; iii. perception of level of activity; iv. breastfeeding; v. bread; type of milk; take-away meals; fat spread usage; usual vegetable & fruit serve; lunch buying habit.	To be analysed by NESB (defn: ES, born in NES country & speak NE at home + NES).

Abbreviations: wt weight, ht height, m measured, SR self-reported, W:H circ's waist & hip circumference, SF skinfolds, phys act physical activity

Table A3.2: Summary of adult surveys conducted in NSW that include dietary intake, anthropometry, and physical activity

Survey title Who conducted (year)	**Method of sampling**	**Sample size males: females (response rate)**	**Age**	**Variables measured**	**BMI cut-points**	**Other comments**
Risk Factor Prevalence Surveys (RFPS), NHF, (1980, 1983, 1989)	Sampling frame electoral roll of people living within 16km radius of NHF centre in Sydney north, Sydney South, Melbourne, Brisbane, Adelaide, Perth, Hobart. 1989 also included Darwin & Canberra.	1980:5617 (75.9%), Sydney 1394. 1983: 7640 (75.3%), Sydney 1908. 1989: 9309 (74.7%), Sydney 1683.	1980,'83: 25–64 yr. 1989: 20–69 years	i.ht & wt (Sr &M) ii.B.P.(m), blood lipids (m) iii. Iron status (m) iv. Alcohol consumption (SR), v. exercise habits.	1980,1983: men: Women: ≤19 ≤18 20–25 19–24 26–30 25–30 >30 >30 1989: <20 20–25 >25–30 >30	i.No rural sampling. ii. Food habit questions differ, limiting trend data.
National Dietary Survey of Adults, (1983), conducted in conjunction with RFPS, subsample of 1983 RFPS.	Conducted in conjunction with RFPS, subsample of 1983 RFPS.	6255: 3027males, 3228 females.	25 – 64 years	24 hour recall, face-to-face interview by dietitian. Food models to estimate portion size.	N/A	i.Does not allow for within person variation; ii.18 % had measured energy intake below level to sustain body weight: under reporting.

Survey title Who conducted (year)	Method of sampling	Sample size males: females (response rate)	Age	Variables measured	BMI cut-points	Other comments
NSW Health Promotion Survey 1994	Telephone survey from households listed in the White pages – random sample of 1000 respondents in each of 16 health areas & districts in NSW.	16 165 (72.6%)	18 + years	i.food habits ii.ht & wt (SR) iii. breastfeeding. iv. (Supp) perceived weight status.	<20 20–24.9 25–29.9 ≥30 (? Not clear from data book) (cut-points differ in tech. Rep. & data book).	Validity data collected on 143 respondents - randomly selected from pilot study.
The National Health Survey (1989–90). ABS.	Random sample to provide information on people from rural, urban areas	NSW sample: 15,176 Total households in Aust: 22,200	18 + years	i. No physical measurements ii.wt & ht (SR) iii.smoking, alcohol iv. Breastfeeding	Initially rounded to whole integers thus 25.5 rounded to 26. Re-analysed to: <20, 20–25, >25–30, >30	i. Can not calculate prevalence rates for breastfeeding.
National Health Survey (1995)	Results represent rural/urban pop. Sampled additional ATSI people, results due to be released late 97.	NSW sample: 8000	18 + years	i. Wt & Ht (SR); ii. Exercise iii. breastfeeding .	<20 20–25 >25–30 >30	Accuracy of self-reported wts/hts queried – inconsistent with ABS Population Survey Monitor. May be validated with NNS data.

Survey title Who conducted (year)	**Method of sampling**	**Sample size males: females (response rate)**	**Age**	**Variables measured**	**BMI cut-points**	**Other comments**
National Nutrition Survey (1995)	Conducted in conjunction with NHS, using subsample from NHS.	2886	2 + years	i. Wt & ht (m) ii. W:H circ's iii. 24 hour dietary recall (replicate on 10% sample); iv.self-completed food frequency 12 + years.	(Adapted from WHO rec's) Underweight <18.5 Accept wt 18.5–<25 Overwt 25–<30 Obese ≥ 30	
National Aboriginal and Torres Strait Islander Survey, 1994, ABS.	Multi-staged stratified sample of 35 ATSIC & TSI areas.	15, 700 interviewed by 90 ATSI people	5 + years	i.Wt & Ht (M) ii.breastfeeding; iii.food habits related to sugar & fat intake.	<20 20–25 >25–30 >30	i.Used standard adult category definitions for overweight and obesity for all from 13 + years. ii.No recorded analysis of weight status of younger children.

Survey title Who conducted (year)	**Method of sampling**	**Sample size males: females (response rate)**	**Age**	**Variables measured**	**BMI cut-points**	**Other comments**
Population Survey Monitor, 1994–95 (ABS)	Household survey covering rural, urban areas across all States and Territories (persons living in non-private dwellings and sparsely populated areas excluded).	2700 private dwellings	18 + years	self-reported weight and height	<20 20–25 >25–30 >30	

Abbreviations: Wt = Weight, Ht = Height, m = measured, SR = self-reported, W:H circ's = waist & hip circumferences, SF = skinfolds, phys act = physical activity
BMI cutpoints shown in order of underweight, acceptable weight, overweight, obesity (unless otherwise stated).

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Acknowledgements

The NSW Food and Nutrition Monitoring Project was funded by the NSW Health Department.

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We would like to thank the following people for their valuable contribution in providing information utilised in the production of this document.

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