



A Framework for Monitoring Overweight and Obesity in NSW



A FRAMEWORK FOR MONITORING OVERWEIGHT AND OBESITY IN NSW

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The Physical Activity Nutrition Obesity Research Group (PANORG) at Sydney University undertakes policy relevant research to promote physical activity, nutrition and obesity prevention. It is funded by NSW Health.

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List of abbreviations used

ABS	Australia Bureau of Statistics
ACHPER	The Australian Council for Health, Physical Education and Recreation
AHFS	Australian Health & Fitness Survey
AHS	Area Health Services
AIHW	Australian Institute of Health and Welfare
ALLS	Adult Literacy and Life Skills Survey
APARQ	The Adolescent Physical Activity Recall Questionnaire
ASAQ	The Adolescent Sedentary Activities Questionnaire
ASSAD	Australian Secondary Students' Alcohol and Drug Survey
BMI	Body Mass Index
CALD	Cultural and linguistic diverse groups
CAPI	Computer Assisted Personal Interview
CATI	Computer Assisted Telephone Interview
CDC	US Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CPHN	Centre for Public Health Nutrition
CSIRO	Australia's Commonwealth Scientific and Industrial Research Organisation
CVD	Cardiovascular disease
DoHA	Department of Health and Ageing
EDNP	Energy Dense Nutrient Poor Foods
ERASS	Exercise, Recreation and Sports Survey
FAO	The Food and Agriculture Organization of the United Nations
GFK	Good for Kids, Good for Life program
GIS	Geographic Information System
HES	Household Expenditure Surveys
HR	Heart rate monitoring
HRS	National Health Risk Survey
HTS	Household Transport Survey

IASO	The International Association for the Study of Obesity
IDF	International Diabetes Federation
IHD	Ischemic Heart Disease
IOTF	International Obesity Taskforce
IPAQ	The International Physical Activity Questionnaire
LSAC	Longitudinal Study of Australian Children
MET	Metabolic Equivalent
MVPA	Moderate-to-vigorous physical activity
NEWS	Neighbourhood Environment Walkability Scale
NHANES	National Health and Nutrition Examination Survey
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
NIP	Nutrition information panels
NNS	National Nutrition Survey
OO	Overweight and Obesity
PA	Physical Activity
PANORG	Physical Activity Nutrition and Obesity Research Group
SES	Socioeconomic status
SFPAS	NSW School Fitness & Physical Activity Survey
SPACES	Systematic Pedestrian and Cycling Environmental Scan Instrument
SPANS	NSW Schools Physical Activity and Nutrition Survey
TUS	Time Use Surveys
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist-hip ratio

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Executive Summary

Monitoring of population weight status is valuable in order to track changes and identify likely causes and implications, and to adjust policy and program priorities.

A monitoring framework sets out what information should be collected, when and how it should be collected, and systems for the reporting of this information. Decisions about what, how and when reflect the specific purposes and objectives of the monitoring system, and depend on policy priorities. Decisions about what to measure can be guided by a conceptual framework which maps the factors associated with and contributing to overweight and obesity. Decisions about what should be measured can also be guided by experience in similar systems in Australia or internationally, as well as costs.

The NSW Centre for Public Health Nutrition (2000) provided recommendations to NSW Health regarding approaches for monitoring overweight and obesity in adults and children in 2000. This document provides an update on that work, in the light of the current context.

This document proposes a framework for monitoring overweight and obesity that covers the following:

- Prevalence of overweight and obesity

Dietary behaviours

- Fruit consumption
- Vegetables consumption
- Fat intake
- Consumption of high energy dense foods and drinks
- Alcohol consumption
- Eating habits and patterns

Physical activity and sedentary behaviours

- Physical activity
- Levels of inactivity
- Small screen recreation time

Food environment factors

- Number and type of take away food outlets
- Availability of food retail facilities
- Availability and pricing of appropriate low fat, low energy dense food choices
- Promotion of appropriate compared with inappropriate food choices

Physical activity environment factors

- Space allocated to open parkland or recreational facilities
- Public transport facilities and use
- Length of bicycle pathways provided
- Proportion of children walking or cycling to school
- Membership of active recreational or sporting clubs
- Opportunities for children to play safely within the neighbourhood

Socio-demographic factors

- Age
- Sex
- Ethnicity (assessed by: country of origin, language spoken at home)
- Aboriginal or Torres Strait Islander status
- Socio-economic status (assessed by: post code of residence, level of education, or income)
- Place of residence (urban, rural/regional)

Other factors

- Health knowledge and health literacy
- Perception of body weight
- Attitudes and practices towards weight management
- Quality of Life measures

This report presents the rationale for including these and related factors as part of monitoring overweight and obesity, and discusses issues regarding appropriate measures and presentation and interpretation of data.

1. Introduction

In Australia, population health monitoring, collation and publication of health information is conducted at both national and state levels.

A population health monitoring system involves periodic cross-sectional surveys across large population groups and regular reporting of patterns and trends. The monitoring system thus involves making decisions about:

- What should be measured
- How variables should be measured
- Who should be monitored
- Frequency of measurement
- Survey methods for measuring weight status
- How information should be aggregated and reported

The decisions about what, how and when reflect the specific purposes and objectives of the monitoring system, and which issues are important for policy priorities. Decisions about what to measure can be guided by a conceptual framework which maps the factors associated with and contributing to overweight and obesity. Decisions about what should be measured can also be guided by experience in similar systems within Australia or internationally, as well as costs.

The NSW Centre for Public Health Nutrition (2000) has previously provided recommendations to NSW Health regarding approaches for monitoring overweight and obesity in adults and children. This document provides an update on that work in the light of the current situation.

Purpose

The purpose of this document is to provide guidance to NSW Health on technical issues related to monitoring the weight status of NSW population.

The importance of monitoring overweight and obesity

Population levels of overweight and obesity are a major health concern as they have significant health, social and economic impact. Australia has been ranked as one of the most overweight developed countries on the globe and thus perhaps has a greater imperative than most other countries to develop strategies, as well as monitoring programs to address overweight and obesity. Current trends suggest that the problem is only going to get worse

in the near term. The obesity rate in adults has doubled over the last twenty years. Similarly, the prevalence of overweight and obesity in children and adolescents has been rising over the last two decades or more (AIHW 2008).

Obese children and adults are affected by a wide range of conditions and diseases, and overweight people suffer an increased risk of health problems (See Appendix 1). High body mass was estimated to be responsible for 7.6% of the total burden of disease in Australia in 2003, placing it in third position behind tobacco and high blood pressure (Begg S 2007). It was shown that the rate of burden from increased body mass increased with age and resulted mainly from Type 2 diabetes and ischemic heart disease (IHD) (2007). The total financial cost of obesity (BMI 30 kg/m² or more) and related diseases in Australia is rising dramatically. In 2008 it was estimated to be \$8.3 billions, compared to \$3.8 billions in 2005 (Access Economics 2008).

Overweight and obesity are the result of energy imbalance over a sustained period. Modern lifestyles have lead to increased energy intake, and reduced energy expenditure.

Monitoring of population weight status is valuable in order to track secular changes among different population groups, to identify likely causes and implications, and to adjust policy and program priorities.

Conceptual framework

The National Preventative Taskforce (2008) proposed that a monitoring system reporting on overweight and obesity could include:

- prevalence of overweight and obesity and patterns across population and age groups
- information on the patterns of factors influencing population weight status
- information on the prevalence of disease and health consequences associated with overweight and obesity
- health and health-related system performance (See Table 1)

Table 1: Proposed set of performance Indicators for Obesity Prevention: National Preventative Taskforce 2008

Tier 1

Health outcomes
Deaths attributable
Hospital separations

Tier 2

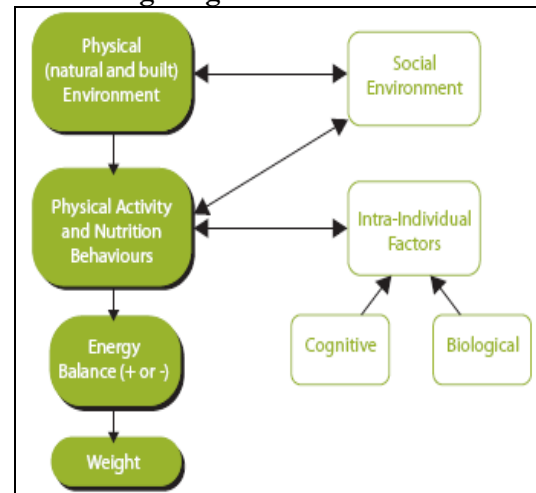
Determinants of health
Proportion adults overweight or obese
Proportion children overweight or obese
Proportion adults eating recommended fruit and vegetables
Proportion adults meeting PA recommendations
Proportion people walking, cycling, using public transport to travel to work/school
Proportion babies breastfed 6 months or more

Tier 3

Health and health-related system performance
Recall of education campaigns
advertisements for EDNP foods during children's TV viewing time
Food price disparities in rural, remote areas
% state and municipal plans including steps to tackle obesity
% schools with comprehensive PA & Nut programs
#% workplaces with comprehensive PA & Nut programs
#OO people receiving brief interventions in primary care settings
Per capita coverage of allied health workforce
\$ on R&E related to OO in indigenous and other disadvantaged communities

This report focuses on the monitoring of weight status and individual behaviours directly associated with weight. It also includes discussion on selected environmental factors associated with key physical activity and nutrition behaviours, as well as weight status directly. Figure 1 presents a simple schema showing how nutrition and physical behaviours are influenced by both intra-individual factors and social and physical environments, and how all these factors thus indirectly impact on weight status.

Figure 1. Ecological framework of factors influencing weight



Source: (Gebel, King et al. 2005)

The selection of which aspects to focus on in any single survey or monitoring system will depend on the immediate purpose and priorities as well as available resources. Typically, information on disease prevalence is sourced from health service data collections (e.g. health service admissions and presentations); and information on health sector performance requires information from a variety of routine sources and specific studies. The prevalence of overweight and obesity and information on related behaviours can be collected through population health surveys.

This report focuses on information that is most directly related to weight status (i.e. Tier 2), and does not address measures of health outcomes or health-related system performance (i.e. Tier 1 and 3).

2. Policy context

2.1 National context

Preventing overweight and obesity in adults and children is a national health priority. The Australian Department of Health and Ageing has developed policy frameworks to guide action: *Healthy Weight 2008* (2003) and *Healthy Weight for Adults and Older Australians 2006-2010* (2006).

National policy and program initiatives have been developed in response to information on the prevalence of overweight and obesity in Australian children and adults. While the information provides a relatively consistent picture, it continues to be drawn from a wide variety of sources as there is no single national monitoring system.

At the national level, an ongoing the National Nutrition and Physical Activity Survey Program was funded by the Federal Government in 2007 in order to collate comprehensive population data through periodic surveys. An Australian National Children's Nutrition and Physical Activity Survey conducted in 2007 provided an assessment of children's food and nutrient intake, physical activity levels and physical measurements; and a survey to collect data on food intake, physical activity participation and physical measurements among Australian adults is being planned for late 2009.

Additionally, the Australia Institute of Health and Welfare (AIHW) produces regular national reports, which organize information from on a mix of national and state-based data collection systems in relation to a conceptual framework of 'health'. *Australia's Health 2008* (AIHW 2008) is the eleventh biennial report on the health of Australians and is based on a conceptual framework which shows that levels of health and wellbeing, including diseases and disability, are influenced by a complex interplay between health determinants, interventions and resources. Following the components in this model the health information presented by AIHW covers:

- assessing the level and distribution of the health of populations
- measuring the level, distribution and influence of determinants
- monitoring and appraising health interventions
- quantifying the inputs to the health system and evaluating the performance of the health system

Overall, the AIHW's approach to reporting on health information takes account of:

- priority population groups
- priority age groups
- disease priorities (which include chronic diseases)
- risk factors or health determinants (which are categorised as behavioural, biomedical, genetic, environmental and demographic), with overweight and obesity considered as a biomedical risk factor.

These determinants influence health and can, in turn, be influenced by interventions and resources applied to them. The National Preventative Taskforce has adopted this approach and promulgated how this conceptual framework specifically applies to determinants of health in relation to obesity, tobacco and alcohol.

There has been considerable recent attention to the need for further national surveys, both as part of the National Partnership Agreement on Preventive Health, and subsequently the development of a proposal by the Department of Health and Ageing for a new biomedical and self-reported National Health Risk Survey.

2.2 NSW Context

The NSW Government (2006) announced in its State Plan that preventing and reducing childhood obesity is a NSW state government priority, as well as preventing risk of chronic disease in adults. The goal of reducing overweight and obesity is also central goal in the NSW State Health Plan and Healthy People NSW.

In 2008, the Premier of NSW agreed to participate in the National Partnership Agreement on Preventive Health. This agreement is supported by the Commonwealth and will focus on a range of activities to enhance healthy lifestyles within the NSW population at different settings. Key indicators and performance benchmarks relate to the population weight status, fruit and vegetable consumption, physical activity levels, and smoking.

NSW Health has a current population health monitoring system which comprises a CATI survey which predominately collects self-report information, including data items on adults' height and weight, and parental report on children's height and weight. Secular information on NSW school children's weight status is also available through a series of school based surveys conducted in 1985 (Australian Health and Fitness Survey), 1997 (NSW

School Physical Activity and Fitness Survey) and in 2004 (School Physical Activity and Nutrition Survey). These surveys included information on physical activity behaviours and in 2004 information on dietary habits and patterns. These surveys have identified trends and reported on increasing rates of overweight and obesity in most age and gender groups (Booth, Dobbins et al. 2007).

Appendix 2 presents a listing of recent, related Australian surveys which have collected information on weight status and related behaviours in (A) adults and (B) children.

3. Monitoring weight status

3.1 What to measure

3.1.1 Anthropometric measures

For population monitoring, simple anthropometric techniques are needed to describe patterns of weight status.

Body Mass Index (BMI) as a measure of weight status

Measurement of height and weight are simple, unobtrusive and relatively inexpensive methods used to calculate BMI (kg/m²). The Body Mass Index (BMI) is also known as Quetelet's index, and can be calculated simply from the measurements of weight and height to allow interpretation of the anthropometric data.

$$\text{BMI} = (\text{body weight in kilograms}) / (\text{height in metres, squared})$$

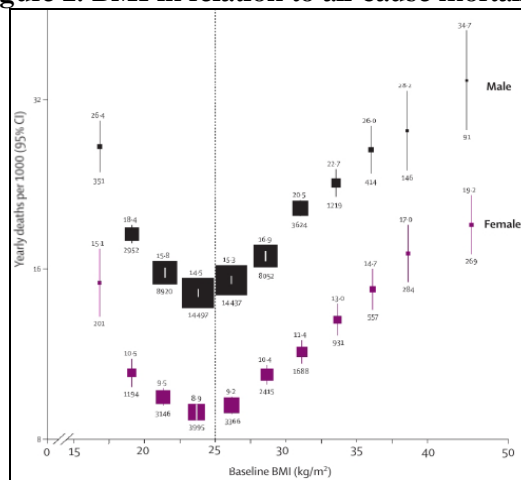
BMI is an adequate indirect measure of body fatness and is considered an appropriate and reliable indicator of adult and child weight status at a population level (WHO 1995). Clinical assessment of individuals' weight status usually includes BMI but may use also other measures.

International cut-offs values for BMI which categories weight status have been developed by the World Health Organization (2000) for adults and by the International Obesity Taskforce for children (Cole, Bellizzi et al. 2000)

Association between BMI and chronic disease among adults:

Recently, The Prospective Studies Collaboration (2009) affirmed that BMI is a strong predictor of overall mortality below and above the apparent optimum range of 22.5-25 kg/m² (J-shaped relation). Figure 2 shows how above this minimum, mortality was on average about 30% higher for every 5 kg/m² higher BMI. Same relation was found for both genders and at all ages up to 79 years, with the highest increase at young ages (35-59 years).

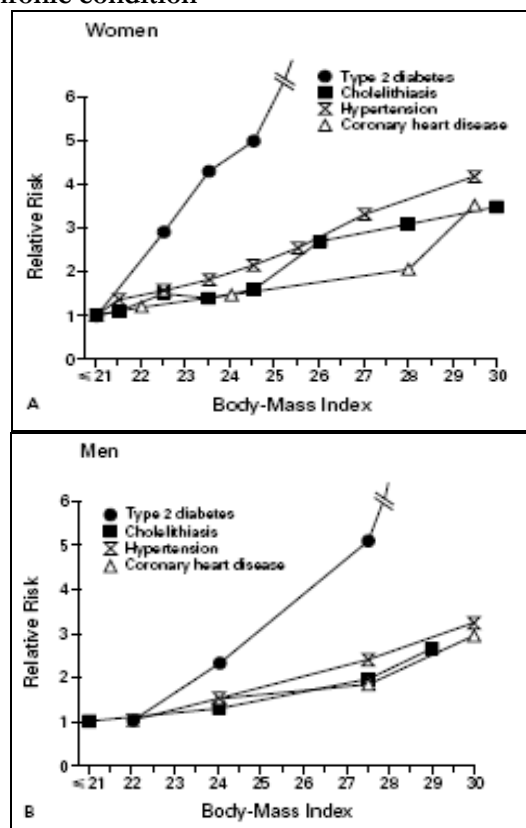
Figure 2. BMI in relation to all-cause mortality



Source: Adapted from (Prospective Studies Collaboration, Whitlock G et al. 2009)

In addition, increased BMI has been associated with the incidence of cardiovascular disease, diabetes mellitus, and gallbladder disease; and is closely associated to other risk factors such as hypertension, dyslipidemia and systemic inflammation (WHO Expert consultation 2004). Willett et al (1999) presented data from two large cohort studies indicating these associations (See Figure 3).

Figure 3. BMI in relation to the relative risk of chronic condition



Source: (Willett, Dietz et al. 1999)
 Panel A shows relations for women (30-55 yrs old) who were followed up for 18 yrs. Panel B shows relation for men (40 to 66 yrs old) who were followed up for 10 yrs.

However, BMI does not distinguish between weight due to fat mass and muscle mass; and this can lead to misclassifying individuals (e.g. athletes and well-trained body builders) and populations (e.g., Australian Aborigines) who differ in body build and body proportions (extremes of age and height) (Caterson and Gill 2002). In addition, BMI does not capture how fat is distributed over the body. Many studies have now shown that an abdominal fat distribution is more related to metabolic disturbances and increased disease risk than overall obesity (Snijder, van Dam et al. 2006). As a result, alternative direct and indirect methods to measure body fat distribution have emerged and are now widely used including waist circumference and waist-to-hip ratio (WHR) (see below).

BMI in older adults

BMI is an inaccurate method to estimate body fatness in elderly people aged 75+ years because of body composition changes such as a reduction in skeletal muscle mass and an increase in visceral fat deposits in the abdomen that occur with aging. In the elderly, waist circumference and waist-to-hip ratio (WHR) correlate better with blood pressure and lipid profile than BMI and have been suggested as better indicators for overall body fatness (Goya Wannamethee, Shaper et al. 2004). Similarly, Visscher et al (2001) studied a population sample of individuals aged 55 years and over in The Netherlands and found that that waist circumference in never smoking men detected more individuals that were at increased risk of mortality than did measuring BMI.

BMI in children and adolescents

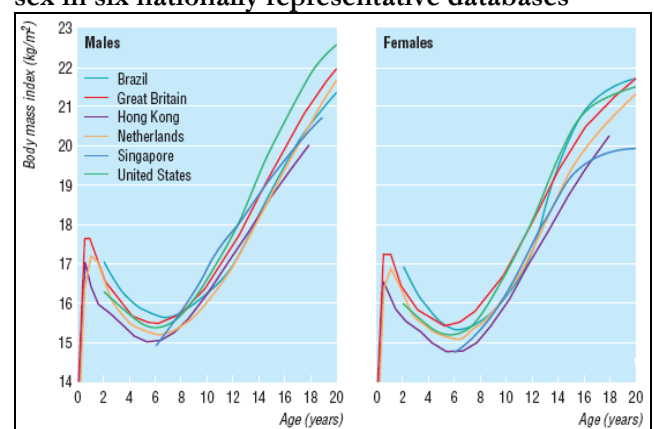
BMI in children changes significantly with age and differs according to gender; therefore any calculation of BMI must be adjusted for age and sex. BMI-for-age may not be accurate in those children and adolescents who have highly developed muscles, or who are particularly short or tall for their age. There are also racial differences in the relationship between the true proportion of fat and the BMI in children.

In 2000 the International Obesity Taskforce (IOTF) published specific age and sex adjusted cut off values for BMI which can be used to classify children aged 2-17 years as not overweight/obese, overweight or obese. The cut off values for overweight and obesity align with adult cut-off points of a BMI of 25 and 30 kg/m². Briefly, data from national surveys in six countries - Great Britain (1978-93), Brazil (1989), the Netherlands (1980), Hong Kong (1993), Singapore (1993), and the United States (1963-80) - was used to construct gender-specific BMI percentile curves that at 18

years passed through the points of 25 and 30. (See Figure 4 and 5) These BMI-for-age reference charts were designed to provide an international reference that can be used to compare child and adolescent populations worldwide but are not for recommended for clinical use (Cole, Bellizzi et al. 2000).

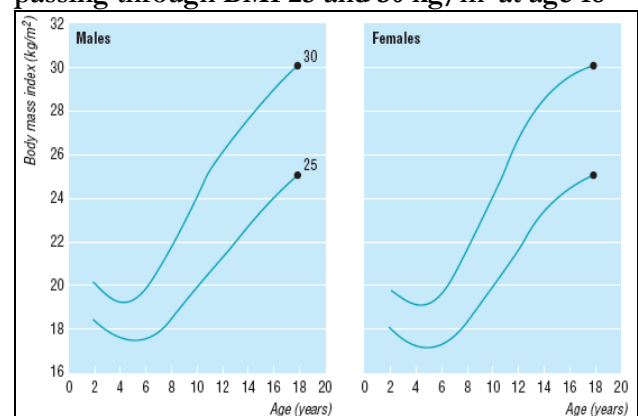
Although no local BMI-for-age reference charts are available yet, Australian experts have endorsed the IOTF classification system charts proposed by Cole and others as the most appropriate measurement of adiposity in children and adolescents for research and population monitoring purposes (Booth M, L et al. 2001).

Figure 4. Median children's BMI by age and sex in six nationally representative databases



Source: (Cole, Bellizzi et al. 2000)

Figure 5. International cut-off points for BMI by sex for overweight and obese children passing through BMI 25 and 30 kg/m² at age 18



Source: (Cole, Bellizzi et al. 2000)

BMI-for-age data can be reported using different methods such as percentiles and z-scores. These measures are more commonly used in clinical rather than population measures of weight status among children and adolescents.

BMI percentiles

Once BMI is calculated and plotted on the BMI-for-age growth charts (for either girls or boys) a percentile ranking can be obtained. Percentiles indicate the relative position of the child's BMI number among children of the same sex and age. They are recommended to assess individual size and growth patterns in clinical settings, but are not appropriate for population monitoring.

The US Centers for Disease Control and Prevention have developed new growth reference charts based on five national health examinations (NHANES) between 1963 and 1994 and five supplementary data sources. These charts include gender and age-specific BMI percentile ranges (CDC 2000 (Revised)).

BMI z-scores

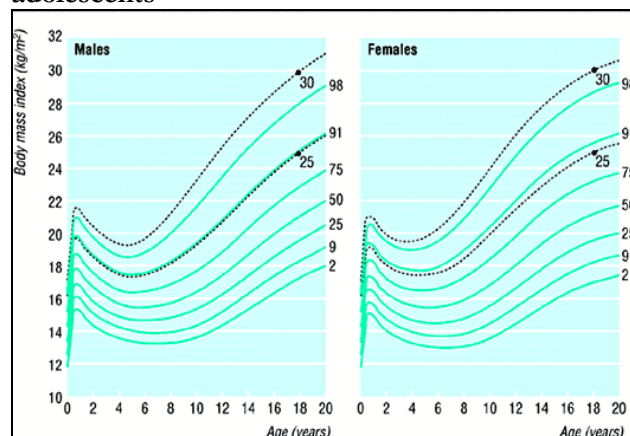
Body mass index z-scores, also called BMI standard deviation (s.d.) scores, are measures of relative weight adjusted for child age and sex. Given a child's age, sex, BMI, and an appropriate reference standard, a BMI z-score (or its equivalent BMI-for-age percentile) can be determined.

It uses a statistical formula to describe how far a child's weight is from the external standard (calculated against the median for CDC growth reference charts) weight of a child of the same height in the reference data. This "distance" is called a z-score. It is expressed in multiples of the standard deviation and is derived as follows: $z\text{-score} = \frac{\text{observed value} - \text{median reference value of a population}}{\text{standard deviation of reference population}}$ (Armitage and Berry 1987)

BMI z-scores correspond to growth chart percentiles, and are particularly useful to monitor changes in children with a BMI above the 95th percentile or below the 5th percentile.

Using the US BMI-for-age reference, a 5-year-old boy with a BMI of 20 kg/m² has a BMI z-score of approximately 2.5 (BMI >99th percentile) and a 15-year-old boy with a BMI of 20 kg/m² has a BMI z-score of approximately 0.0 (BMI=50th percentile) (See Figure 6).

Figure 6. Centile curves for children and adolescents



Source: (Kuczmarski, Ogden et al. 2000)

3.1.2 Monitoring body fat distribution

Waist circumference

Waist circumference is an indicator of body fat distribution, which has emerged as an important predictor of obesity-related morbidity and mortality.

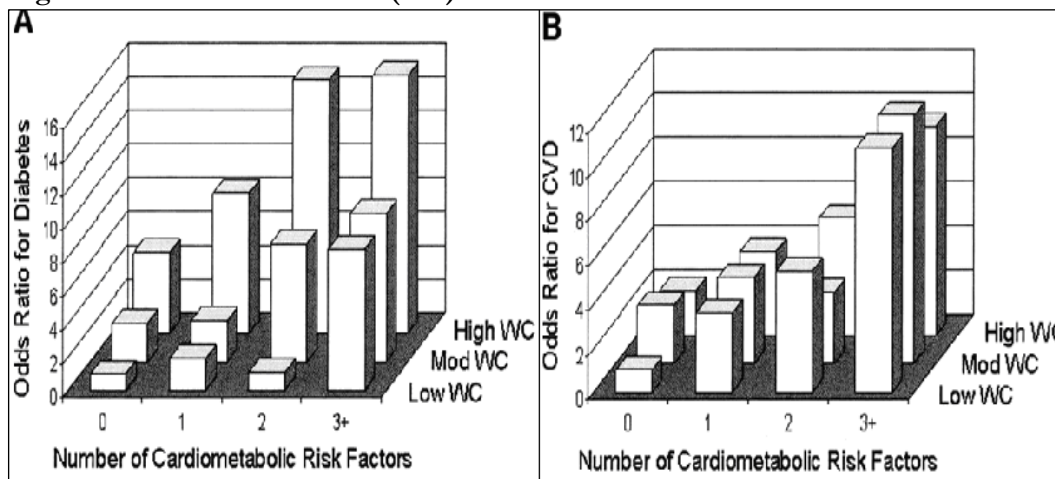
Although many techniques are available to assess the visceral fat deposits, the simplest and the most clinically useful measurement is the waist circumference (Snijder, van Dam et al. 2006). Waist circumference is measured at the mid point between the lower border of the rib cage and the iliac crest with the subject standing at the end of gentle expiration. Waist circumference relates closely to BMI and is considered an appropriate indicator for use in the monitoring weight status among adults at population level.

Association between waist circumference and chronic disease among adults

Abdominal or visceral obesity has been independently associated with metabolic conditions, especially diabetes mellitus, and increased risk of coronary heart disease (CHD), stroke and high blood pressure.

Janiszewski et al (2007) studied the relationship between waist circumference and diabetes and cardiovascular disease after evaluating cardiometabolic risk factors. After establishing low, moderate and high waist circumference percentiles, they found that waist circumference predicted the risk of diabetes independently of cardiometabolic risk factors and BMI. Although there was an association of waist circumference and cardiovascular disease, this did not remain significant after controlling for the cardiometabolic risk factors (See Figure 7).

Figure 7. Waist circumference (WC) in relation Diabetes and Cardiovascular disease (CVD)



Source: (Janiszewski, Janssen et al. 2007)

Classification of waist circumference among adults

In 1995, Lean suggested the cut points for action that are now widely used and supported by the WHO Consultation. These recommended cut-points for increased disease risk in men (94 cm and 102 cm) and in women (80 cm and 88 cm) were derived from a regression curve that identified the waist circumference values that correlated with BMI of 25 and 30 kg/m² respectively. These cut-points permit to identify individuals with normal BMI but with high waist-hip ratio and indicate the levels of central distribution of fat at which individuals should take action (Lean, Han et al. 1995). If BMI is > 30 kg/m², then central obesity can be assumed and waist circumference does not need to be measured.

Waist circumference in children and adolescents

Waist circumference in childhood is strongly correlated to a higher disease risk in adulthood. It is recognised now as the best indicator of central obesity and metabolic risk in children and adolescents. However, there are not universally accepted cut-off points in children and adolescents because the relationship between waist measure and metabolic complications remains undefined (NHMRC 2003). A number of authors have suggested local waist percentiles for children from Italia, Spain, Canada, Cyprus and the United Kingdom. Waist circumference percentiles for 7- to 15-year-old Australians have recently been published and will be presented later in this document (Eisenmann 2005).

Waist-hip ratio

The waist-hip ratio (WHR) in adults is also a strong predictor for cardiovascular risk factors and type 2 diabetes. A value of 0.9 or more in men, and 0.8 or more in women, indicates central obesity and an increased disease risk in Caucasian adults. Although waist and hip circumferences are relatively simple and quick measures, it is difficult to ensure consistency and accuracy in the two measurements which makes the waist circumference the preferred method for monitoring (NSW Health 2003)

$$\text{WHR} = \text{waist circumference (cm)} / \text{hip circumference (cm)}$$

Skin fold measurements

The estimation of body fat with skin fold measurements requires the use of a caliper that pinches a fold of skin and underlying adipose tissue to measure the thickness of large fat stores. By measuring different several sites, total body fat is calculated.

Skin fold measurements may be useful to characterise subcutaneous fat distribution for clinical and research work. However, they are not recommended for population monitoring as it is difficult, expensive and time consuming to obtain accurate measurements. Low accuracy is one of the main limitations of this method to estimate body fat, as there are a large number of site measurements and equations available. Furthermore, skin fold measurement results differ from technician to technician leading to high measurement errors

3.2 Measurement methods and protocols

3.2.1 Anthropometric measurement protocols

Protocols for measuring weight, height, length, waist circumference and hip circumference are listed in Appendix 3. These are adapted from the WHO (1995) recommended protocols. It is recommended as an ideal that data collection forms have the capacity to record up to three measures for each measurement in order to achieve consistency, but this may not be practical. However, adequate training of personnel involved in direct measurement of anthropometry is crucial for reliable and comparable results.

3.2.2 Self-reported heights and weights

Direct measurement of height and weight is the best method to assess weight status in population studies. However, this is not always feasible, and BMI is frequently estimated from self reported weight and height. Participants of health surveys are usually asked “How tall are you without shoes?” and “How much do you weigh without clothes or shoes?”

Self-report data is less expensive, easier and more practical to collect than direct measures, but is often inaccurate (Flood, Webb et al. 2000). Self-report bias might be related to participants not recalling their measurements, or intentionally misreporting due to social desirability (Dauphinot, Wolff et al. 2009).

Evidence has shown that overestimation of height, underestimation of weight or a combination of the two lead to a considerable misclassification of weight status; and this underestimates the true prevalence of overweight and obesity when compared with measured data (Flood, Webb et al. 2000).

Many studies have reported that generally men tend to overestimate their height, and women to underestimate their weight. This incorrect estimation tends to increase with age and occurs especially at higher BMI values. Apart from age and gender, bias in self reported information has also been associated with body composition, other cultural, socioeconomic and health characteristics such as self-perceived health, and lifestyles of a particular population at a specific point in time (Nyholm, Gullberg et al. 2007).

Additionally, the accuracy of self-reported heights and weights vary with the method used to collect

this information. For instance, data from face-to-face interviews tend to be more reliable than data from telephone surveys or self-administered questionnaires, since participants are being observed by the interviewer.

In Australia, the accuracy of self-report weight and height has been assessed against measured weight and heights at different points in time. For example, results from the National Health Survey 1995 showed that 64% of male and 47% of females were classified as overweight or obese based on BMI using direct measurements, compared to 52% and 36% respectively when BMI was calculated from self-report data (ABS 1998). On the other hand, results from the NSW Health Survey 1997 found that 62% of males and 47% of females are overweight or obese based on measured data, but only 39% of males and 32% of females were classified overweight or obese from self-report (Flood, Webb et al. 2000). The bias in self-report data was higher in this last survey, and might be due to the fact that information was collected by telephone interview.

There have been many attempts to correct the bias of self-report data. Different equations have been proposed and tested using diverse samples.

Kuskowska-Wolk et al (1989) analysed relationship between self-report data and direct measurements of a random sample of individuals in Sweden by conducting multiple multivariate linear regression analysis. Findings indicate a systematic tendency to underestimate high values and overestimate low values, and an algorithm was developed using measured BMI as the dependable variable to form an equation to predict self-reported BMI:

- In men, self-reported BMI = $2.292 + 0.893$ measured BMI
- In women, self-reported BMI = $1.835 + 0.893$ measured BMI

Nylon et al (2007) studied direct measurements and self report data from a sample in Sweden and developed an algorithm (adjusted for age) using linear regression to predict measured from self-reported BMI:

- For men, corrected BMI = $-0.202 + 1.005$ x self-reported BMI + 0.014 x age
- For women, corrected BMI = $-0.713 + 1.023$ x self-reported BMI + 0.019 x age

Locally, Hayes et al (2008) developed correction equations for self report data based on a national

representative sample that had measured data from the 1995 National Nutrition Survey and then provided self-report data for the 1995 National Health Survey. Four algorithms were evaluated and simple correction equations for height and weight were recommended to predict true prevalence of overweight and obesity in Australia:

- For men, corrected BMI = $(1.022 \times \text{self-reported weight} + 0.07) / (0.00911 \times \text{self-reported height} + 0.1375)^2$
- For women, corrected BMI = $(1.04 \times \text{self-reported weight} - 0.067) / (0.00863 \times \text{self-reported height} + 0.2095)^2$

Algorithms have become an important tool for correction of self-reported BMI in population studies. Although these methods do not allow the estimation of true prevalence of obesity, the use of correction equations does provide a better estimate. However, it is not easy to generalize a correction factor for all populations as samples are diverse, and usually the algorithms are specific to the population they studied.

Recently, Dauphinot et al (2009) assessed the discrepancy between self-reported and measured data on a large population sample and conducted an analysis using receiver operating characteristic (ROC) curves to determine a new BMI threshold for obesity. A reduced BMI of 29.2 kg/m² was applied for both genders to estimate the obesity prevalence from self-reported data. This threshold was then validated using an external population and it showed a high sensitivity (87.3%) and specificity (97.6%). Authors advocate the choice of a reduced threshold to estimate obesity prevalence for population self-report data to overcome that challenge that equations are specific to the population and to the data introduced for correction.

In summary, self report data should be interpreted with caution as it tends to underestimate the prevalence of overweight and obesity. Correction factors should be applied when comparing self-reported to measured data, if a population specific correction algorithm is available.

3.3 Who should be monitored?

The risks associated with increases in weight status apply across the population of NSW and Australia, and thus are relevant to males and females of all ages (except the very old). The specific rationale for focusing on selected key groups is discussed below.

3.3.1 Age groups

Adults

It is recommended that monitoring surveys cover all adults from age 18 to age 75 years.

Evidence has shown that the mean body weight and BMI increases with age until the mid-60s and then tend to decrease slightly in the 70s (Allman-Farinelli, Chey et al. 2008). Similarly, the relative risk associated with increased BMI declines with age. However, it has been documented that cardiovascular factors and other health complications associated with obesity increase linearly with increasing BMI until the age of 75 yrs (Villareal, Apovian et al. 2005). Therefore, the whole adult population should be monitored, taking into special considerations the older people and young adults.

Most studies in older adults have shown a negative or non-significant association between BMI and all-cause mortality. Only a few studies have shown a positive association between BMI and all cause mortality for elderly people (65-74 yrs old), but not for very old individuals (aged 75 years or more). When a positive association was detected, it was for a BMI higher than 27 kg/m² (Heiat, Vaccarino et al. 2001) (See Figure 8).

Other studies have found protective effects of overweight in older adults. Benefits of a high BMI in elderly include increased bone mineral density and decreased osteoporosis and hip fracture, possibly due to hormonal factors (Rossner 2001; Villareal, Apovian et al. 2005). It has been stated that a lower BMI is associated with greater mortality compared to a high BMI in the elderly (Heiat, Vaccarino et al. 2001).

As a general recommendation, appropriate management of overweight and obesity in the elderly should focus on improving physical function and in preventing medical complications associated with obesity, considering the potential adverse effects on bone and muscle after losing weight at this age.

Age, year of survey and birth cohort (generation) are independent predictors of the prevalence of overweight in Australian population, so that later cohorts (born after 1980) enter adulthood at higher weights than did previous generations. Thus it is also important to ensure adequate representation of young adults in monitoring surveys (NSW Health 2005; Allman-Farinelli, Chey et al. 2008).

Children

Childhood obesity has become a major public health concern, as prevalence rates have increased in the last two decades (Booth, Dobbins et al. 2007). And it has been also predicted that without effective control and intervention paediatric obesity may shorten life expectancy by 2 to 5 years by 2050 (Ludwig 2007). Monitoring children's weight status is also important because overweight children are much more likely to become obese adults and to develop chronic diseases at an early age (Denney-Wilson, Hardy et al. 2008). Whitlock et al (2005) reviewed evidence from longitudinal studies and found that single BMI measures track reasonably well from childhood and adolescence (ages 6-18) to adulthood (ages 20-37). Increased tracking was seen for children older than 8 years old, for younger children (aged 6-12) with BMI above the 95th and 98th percentile, and for children with an obese parent.

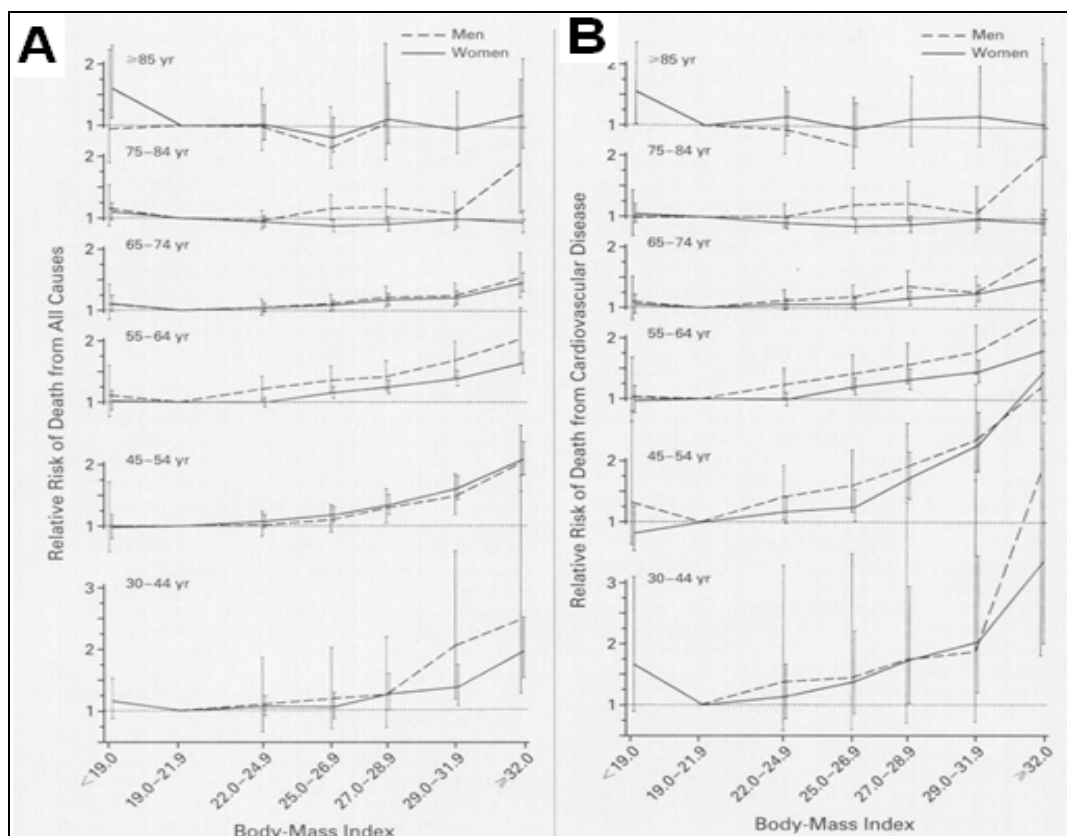
Children under 5 years

It is during the first years of life that children's eating habits, food preferences, food intake, motor skills and physical activity are shaped by early experience with food, eating and play (Birch and Fisher 1998). Genes and family environment,

especially parental attitudes and practices, will determine the establishment of these behaviours that will then impact on the weight status of children (Scaglioni, Salvioni et al. 2008).

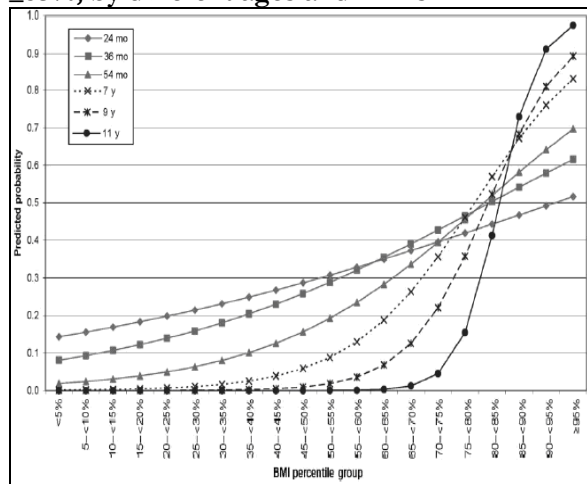
Although the term obese is not usually recommended for young children, evidence shows that prevalence of overweight and obesity is increasing rapidly in children less than 5 years of age (Wake, Hardy et al. 2007) and that rapid weight gain in infancy predicts later obesity (Krebs, Himes et al. 2007). However, evidence about how weight status of children less than 5 years old tracks is mixed. For instance, Magarey et al (2003) studied the tracking of BMI from childhood to early adulthood in an Australian cohort born in 1975–1976 and found that tracking was weakest from early childhood (2 and 4 y) to early adulthood, but BMI from 6 y onwards was a good indicator of later BMI. In contrast, Nader et al (2006) followed up a US cohort born in 1991 and reported that preschool age children (54 months old) whose BMIs were >50th percentile were considerably more likely than those who stay below this point to become overweight by age 12 years (See Figure 9).

Figure 8. BMI in relation to all causes mortality (A) and cardiovascular mortality (B) in adults, by age group



Source: (Stevens, Cai et al. 1998)

Figure 9. Predicted probabilities of age-12 BMI $\geq 85\%$, by different ages and BMIs



Source: (Nader, O'Brien et al. 2006)

3.3.2 Specific population groups

It is important that monitoring systems include adequate representation of specific population sub-groups.

Aboriginal and Torres Strait Islanders

Metabolic disease occurs at a lower BMI in Aboriginal Australians. Evidence has shown that Aboriginal Australians are predisposed to accumulate more abdominal fat deposits compared to Caucasian adults; therefore waist circumference is the best predictor for diabetes and cardiovascular events in this population (Kondalsamy-Chennakesavan, Hoy et al. 2008).

Specific geographic population groups including rural and remote communities

The level of overweight and obesity in adults tends to be higher in 'inner regional' and 'outer regional' areas compared to people living in 'metropolitan' areas. This could be explained by a limited access to appropriate foods and fewer opportunities to participate in appropriate physical activity (NSW Health 2003). Data can be reported by specific geographic groups, although most variations tend to be related to age, gender, socio-economic status, ethnicity and cultural group.

Cultural and linguistic diverse groups-CALD

There are significant differences in overweight and obesity for adults from different CALD. On average, people who arrived in Australia before 1996 are more likely to be overweight or obese (54%) than those who arrived between 1996 and 2005 (40%). This could be explained at the 'healthy immigrant 'effect' usually vanish as time of stay in Australia increases (ABS 2008a) There are certain ethnic groups where rates differ considerable. Results from the National Health Survey 2004-5 indicated that migrants from Southern and Middle

Europe were more likely to be overweight or obese (65%); and their children, particularly girls were more likely to develop a more severe type of obesity with immediate health consequences. In addition, adults born in the Oceania region (except for Australians) had also higher rates of overweight and obesity (63%), compared to those born in Australia (55%). On the other hand, people with a South East Asian background had lower levels of overweight and obesity (31%). However, it is important to consider that the risk of chronic disease in Asian appears at lower BMIs (ABS 2008a).

Socially and economically disadvantaged groups

There is an inverse relationship between income and education and the level of overweight and obesity. Highest disadvantage groups suffer the highest level of overweight and obesity, especially in women.

3.4 Reporting weight status

BMI

A popular common method for reporting on weight status is to report by category or risk level, such as the proportion of people classified as overweight, obese or overweight/obese. Although data for each of the three levels of obesity is not generally reported, this information is important in population monitoring and should be presented. International classification of weight status among adults is provided in Table 2. Same BMI cut-off points as general population apply for the Australian Aboriginal population.

Table 2. Classification of overweight and obesity by BMI (kg/m²) in adults

Classification	BMI (kg/m ²)
Underweight	<18.5
Normal range	18.5–24.9
Overweight	≥ 25.0 - <29.9
Obese	≥ 30
Obese I	30.0–34.9
Obese II	35.0–39.9
Obese III	≥ 40.0

Source: (WHO 2000)

Classifying the weight status from people different ethnic backgrounds

It has been recognised that there are variations in the relationship between BMI, body fatness and morbidity and mortality in different ethnic groups.

There is strong evidence that metabolic disease occurs at lower BMIs in Asian populations, which might be explained for a greater propensity to store

abdominal fat in these populations (Caterson and Gill 2002). Therefore, there has been an attempt to interpret the WHO BMI cut-offs using a different criteria for Asian and Pacific populations. *The Asia-Pacific Perspective: Redefining Obesity and its Treatment* (WHO/IASO/IOTF. 2000) suggested different ranges for the Asia-Pacific region based on risk factors and morbidities. In Asians, cut-offs for overweight (BMI > 23.0 kg/m²) and obesity (BMI > 25.0 kg/m²). And cut-offs for overweight (BMI > 26 kg/m²) and obesity (BMI > 32 kg/m²) for Pacific Islanders (Swinburn, Ley et al. 1999).

However, the WHO has not made an effort to redefine specific cut-offs points for each population separately. Instead, they supported the international classification to be retained and identified trigger action points for public health action by suggesting categories for increased risk for Asian populations (See Table 3) (WHO expert consultation 2004).

Table 3. Cut-off points for public health action in Asian populations

BMI	Risk of co-morbidities
Less than 18.5 kg/m ²	underweight
18.5-23 kg/m ²	increasing but acceptable risk
23 – 27.5 kg/m ²	increased risk
27.5 kg/m ² or higher	high risk

Source: (WHO Expert consultation 2004)

Classifying weight status of Children

The international cut-off points proposed by Cole et al (2000) listed in Table 4 have been accepted in Australia for classifying overweight and obesity in children aged 2 to 18 years. Table 5 shows percentile classification for overweight and obesity in children by the CDC (2000 (Revised)).

BMI value

Another method relevant for adults is to report mean BMI.

BMI z-score

Z-scores have the same statistical relation to the distribution of the reference around the mean at all ages, which makes results comparable across age groups and indicators. Z-scores are particularly useful as a way of presenting BMI-for-age data in children. See below Table 6 for cut-off points recommended by the WHO.

Waist circumference

Waist circumference can be reported in terms of mean or by risk category proposed by Lean (1995). However, it has been recognized recently that the

cut points proposed by Lean are helpful for the classification of Caucasian adults, but may not be appropriate for other ethnic populations. The IDF Consensus group (2005) have recommended cut points for central obesity in adults based on waist circumference which are applicable to individual ethnic groups (See Table 7). For children, there are no endorsed standards, although research conducted by Eisenmann (2005) suggested cut points for Australian Children (See Table 8).

Table 4. BMI Classification of overweight and obesity in children

Age (years)	BMI equivalent to 25 in adult		BMI equivalent to 30 in adult	
	Boys	Girls	Boys	Girls
2	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.80	19.55
3	17.89	17.56	19.57	19.36
3.5	17.69	17.40	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24.00	24.11
10.5	20.20	20.29	24.57	24.77
11	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.70	29.41	29.69
17.5	24.73	24.85	29.70	29.84
18	25	25	30	30

Source: (Cole, Bellizzi et al. 2000)

Table 5. Percentile classification of overweight and obesity in children

Classification	BMI percentile
Underweight	< 5 th percentile
Normal weight	5 th - 84 th percentile
Overweight	85 th - 94 th percentile
Obese	≥ 95 th percentile

Source: (CDC 2000 (Revised))

Table 6. Z-score values of overweight and obesity in children

Classification	Z-score
Overweight	>+1 SD (equivalent to BMI 25 kg/m ² at 19 yrs)
Obesity	>+2 SD (equivalent to BMI 30 kg/m ² at 19 yrs)

Source: Adapted from (WHO website)

Table 7. Ethnic specific cut points for waist circumference for adults

Ethnic group based on ethnicity	Waist circumference (as measure of central obesity)
<i>Europids</i>	
Male	≥ 94 cm
Female	≥ 80 cm
<i>South Asians</i>	
Male	≥ 90 cm
Female	≥ 80 cm
<i>Chinese</i>	
Male	≥ 90 cm
Female	≥ 80 cm
<i>Japanese</i>	
Male	≥ 85 cm
Female	≥ 90 cm
<i>Ethnic South and Central Americans</i>	Use South Asians recommendations until more specific data are available
<i>Sub Saharan Africans</i>	Use European data until more specific data are available
<i>Eastern Mediterranean and Middle East (Arab) populations</i>	Use European data until more specific data are available

Source: ((IDF) 2005)

Table 8. Waist circumference percentiles for Australian Children

Age (y)	5th	10th	25th	50th	75th	90th	95th
Males							
7	49.8	50.9	52.9	55.4	58.5	61.9	64.4
8	51.1	52.2	54.3	57.1	60.5	64.4	67.2
9	52.2	53.4	55.6	58.6	62.3	66.6	69.7
10	53.3	54.5	56.9	60.1	64.1	68.8	72.4
11	54.5	55.9	58.4	61.8	66.1	71.3	75.3
12	56.1	57.5	60.2	63.8	68.5	74.1	78.4
13	58.5	60.0	62.8	66.6	71.5	77.2	81.6
14	60.9	62.5	65.5	69.4	74.3	79.9	84.0
15	63.0	64.6	67.7	71.6	76.4	81.7	85.6
Females							
7	48.5	49.7	51.9	54.9	58.5	62.7	65.8
8	49.5	50.7	53.1	56.3	60.2	64.7	68.0
9	50.3	51.7	54.2	57.6	61.7	66.5	69.9
10	51.3	52.7	55.4	59.0	63.3	68.3	72.0
11	52.5	54.0	56.8	60.6	65.2	70.4	74.2
12	54.2	55.8	58.8	62.7	67.5	72.8	76.6
13	56.1	57.8	60.9	64.9	69.7	75.0	78.9
14	58.1	59.7	62.8	66.8	71.7	77.0	80.8
15	59.5	61.1	64.2	68.2	73.1	78.4	82.2

Source: (Eisenmann 2005)

3.5 Chapter Summary

Monitoring weight status

What to measure?

- ✓ Body Mass Index (BMI)
 - $\text{BMI} = (\text{body weight in kilograms}) / (\text{height in metres, squared})$
 - BMI in children and adolescents to be assessed against age and gender reference standards, BMI-for-age, Cole (2000)
- ✓ Waist circumference
 - Important predictor of obesity-related morbidity and mortality in adults
 - Better indicator than BMI for overall body fatness in older adults
 - Best indicator of central obesity and metabolic risk in children and adolescents

How to measure?

- ✓ Ensure health personnel involved in direct measurement of anthropometry receive proper training
- ✓ In Australia, the following algorithm has been recommended by Hayes et al (2008):

$$\text{For men, corrected BMI} = \frac{(1.022 \times \text{self-reported weight} + 0.07)}{(0.00911 \times \text{self-reported height} + 0.1375)^2}$$

$$\text{For women, corrected BMI} = \frac{(1.04 \times \text{self-reported weight} - 0.067)}{(0.00863 \times \text{self-reported height} + 0.2095)^2}$$

- ✓ Self-report data on weight should be interpreted with caution as it tends to underestimate the prevalence of overweight and obesity.

Who should be monitored?

- ✓ The whole community should be considered as a target group to be monitored
- ✓ Primary target groups:
 - All adults from 18 up to age 75 years
 - All children and adolescents aged 5-18 years old
- ✓ Specific population groups:
 - Aboriginal and Torres Strait Islanders
 - Rural and remote communities
 - Cultural linguistic diverse groups-CALD
 - Socially and economically disadvantaged groups
- ✓ Other specific groups:
 - Older people
 - Young adults
 - Children aged 4 years
 - Pregnant mothers (?)

How to report data?

- ✓ Adults:
 - BMI category, WHO (2000)
 - Mean BMI
 - BMI Z-score
 - Waist circumference, IDF Consensus group recommendations ((IDF) 2005)
- ✓ Children:
 - BMI percentile, CDC (2000 (Revised))
 - BMI Z-score, (WHO website)
 - Waist circumference, no standard cut points are available. Local cut-off points by Eisenmann (2005).

4. Monitoring physical activity, nutrition, sedentary behaviours and other weight related individual factors

Obesity is a consequence of an energy imbalance where the energy intake exceeds the energy expenditure. Ongoing positive energy balance will lead to fat storage and weight gain.

Dietary and physical activity behaviours are directly related to energy intake and energy expenditure respectively, and therefore monitoring these will help to interpret changes in weight, provide intermediate measure of environmental and policy changes, and to guide the design of interventions.

4.1 Nutrition and eating behaviours

The total energy intake refers to all the energy consumed as food and drink that can be metabolised inside the body. The Australian Food and Nutrition Monitoring Unit (2001) conducted a study to compare the trends in food and nutrient intake in Australians using data from the National Nutrition Surveys conducted in 1983, 1985 and 1995. Results indicated that the mean energy consumption increased significantly during this period of time. An energy increase of 3-4% was reported for adults between 1983 and 1995, and a 13% increase in children aged 10-15 years between 1985 and 1995. Carbohydrates were identified as the major source for observed energy intake increments.

It is important to identify those specific nutrition factors that are closely associated with weight gain and include these factors as part of a monitoring system.

Fruit and vegetable consumption

A high consumption of fruits and vegetables has been linked to a reduction in the development of major chronic diseases. Benefits appeared to be mainly for cardiovascular diseases (Hung, Joshipura et al. 2004; Takachi, Inoue et al. 2008) and some cancers (Vainio and Weiderpass 2006; World Cancer Research Fund 2007; George, Park et al. 2009).

It has also been recognised that fruit and vegetable intake has a protective effect in weight management through high water and fibre content, low energy density, increased satiety and reduced hunger. However, there is limited data directly linking the

consumption of fruits and vegetables with the risk of obesity and weight gain (Tohill, Seymour et al. 2004). Recently, findings from The American Nurses Health Study reported that increased intake of fruits and vegetables was associated with a 24% lower risk of becoming obese and a 28% lower risk of gaining weight over 12 years of follow-up (He, Hu et al. 2004)

The Australian Guide to Healthy Eating (Kellet, Smith et al. 1998) recommend that adults consume two to four serves of fruits a day, and four to seven serves of vegetables a day. For children it recommends the consumption of between one and two servings of fruit and two to four of vegetables each day for 4-7 year olds; one to two servings of fruit and three to five of vegetables each day for children aged 8-11 years; and three to four servings of fruit and four to nine of vegetables each day for adolescents aged 12 -17 years. These recommendations have been translated to a 'Go for 2&5' message in National and State social marketing campaigns (See <http://www.gofor2and5.com.au/>).

Carbohydrate consumption

Carbohydrates are generally the main macronutrient of a diet. Results from the Australian National Nutrition Survey conducted in 1995 indicated that carbohydrates contributed about 52% of daily energy intake for children aged 2-11 years, and comprise approximately 45% of daily energy intake for adults aged 45-64 years (ABS, 1997). Substantial evidence reveals an inverse association between carbohydrate intake and BMI which might be explained by the dietary fibre content (i.e. whole-grains) and its beneficial effect on weight control (Gaesser 2007).

Recently there has been a special focus on carbohydrate quality (reflected by the glycemic index) and quantity. Several studies suggest that diets high in glycemic index or glycemic load (with high intake of refined carbohydrates) increase the risk of obesity and other health problems such as cardiovascular disease, type 2 diabetes, metabolic syndrome and some cancers; whereas low glycemic foods produce a lower postprandial insulin secretion and increase satiety (Ludwig 2002; Brand-Miller 2003).

Although recommendations advise consumption of complex carbohydrates rich in fibre and with a low glycemic index, the direct link between carbohydrate quality and quantity and obesity is still controversial. There is no simple way of assessing carbohydrate consumption at population monitoring level. The amount and quality of carbohydrates can only be obtained from detailed dietary intake assessment.

Fat consumption

Fat is the most energy dense of all the nutrients. A diet high in saturated fat increases not only cholesterol levels and the risk of death from cardiovascular disease, but also leads to obesity because of the resulting high-energy intakes associated with fat intake (Marks, Rutishauser et al. 2001).

The 1995 National Nutrition Survey indicated that the major sources of saturated fat in Australian diets were animal meats and products (22%), followed by processed foods like cakes, biscuits and pastries (18%). Dairy products were also a significant source of saturated fat (17%).

The Australian Guide to Healthy Eating (Kellest, Smith et al. 1998) recommends that children age 4 years and over consume between two and five sample serves of dairy products each day, and suggests choosing reduced fat varieties of milk, cheese, and yoghurt over full cream products. In addition, it recommends choosing lean meats, avoiding sausages and processed meats, and using low fat cooking methods such as stir frying and grilling, instead of roasting and frying in fat and oil.

For monitoring purposes, the proportion of people who usually consume whole (full-cream) milk has been identified as a useful indicator of saturated fat intake. Questions that relate to the consumption of fried foods, fried potato products, processed meat products and cooking meat by adding fat have also been included in NSW Health Surveys (NSW Health 2003).

Consumption of energy-dense foods and beverages (non-core foods)

Overconsumption of energy-dense nutrient poor foods has contributed to excessive energy, fat and sugar intake at the population level, and there is convincing evidence that a high intake of energy-dense foods promotes weight gain (WHO/FAO Expert Consultation 2003). These foods are called 'extra' foods or 'non-core' foods and include: sweet biscuits, cakes, high fat savoury biscuits, garlic bread, pastries, pies, quiche, salami, hamburgers, pizza, fried potatoes, fat spreads, oils, confectionery, soft drinks, juice drinks, cordials and alcohol (Rangan, Schindeler et al. 2008).

The Australian Guideline to Healthy Eating recommends up to one to two servings of 'non-core' foods and beverages per day for children up to 11 years, a maximum of two serves for women aged 60 years and older, up to two and a half serves for women aged 19 to 60 years and men 60 years and

older, and up to three serves for adolescents and males age 19 to 60 years; with one serve defined as the amount of food containing 600 kJ. Although the accepted limits are estimated to provide between 5 and 20% of daily energy intake (Kellest, Smith et al. 1998), local data has shown that 'extra' foods consumption is a major issue in Australia. Extra foods contributed to 36% of daily energy intake of adults, 40.9% of energy to the diet of 2–18-year-old children, and 27% to the diet of children aged 16–24 months (Webb, Lahti-Koski et al. 2006; Rangan, Randall et al. 2008).

The reduction in consumption of 'non-core', energy dense foods is or should be one of the first dietary changes recommended to prevent weight gain, followed by an increase in the consumption of fruits and vegetables, and the availability of other healthy food and beverage options. Current monitoring of non-core foods tends to rely on short indicator questions for specific foods, including fried potato, salty snacks, confectionary and soft drinks.

Alcohol consumption

Alcohol is high in kilojoules and contributes to the total energy intake; therefore consumption must be monitored carefully. Although the number of drinks can be estimated, portion sizes are generally unknown and therefore the energy intake due to alcohol is commonly underestimated.

Data from the National Health and Nutrition Examination Survey reported that low to moderate alcohol intake (one to two drinks per day) was associated with lower risk of obesity, but binge drinking or heavy drinking (four or more drinks per day) was associated with a substantial increased risk of obesity (Arif and Rohrer 2005). Studies have suggested that alcohol drinkers have altered dietary patterns and may substitute some nutrients with alcohol. As part of the British Regional Heart Study, Wannamethee et al (2005) studied the type of drink men consumed and its relationship to adiposity and found that beer drinkers had the highest dietary total fat intake in contrast with wine drinkers who had lower total non-alcohol calorie intake and dietary total fat.

Food insecurity

The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" ((FAO) 1996). Food security is a key aspect of nutrition that is determined by a number of social and economical factors generally and somewhat is related to weight status. A subgroup of people at risk of overweight and obesity who are also at a higher risk of limited

food access and food supply include low income earners, unemployed, single parents and Indigenous people.

In Australia, a single question has been used in a number of surveys (i.e. 1995 National Nutrition Survey, 1999 NSW Healthy Older People's Survey and the 2001 NSW Child Health Survey). to measure the estimated prevalence of food insecurity: "In the last 12 months were there any times that you ran out of food and couldn't afford to buy more? ('yes', 'no', 'unsure', 'refused')". More recently, Nolan et al (2006) assessed household food security in three disadvantaged communities in Sydney by using a 16 item tool developed by the US Department of Agriculture Economic Research Services (2002). When comparing these findings with the information provided by the single item tool used previously, results showed that food insecurity might have been underestimated by the single question, as only one aspect was assessed.

Several cross-sectional studies have suggested that adults, particularly women, who are food insecure are more likely to be obese (Townsend, Peerson et al. 2001; Adams, Grummer-Strawn et al. 2003; Martin and Ferris 2007). In Australia, national data has also indicated that obesity is most prevalent in those groups who are at highest risk of food insecurity (Burns 2004). Possible explanations include that high energy density foods are cheaper than healthy food choices; and that food insecurity is associated with disrupted eating patterns (binge eating), based on availability of food. Also, studies have shown that food insecurity is experienced differently by members of a household, and that women may be the first to compromise their diet in food insecure households (Lyons, Park et al. 2008).

On the other hand, there are some contradictory findings where no association between overweight and obesity and food security was found after controlling for education, income, race/ethnicity, marital status and general health (Laraia, Siega-Riz et al. 2004; Whitaker and Sarin 2007). Lyons et al (2008) suggested that discrepancies could be due to differences between definitions and measurement (self-report vs. direct measurement) of overweight and obesity, and the measurement of food security.

A review published by Mirza, Fitzpatrick-Lewis et al (2007) indicates that there are inconsistent associations between food insecurity status and overweight/obesity and suggest that there the association needs to be explored within the local context.

Eating patterns

Eating patterns refer to occasions of eating and the context where eating takes place. Eating patterns influence dietary intake and are related to weight status. There is evidence that skipping meals, especially breakfast, is an indicator of risk for weight gain among adolescents and adults. Generally those who skip breakfast consume more calories due to increased snacking and are more likely to become overweight (Keski-Rahkonen, Kaprio et al. 2003).

Watching television while eating has also been associated with a higher consumption of fast food and with bigger meals. Children and adolescents tend to consume more healthy foods like fruits and vegetables, and less soft drinks and high energy high fat foods when eating meals sitting down with family (Videon and Manning 2003; Gable, Chang et al. 2007)

Other eating behaviours that have been linked to overweight and obesity include snacking/eating frequency, binge-eating patterns, and eating out. On the other hand, the frequency of family meals at home, eating slowly, chewing food properly and concentration in eating are positive strategies for a healthy diet. They tend to increase satiety and therefore avoid consumption of large portions of food (Gillman, Rifas-Shiman et al. 2000; Woodruff and Hanning 2008).

4.2 Dietary measurement methods

It would be ideal to comprehensively monitor the nutrient intake of people in NSW in order to understand changes in the prevalence of obesity and overweight and to facilitate opportunities for intervention. However, people's eating habits and diets are complex to measure, as eating occurs on multiple occasions each day and is the result of multiple behaviours. Not only shopping and food preparation, but also psychological factors such as preference and taste, and physical factors related to food storage and equipment.

Short dietary questions are now commonly used as an inexpensive way to collect valuable data at population level in order to monitor and report on key indicators that indicate food intake, food habits, food security, food access and barriers to dietary change (Rutishauser, Webb et al. 2001).

Although short dietary questions can provide specific and valuable information related to diet, these questions do not provide detailed information on dietary habits or accurate quantitative estimates on food intake. For this reason, short indicator questions should be used to gather information

about selected dietary habits and patterns of population dietary intake at intervals between National Nutritional Surveys when a more comprehensive assessment is conducted and more detailed information is collected (Flood, Webb et al. 2005).

Other methods available for more detailed diet and nutrition assessment but which are not easily conducted as part of routine monitoring surveys, include: weighed food diary, estimated food diary, 24 hour recall, and food frequency questionnaire.

4.3 How to report dietary information

Information collected using short dietary questions should be reported according to the prevalence of consumption and stratified by gender, age group, socioeconomic status, and where possible by ethnicity and place of residence (urban, rural,/regional).

Under ideal circumstances, a local monitoring system should report the following dietary information:

- Mean and median number of serves of fruits consumed per day
- Mean and median number of serves of vegetables consumed per day
- Type of milk usually consumed
- Proportion of people consuming full cream milk
- Frequency of consuming red meat a week
- Frequency of consuming processed meat products a week
- Consumption of soft drinks, cordial or sports drinks a week
- Frequency of consuming hot fried potatoes a week
- Frequency of consuming potato crisps or salty snacks a week
- Frequency of consuming takeaway food a week
- Proportion of people skipping breakfast
- Proportion of families eating meal together
- Frequency of children eating in front of the TV
- Food insecurity in the last 12 months

4.4 Physical activity and sedentary behaviour

Physical activity

The other side of the energy balance equation is energy expenditure. Energy expenditure produced by any muscle movement (physical activity) and by internal body functions; is a critical factor in determining a person's body weight and patterns of weight gain. Physical activity reduces the risk of cardiovascular disease, protects against Type 2 diabetes, some cancers (e.g. colon and breast), strengthens the musculoskeletal system to reduce the risk of osteoporosis and contributes to mental wellbeing. Unfortunately, modern lifestyles are associated with generally low levels of physical activity.

The National Physical Activity Guidelines for Australians (1999) recommend Australian adults spend at least 30 minutes of moderate-intensity physical activity on most, preferably all, days of the week. However, for individuals looking to lose weight and to avoid weight regain afterwards, additional requirements are suggested by the guidelines (60-90 minutes of moderate intensity activity daily).

For children and adolescents aged 5-18 years, the national guidelines recommend at least 60 minutes every day in moderate-to-vigorous physical activity (Salmon and Shilton 2004). National guidelines for children under the age of 5 years are currently been developed.

Measuring Physical activity

The measurement of physical activity is difficult because it is a complex behaviour which comprises all bodily movement and therefore has a spectrum which ranges from fidgeting to participating in extreme sports. The basic dimensions however comprise frequency, intensity, time (duration) and type (FITT).

Physical activity levels vary across days, seasons and years; however in general the focus is only interested in people's habitual physical activity.

The reporting period for physical activity participation may vary according to the method of measuring but can range from 1 day to 12 month periods.

Frequency

Frequency refers to the number of sessions an individual is involved in physical activity, within a reporting period. (Reporting periods may range from 1 day to 12 month periods) however the

primary information of interest is generally habitual physical activity participation

Intensity

Intensity represents the rate of energy expenditure and is measured in metabolic equivalents (METs) where 1 MET equates to basal metabolic rate. METs are classified into categories of light-intensity (<3 METs), moderate-intensity (3-6 METs) or vigorous-intensity (≥ 6 METs). Health benefits are accrued through moderate-to-vigorous physical activity (MVPA). Examples of moderate physical activities include brisk walking and swimming and vigorous activities include jogging or aerobics (Armstrong, Bauman et al. 2000).

Time (duration)

Duration represents the length of time spent in doing the physical activity each time it is done and is reported in hours and/or minutes. Duration is multiplied by frequency to establish the total time spent in a physical activity over the reporting period.

Type

Type includes aerobic activity and muscle-stretching and strengthening activities and identifies the specific physical activity engaged by individuals (i.e. walking is the most prevalent activity reported in Australian surveys). It is important to identify the type of activity in order to determine the health benefits associated with participation in this activity. Although all physical activity provides energy expenditure and overall health benefits, these may vary based on the type of activity.

Physical activity domain

Domain describes the context or reason for participating in physical activity. It includes: leisure-time, incidental activity, transport, occupational and recreational.

'Sufficient' activity

Sufficient time is important to estimate the amount and type of physical activity that is likely to have a health benefit. For population-monitoring purposes, it is recommended to calculate 'sufficient' activity by measuring 'sufficient time' (at least 150 minutes per week of moderate physical activity, which each minute of vigorous activity counted as two minutes of moderate activity), or 'sufficient time and sessions' (at least 150 minutes of moderate physical activity per week over at least five sessions per week, with vigorous activity counted double) (DHAC 1999).

Sedentary behaviour

Sedentary behaviour is not just the absence of moderate or moderate-to-vigorous physical activity, but the engagement in pursuits that require expending low amounts of energy (<2.0 METs). There is an increasing interest in sedentary behaviours as an independent health risk factor for chronic diseases such as coronary heart disease, colon cancer, type 2 diabetes and overweight.

The Australian Diabetes, Obesity and Lifestyle Study (AusDiab) found that independent of time spent in moderate to vigorous intensity activity, there were significant associations of sedentary time and light intensity time with waist circumference and metabolic risk (Healy, Wijndaele et al. 2008). Similarly, findings from a Canadian Study report a strong association between daily time spent sitting in major activities and risk of mortality from all causes and from cardiovascular disease. Adverse health risks are even considered in active individuals who met physical activity recommendations but exceed in time spent sitting (Katzmarzyk, Church et al. 2009).

Sedentary behaviours have been grouped in four categories:

Technological

It is also referred as small screen recreation and includes television viewing, video games, and computer use for fun. Time spent engaging in small screen recreation accounts for a significant amount of the time that many young people spend in sedentary behaviour. Many studies have found a positive association between television viewing habits and body mass index in children (Andersen R.E, Crespo C.J et al. 1998), and in adults (Salmon, Bauman et al. 2000).

Socialising

Refers to other activities such as talking by phone, chatting with friends, attending mass services, and to sedentary hobbies such as drawing, writing, knitting, reading for pleasure or playing a musical instrument.

Motorised transport

Use of car and public transport as passive transport.

Homework (for children) or sedentary occupations

In recent years, measurement of sitting time has gained some attention in the study of overweight and obesity. Although most studies have focused only on time spent sitting while watching television or playing computer games, few studies have concentrated on the independent effect of sitting time at work on overweight and obesity. For

instance, Mummery, Schofield et al (2005) studied the occupational sitting time in a randomly selected sample of Australian adults in full-time employment and found an association between sitting time at modern working environment and overweight and obesity, especially in men, independent of sufficient physical activity.

Table 9 summarises the most important elements for monitoring physical activity and sedentary behaviour at the population level.

Table 9 key physical activity and sedentary behaviour elements for monitoring

- | |
|--|
| <ul style="list-style-type: none"> • ‘sufficient time’ of physical activity • ‘sufficient time and sessions’ of physical activity • Domain, intensity and frequency of physical activity • Small screen recreation time • Sitting time • Method of transport |
|--|

4.5 Physical activity and sedentary behaviour measurement methods

Physical activity

Similar to the assessment of dietary patterns, the comprehensive measurement of physical activity is difficult because there are many components and dimensions. Methods for measuring activity range from self-reported instruments to more objective methods to assess energy expenditure, movement and fitness. Selection of a method mostly depends of the purpose of assessment and type of information required. The age of participants, sample size, assessment timeframe, and resources available need to be considered as well.

Self-report

When measuring large population samples, survey and questionnaires are the preferred method to measure physical activity. Extensive questionnaires measure the type, frequency and duration of physical activity and estimate the intensity. Information either about usual activity or about activity done in a specific time frame (past week, month or year) can be gathered. As an example, The International Physical Activity Questionnaire - IPAQ (Craig, Marshall et al. 2003) was developed by a consensus group as an instrument for self-reported measurement of physical activity and inactivity suitable for assessing population levels across countries.

Generally, short questions have been used to gather self-report physical activity data in adults and children (by parent proxy for younger children). For instance, questions from The Active Australia Survey (initially developed and implemented in 1997) have been incorporated in the National Physical Activity Surveys in 1999 and 2000, and the Australian Diabetes, Obesity and Lifestyle Study in 1999–00 (AIHW 2003). The NSW Population Health Survey and other state-based surveys in Queensland, Victoria and South Australia also use questions from The Active Australia for population monitoring (Centre for Epidemiology and Research 2008).

For children, Booth et al (2002) developed The Adolescent Physical Activity Recall Questionnaire (APARQ) as a comprehensive instrument to measure participation in organised sports, games, and other activities; and participation in non-organised physical activities. This instrument identifies and quantifies most aspects of physical activity participation (type of activity, frequency, duration of participation, context of participation, and seasonal variation). It was used for measurement of self-report physical activity in children who participated in NSW Schools Physical Activity and Nutrition Survey (SPANS 2004), but could be too long to practically administer as part of a population monitoring program.

One limitation of self report measures of physical activity is that surveys related to younger children (under 10 years) rely on parent as proxies, yet parents frequently do not observe children all day and thus may not be in a position to provide reliable information on their child's activity levels. For instance, Basterfield et al (2008) found that levels of habitual physical activity in children were substantially lower than those reported in UK health surveys when compared against accelerometry data. To overcome this, the Canadian Fitness and Lifestyle Research Institute (2008) is now monitoring children's physical activity by using pedometers (CANPLAY survey).

Alternatively to questionnaires, diary and activity logs are preferred for smaller samples and when detailed information such as type of activity and context are required.

Objective methods

Accelerometers and pedometers are the preferred method for monitoring activity as they provide more precise and accurate information. They can be used for individual assessment and population-based surveys. However, the cost involved might limit their use in large samples.

Pedometers provide a measure of overall physical activity and are not restricted to measures of a single domain (e.g. leisure time). While step counts do not give an indication of intensity of activity, they do provide objective measures that have been found to be correlated with data from accelerometers and energy expenditure (Tudor-Locke, Williams et al. 2002). On the other hand, accelerometers provide information on duration and intensity, but the data collected requires specialised skills for analysis and interpretation (Dollman, Okely et al. 2008).

Heart rate monitoring (HR) and direct observation are also useful for measuring physical activity in a small sample. However, HR does not provide any contextual information of the physical activity being performed, and direct observation requires trained staff to document relevant information on children's physical activity in particular settings.

Sedentary behaviour

Measurement of sedentary behaviour has not received the same attention as physical activity. Available tools include: self-report, parental report, and observation. Self-report is the most common method and can gather information by questionnaire or diary. Questions aim to identify the sedentary behaviour, frequency, duration and domain social/physical environment context where it takes place.

As an example, the Adolescent Sedentary Activities Questionnaire (ASAQ) developed by Hardy et al (2007) assesses time spent in a comprehensive range of sedentary activities, among school-aged children, outside of school hours. For adults, questionnaires such as the Women's Health Australia Survey and IPAQ have included a few questions regarding sitting time spent at home, work, transport and other leisure activities.

4.6 How to report physical activity and sedentary behaviour information

Information is generally collected by short indicator questions and should be reported according to the proportion of participation and time spent/intensity, and stratified by gender, age group, socioeconomic status, and where possible by ethnicity and place of residence (urban, rural,/regional).

Under ideal circumstances, a local monitoring system should report the following physical activity and sedentary behaviour information:

Physical activity

- Total sessions per week in different intensities of activity (nil, 1–2, 3–4, 5 or more),
- Total time per week in different intensities of activity (nil, 1–2, 3–4, 5 or more)
- Report proportion of individuals achieving 'sufficient time' of physical activity
- Proportion of individuals achieving 'sufficient time and sessions' of physical activity
- Proportion of individuals meeting physical activity guidelines
- Proportion of people walking for recreation
- Proportion of people walking or cycling for transport
- Prevalence of travelling to work/school by car, walking or public transport
- Trends of physical activity over time

Sedentary behaviour

- Time spent at small screen recreation activities on weekdays and weekend
- Sitting time per week spent at education, travel and sociocultural activities
- Trends of sedentary behaviour over time

Both physical activity and sedentary behaviour data should be reported by gender, age group, SES, ethnicity, rurality.

4.7 Other factors

There are other individual and social factors that have an effect on weight status. Individual factors such as biological, physiological and genetic characteristics, knowledge, attitudes and beliefs will have an impact on health behaviours. Additionally, socioeconomic, cultural, organizational and political factors will have an indirect influence. Under ideal circumstances, ongoing monitoring of key indicators that measure these factors is desirable for a proper understanding of changes in prevalence of overweight and obesity and for the planning of health initiatives.

Socio-demographic characteristics

Socio-demographic variables such as age, gender, ethnicity, employment and socio-economic status are important determinants of the health of individuals. They have also a strong effect on dietary and physical activity behaviours, other patterns of illness and in the use of health care services. In general, limited resources and being part of a disadvantaged community have been related to poorer quality diet, low consumption of fruits and vegetables and less participation in physical

activities, as well as higher rates of overweight and obesity.

Health Literacy

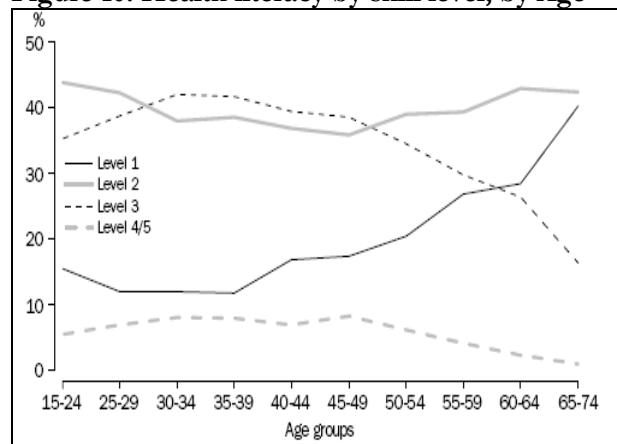
Health literacy has been a focus of research recently, and it is now recognised as an important determinant of health. The US Department of Health and Human Services (2000) defined health literacy as “the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions”.

Health education and literacy influence judgement and day-to-day choices people make in regards to their health at home, work and the community level. Both individual factors (such as education level) and other socio cultural issues play a role in health literacy. Communication skills, preferences and expectations of health care providers also influence people’s access and understanding of health information.

It has been reported that lower health literacy levels have negative effects on health, as US studies show that people tend to understand less health information, use less preventative health care services, and attend more emergency services. They are also at a higher risk of hospitalisation, and tend to be unable to understand and comply with the use of prescription drugs (Institute of Medicine 2004).

In Australia, the Adult Literacy and Life Skills Survey (ALLS) conducted in 2006 measured 191 health-related items across four domains (prose literacy, document literacy, numeracy and problem solving) (ABS 2008b). For each of these domains, proficiency was measured on a scale from 0 to 500 points, and scores were grouped in to 5 skill levels being Level 1 the lowest level of literacy and 5 the highest. Results showed that health literacy increased from the 15 to 19 years age group up to the 35-39 years age group, and then declined in those 40 years and older. Overall, only 40% of Australian adults achieved a skill level of 3 or above (See Figure 10). Therefore, health literacy levels needs to be considered when delivering health promotion activities that aim to empower individuals in self-managing health practices.

Figure 10. Health literacy by skill level, by Age



Source: (ABS 2008b)

Self perception of body weight

An accurate perception of body weight (and an appropriate response) is an important aspect of community awareness of the problem of obesity. Sociocultural factors and psychological influences drive the standards of desirable body weight, and perceptions vary among different population groups. Usually men tend to underestimate their weight, whereas women tend to overestimate their weight (Paeratakul, White et al. 2002).

Many overweight adults believe their weight is not hazardous for their health (Atlantis, Barnes et al. 2008). Overweight is even considered as a positive sign of health in some societies. For instance, Black Americans, Eastern and Western Europeans are more likely to under-report their weight (Howard, Hugo et al. 2008). In contrast, normal weight white women tend to be dissatisfied with their body image and body size and engage in negative behaviours such as over dieting (Paeratakul, White et al. 2002)

Self-perception of body weight status is usually assessed by asking “do you consider yourself to be in accepted weight, underweight or overweight?”. Chang et al (2003) reported that 29.8% of men and 27.5% of women misclassified themselves into another weight status category. Women were five times more likely to view themselves as overweight than men. Younger people were also more likely to allocate themselves into a higher weight category, as well as individuals with a higher education or income. Additionally, parents of overweight children have similar misperceptions and do not recognize if their child has a weight problem (Howard, Hugo et al. 2008).

All these weight status misperceptions are important barriers to healthy lifestyle behaviours and need to be considered when planning and implementing public health programs (Atlantis, Barnes et al. 2008). Behaviour change is not likely to

occur unless individuals recognize their weight problem and perceive associated health consequences. In addition, some individuals perceive that being overweight limits their ability to participate in physical activity (Atlantis, Barnes et al. 2008). Therefore, overweight men, people with low income and low education need special attention when health professionals advise them to engage in healthy lifestyle and to lose weight (Chang and Christakis 2003).

Inappropriate weight-control behaviours

The term ‘inappropriate weight-control behaviours’ describes a wide range of practices designed to influence one’s shape or weight, but which are associated with unhealthful practices such as excessive shape and weight concerns, dieting and other unhealthy weight-control methods (e.g. diet pills, products containing epinephrine, purging, smoking more, fasting, skipping meals, vomiting, and the use of laxatives or diuretics) and binge eating. These is mainly seen in adolescents, particularly girls, but has been also observed in adults (Goldschmidt, Aspen et al. 2008).

Extensive research has found that dieters and individuals with highest levels of weight concerns are not only at a higher risk of weight gain compared to non-dieters, but also are at a higher risk of becoming overweight, experiencing disordered eating and developing eating disorders such as anorexia nervosa, bulimia nervosa and binge eating (Neumark-Sztainer and Hannan 2000) Longitudinal data from the United States suggest that although more than half of female adolescents and one quarter of male adolescents report engaging in weight-control behaviours, none one these behaviours have benefits in terms of weight status (Neumark-Sztainer, Wall et al. 2006).

Not all weight-control behaviours involve unhealthful practices. Those characterised as healthful include high consumption of fruits and vegetables, less fat intake and calorie intake proportional to energy expenditure.

Although there is no accepted standard way to assess inappropriate dieting, researchers have used questions such as “are you currently on a diet to lose weight”, “are you currently of a diet to maintain weight”, “how often have you gone on a diet during the last year” to identify participants as ‘dieters’. However, these questions could be interpreted in many ways and do not provide much details on the kind of behaviours participants are engaging in. Some studies have assessed specific types of weight-control behaviours by asking “have you done any of the following things in order to

lose weight or to keep from gaining weight during the past year?”, or “please list what you are doing to lose or maintain weight” (Timko, Perone et al. 2006). Specific questions to assess binge eating with loss of control include “In the past year, have you eaten so much food in a short period of time that you would be embarrassed if others saws you?” and “During the times when you ate this way, did you feel you couldn’t stop eating or control what or how much you were eating?” (Neumark-Sztainer, Wall et al. 2006)

Monitoring of disordered eating symptoms is important as there is evidence they predict the development of overweight and eating disorders, and are counterproductive to weight management. Therefore, identifying the proportion of population involved in these practices would be the first step to guide public health policy.

4.8 Chapter Summary

Nutrition and eating behaviours

What to monitor?

- ✓ Fruit consumption
- ✓ Vegetable consumption
- ✓ Fat intake (e.g. type of milk and type of meats)
- ✓ Consumption of extra foods
- ✓ Soft drinks consumption
- ✓ Selected set of eating behaviours
- ✓ Alcohol consumption
- ✓ Food insecurity

How to measure?

- ✓ Short dietary questions
- ✓ Detailed nutrition surveys conducted regularly at national (or state) levels

What / How to report?

- Mean and median number of serves of fruits consumed per day
- Mean and median number of serves of vegetables consumed per day
- Type of milk usually consumed
- Proportion of people eating full cream milk
- Frequency of consuming red meat a week
- Frequency of consuming processed meat products a week
- Consumption of soft drinks, cordial or sports drinks a week
- Frequency of consuming hot fried potatoes a week
- Frequency of consuming potato crisps or salty snacks a week
- Frequency of consuming takeaway food a week
- Proportion of people skipping breakfast
- Proportion of families eating meal together
- Frequency of children eating in front of the TV

Food insecurity in the last 12 months

These should be reported by gender, age group, SES, ethnicity, rurality

Physical activity & sedentary behaviour

What to monitor?

- ✓ Duration, frequency, intensity, type and domain of physical activity
- ✓ Sitting time spent at sedentary activities (technological, social, homework/occupation)
- ✓ Mode of transport

How to measure?

- ✓ Survey and questionnaires (APARQ, ASAQ) and short questions
- ✓ Be cautious when collecting self report measures of young children's physical activity using parents as proxies, as information may not be accurate
- ✓ Objective measures: Pedometer is the prefer method

What / How to report?

- Total sessions per week in different intensities of activity (nil, 1–2, 3–4, 5 or more)
- Total time per week in different intensities of activity (nil, 1–2, 3–4, 5 or more)
- Report proportion of individuals achieving 'sufficient time' of physical activity
- Proportion of individuals achieving 'sufficient time and sessions' of physical activity
- Proportion of individuals meeting physical activity guidelines
- Proportion of people walking for recreation
- Proportion of people walking or cycling for transport
- Prevalence of travelling to work/school by car, walking or public transport
- Time spent at small screen recreation activities on weekdays and weekend
- Sitting time per week spent at education, travel and sociocultural activities
- Trends of physical activity and sedentary behaviours over time

These should be reported by gender, age group, SES, ethnicity, rurality

Other factors

- ✓ Sociodemographic factors: age, gender, ethnicity, employment and SES
- ✓ Health literacy
- ✓ Self-perception of body weight
- ✓ Inappropriate weight-control behaviours

5. Weight - related environmental influences

Individuals' behaviours are affected daily by their interactions with a broad range of environmental factors in settings such as schools, the workplace, home, restaurants, supermarkets, neighbourhoods and communities. These, in turn, are influenced by laws, policy, industry, economy, governments and societies. In one way or another, the environmental factors will influence dietary and physical activity behaviours (NSW Health 2003). Unfortunately, the environment where we live nowadays has been considered as 'obesogenic', where modern lifestyles encourage the overconsumption of food and promote sedentary activities.

International agencies such as the World Health Organization and the International Obesity Task Force strongly support positive environment changes that improve diet and physical activity (Sallis and Glanz 2009). Environmental changes can usually reach and influence a large number of people and create sustainable behavioural change, which may contribute to preventing weight gain at population level.

5.1 Food environments

Food and nutrition environments refer to settings where food is produced, distributed, purchased, stored, prepared and consumed. Environmental factors and changes have an impact on the availability, accessibility, affordability, quality, amount, variety, promotion and labelling of foods; and collectively they influence what, where and how much individuals eat (Gebel, King et al. 2005).

Expanding portion sizes, greater variety and availability of cheap processed and convenient foods high in fat and sugar, extensive food advertising and food marketing aiming at children, parents working longer hours, fewer family meals, more meals eaten away from home, other food and agriculture policies, and technology advancements are believed to have contributed with the current increases in obesity (Story, Kaphingst et al. 2008).

Food and nutrition environments are complex and multilevel. They have been categorized by Glanz et al (2005) into four types for a better understanding:

Community food and nutrition environments

This describes the type, number, location and accessibility of food retail outlets (grocery stores, convenience stores, supermarkets and vending machines) and food service outlets (restaurants,

fast-food and take-away shops, cafes, and catering companies).

Several reviews of representative studies have been published and show an association between food environment and healthy eating or obesity (Gebel, King et al. 2005; Story, Kaphingst et al. 2008; Sallis and Glanz 2009). Findings reported that the presence of food shops contributed to the eating patterns of neighbourhood residents. Proximity to supermarkets has been associated with a better-quality diet and a higher consumption of fruits and vegetables. In contrast, proximity to fast-food restaurants has been associated with a higher consumption of calories and fat. Similarly, greater access to chain supermarkets was associated with lower BMI whereas higher availability to convenient stores was associated with higher BMI (Morland, Diez Roux et al. 2006; Moore, Diez Roux et al. 2008).

Additionally, some evidence has indicated that the density of food outlets in low income urban areas has contributed to income and racial/ethnic disparities in access to healthy foods. It has been shown that low income and minority groups have fewer chain supermarkets than middle and upper-income groups in the US. Also in the US, higher numbers of take-away places and fast-food restaurant have been identified in low SES communities (offering poor nutrition and cheap choices) has been linked to the higher prevalence of obesity in disadvantage communities (Powell, Chaloupka et al. 2007). However, there is not enough evidence from large studies to support this relationship between the weight status of residents and the density of restaurants in the neighbourhood.

Some studies reported inconsistent findings, and it is likely that these associations vary according to geographic and cultural contexts. For instance, Simmons et al (2005) found no correlation between increasing take away consumption and obesity in regional and rural areas in Australia.

Consumer food and nutrition environments

This category refers to what consumers encounter within and around food outlets; and comprises the availability and pricing of healthful food choices, the variety and quality of food, portion sizes, convenience, promotions, and nutrition information.

Availability and pricing

Variations in consumer environments such as differential availability and affordability of healthy food choices may contribute to socioeconomic or

other disparities in diet-related chronic diseases. For instance, Glanz and Sallis (2007) found that lower-income communities had less access to healthful food choices like fruits, vegetables and low-fat dairy products.

Similarly, Burns et al (2004) reported that cost and availability of healthy food choices in Australia was compromised by remoteness. Although basic foods were available at local community stores, healthy food choices were limited to large food retail chain stores located at major regional centres or large towns. On the contrary, an study in the Illawarra region did not find a consistent relationship between SES of food outlet location and the food prices (Williams, Hull et al. 2009)

Variety and pricing

Whilst Story et al (2008) reported that large supermarkets offer a greater variety of foods, including more higher-quality choices at the lower cost compared to small grocery stores and other food outlets, Williams et al (2009) reported that prices of fresh food products such as fruits, vegetables and meat in Australia were cheaper when purchased at local independent grocery stores.

Portion size

Jumbo-sized portions available in supermarkets and restaurants, plus an increased size of the dinnerware at home have contributed to a bigger serving portions and a higher energy intake. Evidence shows that people tend to eat more from large-sized portions and to serve themselves more from larger-sized packages (Wansink and Van Ittersum 2007).

Food choices and promotions

Nowadays, when purchasing packaged food at large supermarkets, Australian consumers are have many food choices. Numerous strategies such as 'line extensions' (new flavour for a well-established product), 'me-too- foods' (mirroring rival products) and multiple packaging have been implemented to stimulate consumer demand and promote a specific product (Walker, Woods et al. 2007).

Nutrition information

More than 90% of consumers report checking information at some point in order to select a product. Although nutrition information (food labels and food claims) are intended to assist consumers in making food choices, it may not be useful unless it is presented in an easy to be understood by format to the general public.

In 2002 nutrition labelling became compulsory for all manufactured food sold in Australia and New Zealand; and standardised Nutrition information panels (NIP) are required to provide information on

levels of energy, protein, total fat, saturated fat, carbohydrates, sugar and sodium (Mhurchu and Gorton 2007).

In the UK, the Food Standards Agency developed a food labelling system which recommends the introduction of a front-of-pack multiple traffic light system. It is important to note this system is not mandatory. In Australia, a similar system for front of pack labelling is the subject of debate (Kelly, Hughes et al. 2008).

A minority of chain restaurants are now offering nutrition information in regards to their main menu items. However, when they do, information is provided online rather than at the point of purchase. Policies encouraging the listing of calorie, fat and other nutritional information on menus are now rising in different places (Sallis and Glanz 2009).

Organizational food and nutrition environments

This refers to settings and places where food is consumed, such as home, schools, worksite, day care centres, community gardens, breastfeeding places and hospitals.

Home environments

The home has been described as a complex and dynamic food environment (Sallis and Glanz 2009). Factors like availability and accessibility of healthy foods, frequency of family meals, parental intake, role modelling, and other patterns of parent-child interaction in regards to foods and mealtimes (food practices and feeding style) have been linked with healthful eating habits, especially in children and adolescents. Evidence suggests that healthful dietary intake is enhanced by readily available and easy accessible healthful foods at home, as well as parental presence at the evening meal and parental consumption of healthy choices (Story, Kaphingst et al. 2008).

On the other hand, several studies have shown a negative association between the availability of less nutritious food at home and the eating behaviours of family members. For instance, Grimm et al (2004) showed that availability of soft drinks at home was strongly associated with greater soft drink consumption in children. In regards to adolescent eating, Campbell et al (2007) reported that availability of unhealthy food at home was a strong predictor of the consumption of these foods and might be a barrier to the intake of healthy choices such as fruits and vegetables. Similarly, Boutelle et al (2007) found that when parents reported frequent fast-food purchase for family

meals, adolescents reported a higher intake of fast foods and salty snacks, less availability of healthful options and less breakfast consumption. Both studies restated the significant influence parents have as family food preparers.

School environments

Schools can have a high impact on children and adolescents dietary intake as children usually eat up to two meals and snacks at school every day. Extensive facilities for selling food and drinks are available such as vending machines, cafeterias, canteens and fundraising activities. Some evidence has shown that the number of vending machines is associated with student snack purchases and lower fruit intake (Kubik, Lytle et al. 2003). However, other studies have not found any association (Van der Horst, Timperio et al. 2008)

Regulation of school nutrition standards and policies that limit the availability of energy-dense foods and drinks at schools have been introduced in recent years. The NSW Government has sought to influence the school food environment through the 'Fresh Tastes @ School' policy. This strategy limits the scale of energy-dense foods in school canteens and provides supportive resources for schools and canteens (NSW Health 2006).

Worksite environments

Adults spend most of their days at work places and consume meals and snacks there. Studies have shown that changes in the worksite environment can have a positive impact on dietary intake. Feasible strategies that have been implemented with positive results include: increasing the availability and variety of healthful foods, reducing the price in cafeterias, and sending nutrition health education via emails. The involvement of employees in planning and implementation of changes, and obtaining support from managers ensure the sustainability of these initiatives (Story, Kaphingst et al. 2008).

Information food and nutrition environments

Information environments include all media and food advertising at local, national, and organizational settings. In the last decades, children and adolescents have been targeted with numerous television food marketing and advertising practices that encourage the consumption of sweets, soft drinks, snacks, sugared cereals, and fast foods (Chapman, Kelly et al. 2009). In recent years, food marketing has expanded to the internet and to other digital media like mobile phones and video games (Kelly, Bochynskak et al. 2008; Story, Kaphingst et al. 2008).

5.2 Measurement methods and issues

Although the multiple dimensions of food and nutrition environments have been extensively reported, there is poor guidance about comprehensive methods to measure these environments. McKinnon et al (2009) reviewed several instruments and methodologies available in the literature from 1990 to 2007 for the measurement of food environment. Standard assessment comprises direct observation (checklist, market basket and inventory) and self-report data collected by interviews or questionnaires.

Community food and nutrition environments

Geographic analysis gathers data from specific geographic measures to assess the spatial distribution of food outlets, including their diversity, proximity and variety. Diversity is measured by assessing food density and the type of food outlets available within an area. The number of food outlets can be obtained from license records for retail and food service establishments, public directories such as Yellow Pages or online directories. Numbers are usually reported by counting per population, per area unit or within a given radius. Proximity is based on the nearest distance between residence and food outlet, and may be assessed by the shortest path. Variety is measured by documenting the differences between various types of food outlets, their prices and quality (Glanz 2009).

Consumer food and nutrition environments

To objectively measure the availability of certain type of foods and the nutrient content of menus, methodologies such as sales analysis, menu analysis and nutrient analysis have been developed (McKinnon, Reedy et al. 2009). Sales analysis uses data from sales, cashier receipts and food service reporting forms to evaluate consumer preferences and to compare food prices. Menu analysis reviews information on a menu to determine the specific food and beverage listed. For instance, restaurant menu checklists have been used to assess food preparation, number of healthful choices, and fruits and vegetables availability (Cassady, Housemann et al. 2004). Finally, nutrient analysis and labels assessment collects data on calories and nutrients such as saturated fat, fibre and sodium.

Self-reported measures from consumers have been used in the past to report the location of stores where they normally purchase food, the distance to the nearest shop, the perception of food prices and accessibility of healthful foods. Perception measures and opinions that assess facilitators and barriers to healthful eating, pricing and signage/promotion of

healthy and unhealthy foods have also been considered (Saelens, Glanz et al. 2007)

Organizational food and nutrition environments

Schools, workplaces and home environment are the most commonly measured. Van der Host et al (2008) designed an audit instrument to assess availability of food in the schools. The total availability of soft drinks, low-calorie drinks, energy-dense snacks, low energy-dense snacks and fruits and vegetables were observed at vending machines and canteen counters.

Oldenburg et al (2002) developed in Australia a Checklist of Health Promotion Environments at Worksites (CHEW) in order to assess different categories of workplace food and nutrition environments like cafeteria, vending machines and indicators of healthful choices.

For home assessments, population-based telephone interviews have used short questions to assess the availability and accessibility of healthful foods like fruits, vegetables and reduced-fat foods; and presence of high-fat foods (Glanz 2009)

Information food and nutrition environments

Surveillance and content analysis of the number of advertisements promoting foods of low nutritional value within children's television programming has been evaluated locally and results have been used to advocate for change in policies that limit exposure of children to food advertising.

Measurement issues

Main concerns in regards to the measurement of food and nutrition environments include the use of self-report data (consumers, restaurant and store managers) and manual records (i.e. sales data). Different tools have been developed for local settings and small samples, but have not been used with larger samples or in population-based studies.

5.3 Physical activity environment

Physical activity environment refers to places that support daily activities and allow individuals to be physically active; and includes the natural and the built environment. Natural environment comprises places where people can be physically active (open spaces) and aspects of nature that could alter physical activity behaviours (typography, climate, altitude, vegetation). The built environment includes all buildings and spaces created or modified by people in the community. It includes land use patterns, parks and recreational areas, design features of buildings, neighbourhoods, schools and workplaces; and transportation systems (Sallis 2009).

Built environmental factors like urban design of towns and buildings, availability of public parks, playgrounds and other recreation facilities, access to sidewalks and bicycle paths, and security and safety of facilities promote active living. On the other hand, modern lifestyle factors and technologies such as computers, video games, use of cars and lifts, and office occupations, encourage sedentary behaviours (Gebel, King et al. 2005; Sallis and Glanz 2009).

The built environment influences opportunities for physical activity in four domains:

Recreation

Recreational activities can take place at home and in the neighbourhood. Evidence has shown that people who have access to physical activity equipment at home, and who live closely to recreational facilities (i.e. public parks and trails, public swimming pools, playing fields, community organizations, private health clubs, sports programs) are more physically active overall (Sallis and Glanz 2009). Proximity to parks, playgrounds and recreation areas was also associated with children's total physical activity (Davidson and Lawson 2006).

Aesthetics is an important aspect of the physical environment and relates to the level of satisfaction people experience physically and visually. Multiple studies have found that features that make recreational physical activity more pleasant include: the presence of trees, parks, gardens, water views, availability of shade, and place to rest. Additionally, safety issues and the absence of air pollution and the presence of architectural designs within the neighborhood also promote engagement in physical activities (Hawthorne 1989; Bauman and Bull 2007).

Transportation

The transportation system involves the streets and highways for cars, the public transport system and the infrastructure for active transport such as footpaths and cycle paths. Whereas driving is an independent risk factor for obesity, using public transport supports people to meet the physical activity guidelines (Lachapelle and Frank 2009).

In the past, most towns and cities were built to ensure people could walk to facilities using streets networks that provided a direct route. Land use patterns were mix-use of residential, commercial and industrial zones and supported active transportation. However, the primary mode of transport in modern societies is the car, and design of roads and towns is being made to ensure people travel mostly by car. Streets connectivity has been

lost and more zones are being designed for separate use which has led to more people living far from work and from shopping areas (Sallis and Glanz 2009).

The concept of 'walkability' was developed in order to describe people's ability to walk to community, commercial and recreational facilities in a local area. Sidewalks are used for both recreation and transport purposes. Studies have found that people who live in walkable neighbourhoods walk and cycle more, and drive less compared to those who live in areas designed to be dependant in cars. Likewise, children and adolescents tend to walk or cycle more to school when they live close by, the area is safe and has low traffic, and sidewalks are available (Kerr, Rosenberg et al. 2006).

Safety issues are important factors when considering active transportation in the community. People are concerned about personal and traffic safety. Personal safety refers to adequate lighting, improved surfaces to walk and cycle, and surveillance by local residents; and traffic safety refers to the availability of crossings, design of roads to control speed and traffic volume (Pikora, Giles-Corti et al. 2003).

Consistent evidence shows that proximity to commercial and recreational facilities, low traffic flow, interconnected streets, higher residential densities, attractive and safe local areas are the most important environmental factors that support walking and cycling (Gebel, King et al. 2005; Sallis and Glanz 2009). In contrast, environmental barriers for active transportation comprise: air pollution, garbage, dangerous crossings, traffic noise, poor maintained footpaths, and crime (Pikora, Giles-Corti et al. 2003).

An adequate public transport infrastructure (bus stops and train stations), cycle ways and bicycle parking at commercial facilities and workplaces also encourages active transportation when walking might not be appropriate because of large distances.

Occupation

Physical environmental features at the workplace environment influence participation in physical activity. Building design, easy access to the site, design of stairs, showers facilities, and physical activity facilities and programs enable people to be more physically active at work. For instance, Sallis and Glanz (2009) reviewed several interventions that focused in making stairs more attractive, offer a more convenient access, and promote stair use by signs showed greater use of stairs.

Similarly, schools with a supportive physical activity environment such as basketball hoops and open spaces, school playgrounds, physical exercise programs, and access to other equipment facilitate students' participation in physical activity during lunch break and after school classes (Sallis and Glanz 2009).

Household

Factors that influence physical activity at home include easy access to stairs, gardens, and physical activity equipment for exercise.

5.4 Measurement methods and issues

Brownson et al (2009) identified three categories of built environment measures being used in the literature. The first examines the access and barriers to various recreation, land use and transportation environments, and usually collects information by interviews or questionnaires. The second quantifies specific attributes of the built environment by audits and systematic observation, and the last one analyzes existing datasets with Geographic Information Systems (GIS).

Perceived environmental features

A framework was developed in order to assess the perceived-environment measures that influence the participation in physical activity. Pikora et al (2003) identified four key domains being evaluated by most instruments: functional, safety, aesthetic and destinations. Most common elements assessed include land use, traffic, aesthetics, and safety from crime.

The Neighbourhood Environment Walkability Scale (NEWS) has been used widely to measure residents' perceptions of the environmental attributes of their local area. This scale assesses the residential density, proximity and access to commercial facilities (land use mix-diversity and land use mix-access), street connectivity; walking or cycling facilities, aesthetics, pedestrian traffic safety; and crime safety (Saelens, Sallis et al. 2003). More recently, an abbreviated version of this scale has been developed (Leslie, Saelens et al. 2005; Cerin, Saelens et al. 2006)

Observed measures (community audits)

Systematic observation of the physical environment can be conducted through an auditing process. Some audits are developed for research purposes and others to support local changes. Researchers perform direct observation and collect data on physical features that are not available on GIS database. Audit tools generally assess community environments, parks or trails by using close-ended

questions, and open-ended questions or comments (Brownson, Hoehner et al. 2009).

Most community audit instruments include measures of: land use, traffic volume, presence and continuing of sidewalks and cycle ways, public amenities, architecture or building characteristics, landscape maintenance, parking, and indicators related to safety. In Australia, the Systematic Pedestrian and Cycling Environmental Scan Instrument (SPACES)

Although detailed information can be collected by direct observation, this method is time consuming, requires trained observers, a sampling of the segments to evaluate, and manual data entry. Therefore, it is advised to use direct observation only in limited areas and when existing GIS data does not provide sufficient information.

GIS-based measures

Measures of the built environment derived from existing data sources are used when assessing individuals or neighbourhoods dispersed across large areas. Measures include: population density (population per total land area) and net residential density (housing units per residential acre), land-use mix (accessibility, intensity and pattern), access to exercise or recreational facilities, street pattern, sidewalk coverage, vehicle traffic, crime, and others (i.e. building design, public transit).

Measurement issues

The number of variables that could be measured when assessing the physical built environment is large. Other concerns include the lack of operational definitions for GIS measures and the variety of geographical scales. Finally, it is not clear if existing measures are sensitive across varying geographic and cultural environments.

5.5 Chapter Summary

Food environments

What to monitor?

- ✓ Community food and nutrition environments: (food retail and food service outlets)
 - Location
 - Number
 - Proximity
 - Diversity
 - Accessibility
- ✓ Consumer food and nutrition environments:
 - Availability
 - Pricing
 - Variety
 - Quality
 - Convenience
 - Portion sizes
 - Promotions
 - Nutrition information.
- ✓ Organizational food and nutrition environments:
 - Home
 - Schools
 - Hospitals
 - Worksite
 - Day care centres
- ✓ Information food and nutrition environments
 - Media and food advertising
 - Food marketing

How to measure?

- ✓ Community food and nutrition environments: (food retail and food service outlets)
 - License records and business directories
 - Food density (number of food outlets per population or are unit)
 - Type of food outlets
 - Spatial distribution
 - Distance between residence and food outlet
- ✓ Consumer food and nutrition environments:
 - Sales analysis using data from cashier receipts and food service reporting
 - Menu analysis to assess food preparation, number and availability of healthful choices
 - Nutrient analysis and labels assessment
 - Distance to the nearest shop
 - Perception of food prices and accessibility of healthful foods
- ✓ Organizational food and nutrition environments:
 - Audit instruments to measure availability of specific type of foods at vending machines and canteen counters
 - Short questions to assess availability and accessibility of healthful foods like fruits, vegetables and reduced-fat foods; and presence of high-fat foods at home
- ✓ Information food and nutrition environments
 - Surveillance and content analysis of advertisings promoting specific foods

Physical activity environment

What to monitor?

- ✓ Recreation facilities at home and in the neighbourhood
 - Type of facility
 - Safety issues
 - Location
 - Aesthetics
 - Proximity
 - Air pollution

- ✓ Transportation systems
 - Streets and highways for cars (traffic volume)
 - The public transport system (bus stops and train stations)
 - Street connectivity
 - Proximity and access to commercial facilities
 - 'Walkability' (footpaths and cycle paths)
 - Public amenities
 - Safety (personal and traffic)
 - Environmental barriers (garbage, noise, air pollution)

- ✓ Infrastructure of different settings (workplaces, schools and homes)
 - Building design
 - Physical activity facilities
 - Accessibility
 - Availability of equipment

How to measure?

- ✓ Perceived environmental features
 - Residents' perceptions of the environmental attributes of their local area (survey)

- ✓ Observed measures
 - Community audits (direct observation and data collection on physical features not available on GIS database)

- ✓ GIS-based measures
 - Population density (population per total land area)
 - Residential density (housing units per residential acre)
 - Land-use mix (accessibility, intensity and pattern)
 - Access to exercise or recreational facilities
 - Street pattern
 - Sidewalk coverage,
 - Vehicle traffic

6. Survey vehicles for monitoring weight status, physical activity and nutrition in NSW

Different surveys are designed for different purposes, and there is no one survey that covers all needs. However, there is a value in using an integrated approach that combines existing health and non-health surveys in order to monitor weight status, physical activity and nutrition in the NSW population. Relevant surveys for monitoring weight-related variables that are already in place are listed below.

6.1 Options for health survey vehicles

NSW Population Health Survey

Since 2002, the NSW Department of Health has continuously conducted the New South Wales Population Health Survey. Prior to this, several adult health and child health surveys were conducted.

The NSW Population Health Survey covers the whole state population and approaches households by phone using list assisted random digit dialling. Telephone interviews are conducted by trained interviewers, and children data is reported by parent proxy. Respondents provide information about demographics, health behaviours, health status, and access to and satisfaction with health services.

This is the main mechanism in place for NSW population health monitoring and allows monitoring of changes over time. Annual reports on adult health by Area Health Service, and biennial reports on child health for the whole state.

National Health Survey (NHS)

Initiated in 1995, and 3 yearly since 2001, the National Health Survey seeks to obtain national data in relation to benchmarks on a wide range of health issues, and to enable changes in health to be monitored over time. Information is collected about the health status of Australians, their use of health services and facilities, other health-related aspects of lifestyle and health risk factors such as smoking, alcohol consumption, exercise, BMI and some dietary habits. Additionally, data from the NHS provide an understanding on health indicators for national health priority areas and for important subgroups of the population.

The results of the 2007-8 NHS were published recently (ABS 2009), and for the first time since 1995 objective measurements including height, weight, hip and waist circumference were obtained for respondents aged 5 years or more.

The 1995 National Nutrition Survey (NNS)

The NNS, conducted over a 12-month period, was a joint project between the Australian Bureau of Statistics and the Commonwealth Department of Health and Aged Care (ABS 1998). It is the largest, most comprehensive and most recent Australian survey of food and nutrient intake, dietary habits and body measurements.

Its main purpose was the provision of food and nutrient data to assist with the implementation of Australia's Food and Nutrition Policy, future revisions of the Recommended Dietary Intakes, and future revisions of national health goals and targets. And it collected information for people aged two years or more on food and beverage intake, usual frequency of intake, food-related habits and attitudes, and physical measurements.

The NNS was implemented across all States and Territories by specially trained Dietitian-Nutritionists who conducted personal interviews in participants' homes. Food intake data was collected using the 24-hour dietary recall method, and a Food Frequency Questionnaire was left for self-completion. Additionally, physical measurements including blood pressure (those over 16 years), height, weight; and waist and hip circumferences were taken.

2007 Australian National Children's Nutrition and Physical Activity Survey

This survey was funded by the Department of Health and Ageing, the Department of Agriculture, Fisheries and Forestry, and the Australian Food and Grocery Council; and was implemented by The CSIRO and the University of South Australia. It collected data on food and nutrient intake, physical activity levels and physical measurements (height, weight and waist measurements) against the existing national dietary and physical activity guidelines.

Randomly selected households with children aged 2-16 years were interviewed over the phone, food and physical activity data were collected using two separate 24 hour recalls, and a pedometer record was available for children aged five years and over. Additionally, children height, weight and waist measurements were taken, along with demographic

information, including age, gender, parents' work and socioeconomic status.

National Health Risk Survey (HRS)

The Australian Government announced at the end of 2008 that as part of the National Prevention Partnership, additional funding would be available to supplement the National Nutrition and Physical Activity Survey Program by introducing a self-reported and biomedical health risk survey to cover adults, children and indigenous populations every five to six years. The HRS will collect and report on comprehensive and representative data about the prevalence of chronic diseases and their risk factors, including dietary and physical activity habits. Data collection for the first survey is being planned for mid 2010 ((DoHA) 2009).

Australian Secondary Students' Alcohol and Drug Survey (ASSAD)

The ASSAD surveys have been conducted every three years since 1984 at secondary schools across Australia by local cancer councils and health department in each state. They include questions on tobacco, alcohol, pain relievers, sleeping tablets and illicit substances such as cannabis and hallucinogens, and sun protection. Supplementary questions on nutrition and physical activity were included in the survey for the first time in 2002.

NSW Schools Physical Activity and Nutrition Survey - SPANS

The NSW Government has supported a series of surveys on school students' weight status and physical activity behaviours in 1985 (ACHPER), 1997 and 2004. In 2004, information on dietary patterns, eating habits and sedentary behaviours was also included. These data are collected through self-completed questionnaires completed by parents and children. In addition, objective measures include anthropometrics, fundamental movement skills and fitness assessment is conducted at schools. The next survey is being planned for 2010 and will follow the same methodology as the previous surveys.

Ad hoc and longitudinal surveys

Appendix 2 presents a variety of current and recent surveys which cover physical activity, nutrition, weight status and related variables in adults and children. Many are ad hoc, rather than a monitoring system.

6.2 Using non-health surveys

Exercise, Recreation and Sport Survey (ERASS)

The ERASS is a joint initiative of the Australian Sports Commission and the state and territory government agencies responsible for sport and recreation. It started in 2001 and is conducted annually. It collects information on the frequency, duration, nature and type of participation by persons aged 15 years and over in organised and non-organised physical activity for exercise, recreation and sport during the 12 months prior to interview.

Although these data have been used by the sport and recreation industry to document the participation in specific activities and to monitor trends for funding and resources allocations, Merom and Bauman (2004) recognised that this survey provides useful health-related information about physical activity among NSW adults, supplementary to other physical activity surveys. The variety of activities recorded are useful for monitoring physical activity trends over time, especially changes in cycling or walking in NSW.

Time Use Surveys (TUS)

The TUS examine how people allocate time to different kinds of activities. It was introduced in the 60s and 70s in many countries. In Australia, it was first conducted in 1974, then in 1992, 1997 and 2006. It recruits household members aged 15 years or more and captures a detailed diary (recorded in 5-minute intervals) of all of their activities over two consecutive days during all four seasons over the calendar year.

Daily time spent in voluntary work, leisure activities, fitness and health activities, various modes of transport and use of technology is recorded. This data provides detailed information on activities in different domains, has low recall bias and low social desirability.

Lately, it has been recognised to be a good source of data to describe nationally representative patterns of physical activity and sedentary behaviour. For instance, Tudor-Locke et al (2005) studied population walking patterns, relative to both exercise and transportation purposes.

Although limitations of data analysis include the inability to differentiate between moderate and vigorous activities and to assign intensity to occupational time, it has been proposed that the TUS data would permit further analysis of relationships between demographic variables, environment characteristics and behaviour.

Household Expenditure Surveys (HES)

The HES collects detailed information about the expenditure, income, net worth and household characteristics of a sample of households resident in private dwellings in urban and rural areas of Australia. It has been conducted by ABS since 1974, and now occurs 6 yearly (last 2003-2004). It measures expenditure in a broad number of items, including food and non-alcoholic beverages, alcoholic beverages, tobacco products, transport and recreation.

Data from the HES assists in measuring the economic well-being of the population and provides information on the command over economic resources of individuals and households. Some researchers have analysed these data in order to investigate the relationship between expenditure and health related behaviours. For instance, Aitken et al (2008) examined the expenditure on active and screen-based recreation and its relation to income levels, and to other socioeconomic and demographic characteristics of households with dependant children. In addition, Smith and Subandoro (2007) recognised that different indicators of food security can be measured using HES data.

Household Transport Survey (HTS)

The Transport Data Centre of the NSW Ministry of Transport collects data on travel behaviour of residents of the Sydney Greater Metropolitan Area. This includes the Sydney and Illawarra Statistical Division and the Newcastle Statistical Subdivision). The HTS survey was first conducted in 1997/98 and has been running continuously since then. Prior to this, transport data was collected in Sydney at three one-off surveys in 1971, 1981 and 1991.

Residents over 5 years of age from randomly selected households are asked to complete a 24 h diary that recorded details on all trips made during the designated travel day. Information in regards to trip includes origin, destination, purpose, mode, time and cost.

This longitudinal data has been used by public health researchers in order to describe trends in active transport in Australian children and adults. For instance, van der Ploeg and Merom (2008) reported the declining trend of children walking to school.

Literacy surveys

The Adult Literacy and Life Skills Survey (ALLS) was mentioned previously in this report. It was conducted in Australia in 2006 as part of an international

comparative study designed to provide information about the skills of their adult populations. It provides useful information which could contribute to a more comprehensive perception about people's understanding of health and health messages.

Apparent Consumption of Selected Foodstuffs Australia

Conducted initially in 1978-9 and then annually from 1993-4 to 1997-8 by the ABS, this survey collected apparent consumption and per capita consumption of selected food items (i.e. meat, meat products, dairy products, beverages and alcohol) from individuals, businesses, governments and other organisations. Data like these would be useful to monitor current trends in consumption of selected set of eating behaviours, and to supplement information provided from other nutritional surveys. However, there is no indication this survey will happen in the near future.

6.3 Interview modes

Currently, data for health monitoring is collected using different interview modes such as telephone interviews, face-to-face interviews, and self-completed questionnaires. When interpreting data, it is important to know how it was collected and also, if it is comparable to other data sources.

Face-to-face interviews

This mode of survey allows the interviewer to listen and watch the respondent. Although it permits more probing questions and encourages a higher accuracy of data reported, it is the most expensive and labour-intensive data collection option.

Computer Assisted Telephone interviews (CATI)

CATI surveys are commonly used in Australia. They are attractive because of lower costs and easier administration compared to face-to-face interviews. However, limitations include the use self-reported height and weight, parent proxy report for child, subjective measurements for physical activity, people excluded if they do not have a land-line or their phone is not listed, or they are away from home. In addition, the popularity of telemarketing and the advent of answering machines as people screen calls to their home phones have lead to lower response rates for phone surveys (Wilson, Taylor et al. 2001).

Self-completed questionnaires

Mail out surveys are cheap and can reach a wide sample of respondents. They allow more privacy for asking sensitive questions, and time for self-

measurement of height and weight, but data is self-reported.

- respondent burden
- response rates

6.4 Other issues

Survey mode and frequency needs to take account of issues related to:

- cost
- administration

Appropriate sampling frame will vary according to purpose and the selected survey method (see Appendix 2).

6.5 Chapter Summary

Survey vehicles for monitoring weight status, physical activity and nutrition in NSW

Options for health survey vehicles

- ✓ NSW Population Health Survey – is the main mechanism in place for population health monitoring.
- ✓ Proposed National household survey system
- ✓ Ad hoc and longitudinal surveys

ADULTS

- AusDiab
- Women's Health Study
- 45 and up

CHILDREN

- LSAC
- SPANS, other school based surveys

Using non-health surveys

- ✓ Exercise, Recreation and Sport Survey (ERASS)
- ✓ Time Use Surveys (TUS)
- ✓ Household Expenditure Surveys (HES)
- ✓ Household Transport Survey (HTS)
- ✓ Literacy surveys
- ✓ Apparent Consumption of Selected Foodstuffs Australia

Interview modes

- ✓ Face-to-face interviews
- ✓ Computer Assisted Telephone interviews (CATI)
- ✓ Self-completed questionnaires

Other issues to consider

- ✓ cost
- ✓ administration
- ✓ respondent burden
- ✓ response rates

7. Current information from population monitoring systems

7.1 NSW Adult population

Current prevalence of overweight and obesity

Measured height and weight were most recently collected in NSW in 2004 as part of the AusDiab study. Analysis of this data found that 63.9% of adults aged 25 years and over were overweight or obese. The prevalence of obesity was highest among those aged 55-64 years (28.5%), with the lowest rates being amongst those aged 25-34 years. On the other hand, those aged 65-74 years had the highest prevalence of overweight (but not obesity) followed by those aged 25-34 years.

Compared to baseline data collected in 1999 (for the same study cohort), results suggested that weight, BMI and waist circumference increased in people aged 25–64 years. This increase was less significant with increasing age. In those aged 65–74 years at baseline, weight decreased while BMI and waist circumference increased. And in those aged 75 years and older at baseline, weight and BMI decreased while waist circumference remained virtually unchanged. Adults aged 25–34 years at baseline showed the greatest increase in weight, BMI and waist circumference, compared to the other age groups (Barr, Cameron et al. 2005). However, these results may not accurately reflect prevalence changes in the overall population.

Self-report data was collected recently as part of the 2008 NSW Population Health Survey. Results indicated that 34.3% of the adult NSW population was considered to be overweight and 18.6 % to be obese. The estimated prevalence of overweight and obesity was higher in men (Centre for Epidemiology and Research 2009). Although the distribution of overweight and obesity across age groups followed a similar pattern when compared against data from the AusDiab study, these numbers are lower, as they rely on self reported height and weight (See Table 10).

Overweight and obesity by Area Health Services and rurality

Figure 11 shows illustrate the distribution of overweight and obesity across NSW Area Health Services in 2008. Whereas the highest estimate prevalence of overweight and obesity was reported in Greater Sydney (65.4%) and Greater Southern (59.9%), South Eastern Sydney and Illawarra (47.9%) and Northern Sydney and Central Coast (49.1%) showed the lowest estimate prevalence (Centre for Epidemiology and Research 2009).

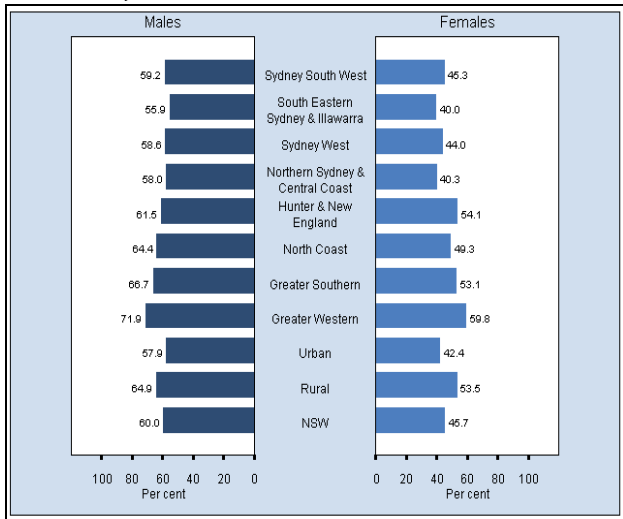
Adults living in a rural area had a higher prevalence of overweight and obesity (59.2%), compared to those living in a metropolitan area (50.1%). These findings are consistent with national data reported by the National Health Survey 2004-5, where the level of overweight and obesity in adults living in ‘inner regional’ areas (56%) and ‘outer regional’ (60%) was higher than those adults living in ‘metropolitan’ areas (52%) (ABS 2008a).

Table 10. Age-specific prevalence (%) of overweight and obesity among persons aged 16 years and over, NSW 2008

Weight Status by gender	Age group (years)						Total
	16-24	25-34	35-44	45-54	55-64	65+	
Overweight							
Men	29.5	41.0	45.1	45.9	42.1	47.7	42.0
Women	19.0	22.0	28.4	28.2	30.0	31.1	26.6
Obese							
Men	8.9	15.5	18.7	21.2	28.2	15.7	18.0
Women	8.4	15.4	18.1	23.9	27.8	21.5	19.1
Overweight + obese							
Men	38.4	56.5	63.8	67.1	70.3	63.4	60.0
Women	27.4	37.4	46.5	52.1	57.8	52.6	45.7

Source: (Centre for Epidemiology and Research 2009)

Figure 11. Overweight and obesity by area health service and rurality. Persons aged 16 years and over, NSW



Source: (Centre for Epidemiology and Research 2009)

Indigenous Australians

The 2004-05 National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) estimated that 29% of Aboriginal and Torres Strait Islander adults were overweight and a further 31% were obese based on self-reported height and weight (See Figure 12). It can be seen that rates were higher in older age groups, and Indigenous women were more likely to be obese

than men. After comparing the data from the NHS 2004-5 and the NATSIHS 2004-5, it was revealed that Indigenous Australians were 17% more likely to be overweight or obese than the rest of the Australian population (ABS 2008c)

Socially and economically disadvantage groups

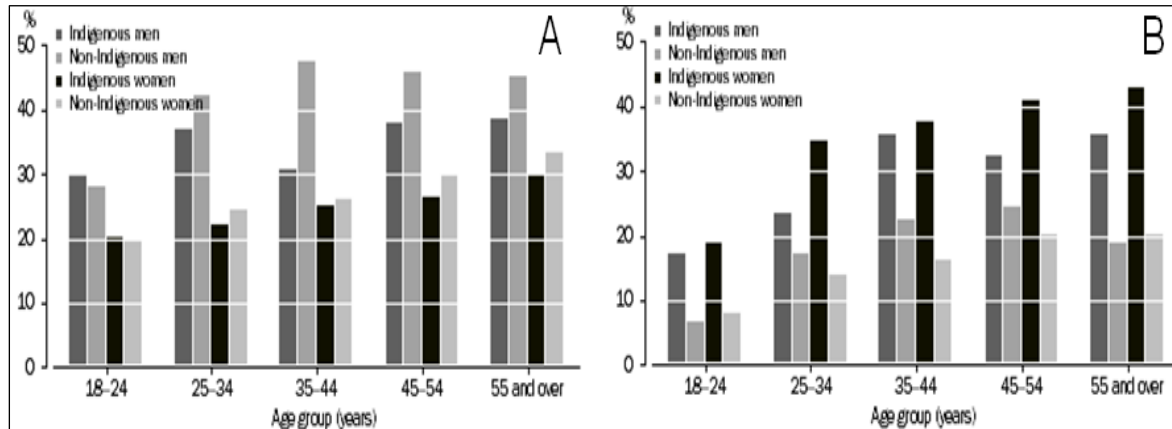
The Centre for Epidemiology and Research (2009) reported that the proportion of overweight or obese adults living in the most disadvantaged areas was 55.5% compared to 43.6% of adults living in the least disadvantage areas in NSW (See Table 11).

Table 11. Weight status of Australian adults by socioeconomic disadvantage persons aged 16 years and over, NSW, 2008

Index of disadvantage	BMI category		
	Normal (%)	Over-weight (%)	Obese (%)
First quintile	56.4	32.2	11.4
Fifth quintile	44.5	33.6	21.9
All persons aged 18 years and over	47.1	34.3	18.6

Source: (Centre for Epidemiology and Research 2009)

Figure 12. Overweight (A) and Obesity (B) rates in adults by Indigenous status, sex and age - 2004-05



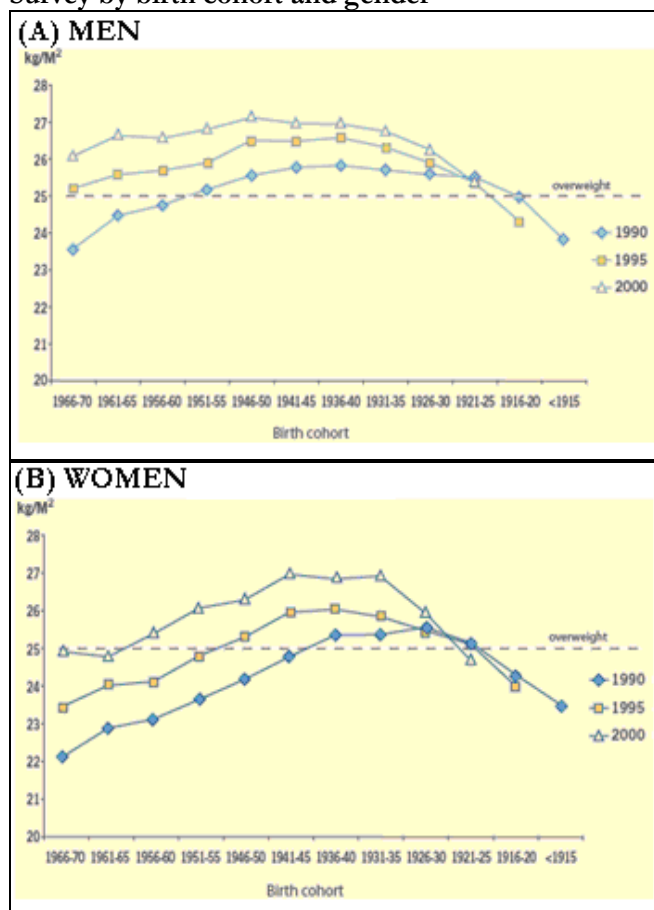
Source: (ABS 2008c)

Trends and change in time

Recent National Australian surveys show that prevalence of overweight and obesity has increased in the past decade for men and women of all age groups (Centre for Epidemiology and Research 2008). Additionally, different generations, known as well as 'birth cohorts', have had differential patterns of weight gain. Allman-Farinelli, M et al (2006) reported that younger generations of Australians, especially those born after 1980, are at a higher risk of becoming overweight and obese at a younger age as a result of multiple obesogenic factors present in the modern environment.

Figure 13 shows changes in average BMI for different birth cohorts of men and women over ten years, being those born between 1966-1970, the group who experienced the largest increase in BMI over this period of time.

Figure 13. Mean BMI at each National Health Survey by birth cohort and gender



Source: Adapted from (Allman-Farinelli, King et al. 2006)

Food and nutrition behaviours

Recent data from the National Health Survey 2004-5 (2008a) showed that only 10% of adults reported consuming the recommended amount of fruit or vegetables. Young adults tend to consume fewer amounts of fruits and vegetables compared to older adults, and men tend to consume less fruits than women. Interestingly, the AIHW (2008) found that people living in regional and remote areas were more likely to eat the recommended serves of vegetables and fruits per day.

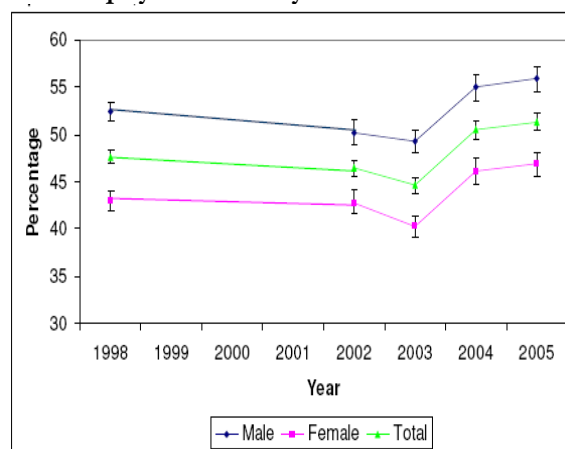
Rangan et al (2008) reported that in 1995 Australians adults were exceeding the recommended accepted limits for energy from consumption of 'extra' foods. When combined, 'non-core' foods and beverages contributed nearly two times (35.9%) to the recommended limit for total energy intake in adults. Young males were the highest consumers of 'extra' foods, and old women were the lowest.

Physical activity and sedentary behaviour

Evidence from the Active Australia Survey suggests that in NSW the prevalence of sufficient physical activity in adults has increased in recent years, due mainly to a larger participation in walking. Figure 14 shows an increased in the proportion of Australian adults doing sufficient physical activity over time (Chau, Smith et al. 2007).

The National Health Survey reported that in 2004-05, 70% of Australians aged 15 years and over were classified as sedentary or having low exercise levels; and that the proportions of sedentary behaviour have not changed much during the last decade (ABS 2006).

Figure 14. Proportion of Australian adults doing sufficient physical activity over time



Source: (Chau, Smith et al. 2007)

7.2 NSW Children and adolescent population

Prevalence of overweight and obesity in NSW

Measured data from the 2007 Australian National Children's Nutrition and Physical Activity Survey reported that 17% of boys and girls living in NSW were classified as overweight and 6% were obese. There was little difference overall in the prevalence of overweight or obesity between boys and girls, although girls aged 6-11 years were more likely to be overweight or obese than boys of the same age (28% compared with 17%) (Australia 2008). The AIHW (2009) published this data as part of the report *A Picture of Australia's children 2009*.

Trends and change in time

Information on the secular trends in weight status among NSW children is available from five population based surveys conducted between 1985 and 2007. A summary of the characteristics of each survey are provided in Table 12. Height and weight were measured in each survey; however it is important to note that there are differences across the surveys which can influence prevalence estimates of BMI.

Table 13 and Figure 15 show results for the five surveys mentioned above. The prevalence of overweight and obesity among NSW children doubled between 1985 and 2004. Data from the two surveys conducted in 2007 suggest there has been no significant increase in overweight and obesity,

however there are difference between the earlier surveys and the 2007 surveys. The GFK is not state-wide survey of children, rather comprises children in the Hunter New England area of NSW and the National PAN was not school based, rather children were selected by Random Digit Dialling of households.

Figure 15. Prevalence trend of overweight and obesity in children and adolescents living in NSW, comparison of different samples over time

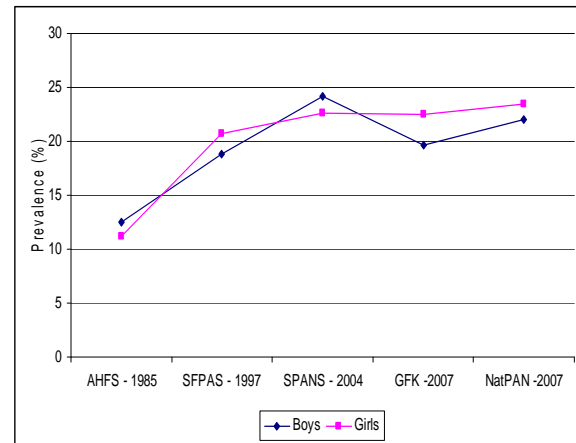


Table 12. Descriptive characteristics of surveys conducted among NSW children and adolescents

Survey Year	Sample size (i)	Age or class groups	Response rate Schools (ii)	Response rate Participants	Survey weighted (iii)	Survey methodology
AHFS 85 Australian Health & Fitness Survey						
1985	Nat: 8,484 NSW: N/A	Ages 7 to 15 years	90%	Nationally: 67.5 NSW: N/A	No	School based
SFPAS 97 NSW School Fitness & Physical Activity Survey						
1997	5,518	Years 2, 4, 6, 8, & 10	95%	Primary: > 91% Year 8: 85% Year 10: 76%	No	School based
SPANS 04 NSW Schools Physical Activity & Nutrition Survey						
2004	5,407	Kindergarten, Years 2, 4, 6, 8, & 10	Primary 78% High: 61%	Primary: 70% Year 8: 63% Year 10: 50%	No	School based
GFK 07 (regional) Good for Kids, Good for Life (Hunter New England area)						
2007	4,006	Preschool & long day care centre (2-5 yrs) Kindergarten, Years 2, 4, 6, 8, & 10	Primary 55% High: 47%	Child care: 63% Primary: 53% High: 37%	Yes	Preschool, School based
Nat PAN 07 Children's National Physical Activity & Nutrition Survey						
2007	Nat: 4,487 NSW: 1,203	Ages 2 to 16 years	N/A	Nationally: 40% NSW: N/A	Yes	Random Digit Dialling - CATI/CAPI

N/A = not applicable or not available

(i) Selection of children: With the exception of the Children's National Physical Activity & Nutrition Survey each school based survey used a two-staged proportional stratified random sample of NSW primary and secondary schools. The first stage involved the random selection of schools proportional to education sector and school size. The second stage of sampling consisted of the random of students either by age (AHFS) or school year group (SFPAS, SPANS, GFK). Only 2 surveys (GFK and Nat PAN) included preschool aged children (i.e., 2-5 year olds)

(ii) Response rates: Prevalence studies of behaviour/conditions require random selection from a representative sample of people in order to minimise potential non-response bias (i.e., characteristics of non-responders differ from characteristics of the responders). There is however growing evidence which suggests that a low response rate does not guarantee lower survey accuracy and instead simply indicates a risk of lower accuracy ((AAPOR) 2008).

(iii) Survey weighing: Surveys weights, to adjust for differences in the probabilities of selection among participants, are applied to only GFK and Nat PAN surveys.

Table 13. Prevalence trend of overweight and obesity in children and adolescents living in NSW, comparison of different samples over time

Weight Status by survey	Girls						TOTAL		Boys						TOTAL	
	< 5 yr olds		5-11 yrs olds		12-18 yr olds		n	%	< 5 yr olds		5-11 yrs olds		12-18 yr olds		n	%
	n	(%)	n	%	n	%			n	%	n	%	n	%		
ACHPER 85																
Healthy weight	n/a		736	85.5%	532	90.3%	1268	77.7%	n/a		758	86.8%	560	88.5%	1318	87.5%
Overweight	n/a		106	12.3%	51	8.7%	157	9.6%	n/a		95	10.9%	67	10.6%	162	10.8%
Obese	n/a		19	2.2%	6	1.0%	25	1.5%	n/a		20	2.3%	6	0.9%	26	1.7%
O + O			125	14.5%	57	9.7%	182	11.2%			115	13.2%	73	11.5%	188	12.5%
NSWSFPA 97	n/a															
Healthy weight	n/a		1208	77.4%	811	82.3%	2019	79.3%	n/a		1413	80.0%	966	83.0%	2379	81.2%
Overweight	n/a		257	16.5%	144	14.6%	401	15.8%	n/a		242	13.7%	160	13.7%	402	13.7%
Obese	n/a		95	6.1%	30	3.0%	125	4.9%	n/a		112	6.3%	38	3.3%	150	5.1%
O + O			352	22.6%	174	17.7%	526	20.7%			354	20.0%	198	17.0%	552	18.8%
NSW SPANS 04																
Healthy weight	55	79.7%	1329	76.0%	657	80.1%	2041	77.4%	38	79.2%	1325	76.9%	727	73.7%	2090	75.8%
Overweight	12	17.4%	300	17.2%	133	16.2%	445	16.9%	7	14.6%	279	16.2%	193	19.6%	479	17.4%
Obese	2	2.9%	119	6.8%	30	3.7%	151	5.7%	3	6.3%	120	7.0%	66	6.7%	189	6.9%
O + O	14	20.3%	419	24.0%	163	19.9%	596	22.6%	10	20.8%	399	23.1%	259	26.3%	668	24.2%
GFK 07 (regional)																
Healthy weight	281	81.9%	713	74.9%	483	79.1%	1477	77.5%	281	84.1%	745	80.7%	474	77.6%	1500	80.3%
Overweight	49	14.3%	180	18.9%	102	16.7%	331	17.4%	40	12.0%	117	12.7%	110	18.0%	267	14.3%
Obese	13	3.8%	59	6.2%	26	4.3%	98	5.1%	13	3.9%	61	6.6%	27	4.4%	101	5.4%
O + O	62	18.1%	239	25.1%	128	20.9%	429	22.5%	53	15.9%	178	19.3%	137	22.4%	368	19.7%
Nat PAN 07 (NSW sample)																
Healthy weight	143	80.8%	156	71.9%	146	78.1%	445	76.6%	145	78.8%	165	82.9%	161	72.9%	471	78.0%
Overweight	27	15.3%	46	21.2%	28	15.0%	101	17.4%	32	17.4%	22	11.1%	42	19.0%	96	15.9%
Obese	7	4.0%	15	6.9%	13	7.0%	35	6.0%	7	3.8%	12	6.0%	18	8.1%	37	6.1%
O + O	34	19.2%	61	28.1%	41	21.9%	136	23.4%	39	21.2%	34	17.1%	60	27.1%	133	22.0%
Nat PAN 07 (National sample)																
Healthy weight	577	82.0%	629	73.7%	608	74.4%	1814	76.4%	610	80.1%	662	80.2%	628	76.3%	1900	78.8%
Overweight	104	14.8%	163	19.1%	150	18.4%	417	17.6%	124	16.3%	112	13.6%	147	17.9%	383	15.9%
Obese	23	3.3%	61	7.2%	59	7.2%	143	6.0%	28	3.7%	51	6.2%	48	5.8%	127	5.3%
O + O	127	18.0%	224	26.3%	209	25.6%	560	23.6%	152	19.9%	163	19.8%	195	23.7%	510	21.2%

Food and nutrition behaviours

The SPANS 2004 survey reported that the majority of school children ate adequate amounts of fruit each day, but not enough serves of vegetables. Results showed that only 20% of children consumed the recommended four serves or more of vegetables (Booth, Okely et al. 2006).

Children and adolescents were also exceeding the recommended limits for energy from consumption of extra foods. 41% of total energy intake was obtained from ‘non-core’ foods and beverages (Rangan, Randall et al. 2008). This might be due to a high exposure to media advertising that promotes unhealthy food purchasing behaviour (Bell, Kremer et al. 2005).

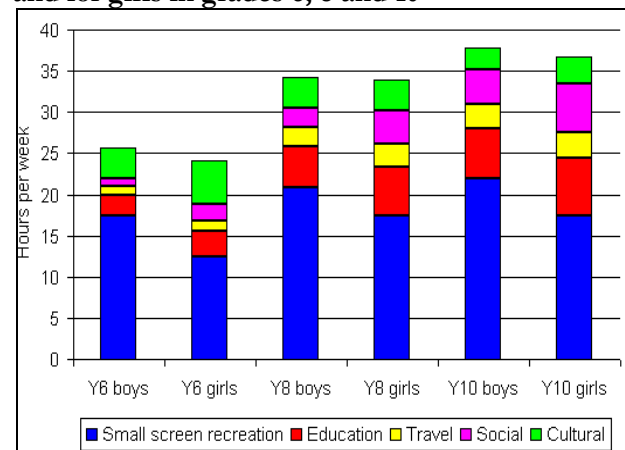
Physical activity and sedentary behaviour

SPANS 2004 data (2006) has also shown that physical activity has increased in school children over the period 1985 to 2004. Approximately 85% of boys and 72% of girls in Years 6, 8 and 10 participated in at least one hour of moderate-to-vigorous physical activity during summer school term. During winter school terms the prevalence of physical activity was lower in the same year groups (80% for boys, and 64% girls).

Booth et al (2006) reported that the median number of hours per week boys spent in sedentary behaviours were 38, compared to 27 hrs for girls. The time spent being sedentary increases with age; and more than half of all sedentary time was spent in small screen recreation (SSR).

Figure 17 shows the median hours per week spent in the different categories of sedentary behaviour for boys and girls in grades 6, 8 and 10. SSR was the most popular sedentary behaviour among students and accounted for approximately 60% and 54% of total time spent engaged in sedentary behaviours for primary and high school students, respectively (Hardy, Dobbins et al. 2006).

Figure 16. Median hours per week engaged in small screen recreation, educational, travel, cultural and social sedentary activities for boys and for girls in grades 6, 8 and 10



Source: (Hardy, Dobbins et al. 2006)

8. Discussion

A comprehensive approach to the monitoring of population weight status involves the measurement of a range of variables across age and gender population groups, and a considered approach to how the information is reported and interpreted.

While many of the issues involved are technical, there are nevertheless a range of perspectives and discussion points, particularly in relation to how information is presented and used, as well as the priority of surveys for resource allocation, which in turn influences the quality and scope of measures and regularity of surveys.

Monitoring versus screening

Systems for monitoring weight status at population level are primarily designed to gather information about a problem or issue in order to guide planning and track significant changes over time. This monitoring purpose differs from a screening system, which would seek to identify and treat at risk individuals. Debate regarding the extent to which systems for monitoring weight, especially children's weight status, can also be used for screening or case finding purposes has arisen through proposals whereby monitoring results are used to generate feedback at school or individual level. A systematic review on this question concluded that there may be risks in using a monitoring system to provide individual or school level feedback, and recommended against doing so in the absence of sound evidence that it is an effective and safe approach (Westwood et al. 2007). It is argued that labelling children according to weight status may promote stigmatization. On the other hand, the US state of Arkansas conducts a state-wide school measurement program that includes the use of a health report card which contains information on individual's BMI and a description of the risk category. This information is given to parents annually. Investigators support giving feedback to parents on the basis that it raised awareness and supported changes towards healthy lifestyles.

It is also relevant to distinguish monitoring from research, where monitoring is designed to track trends on identified variable that are known to be relevant; whereas research is designed to investigate new patterns between behaviours and generate new knowledge, sometimes in relation to specific groups. Research studies may thus focus on different target

groups, use different measures and report information in less routine ways.

Reporting formats

The two main approaches to population-level reporting that have been considered in this report comprise:

- reporting of data in relation to a specified threshold, usually related to a health recommendation;
- reporting on the distribution of responses, either in terms of a continuous or categorical variable.

These two formats provide differing information and thus suit different purposes. Reporting in relation to a threshold (e.g. proportion of adults eating the recommended number of serves of vegetables each day) provides data in the form of a single indicator. However, such an indicator may be less responsive to change than a continuous variable (e.g. median number of serves of vegetables eaten per day). The latter may thus be more appropriate as an indicator for setting objectives, planning and evaluation purposes.

Level of reporting

As illustrated in section 4 of the report, data from NSW shows that most of the variation in weight status and risk factor profiles are associated with age, gender, socio-demographic and cultural differences (particularly indigenous and cultural background), rather than geographic or administrative variables, such as Area Health Service boundaries.

Nevertheless, local, area or regional information is frequently sought in order to guide the planning of local programs and support program evaluation. Where sample sizes are sufficiently large, data can be usefully reported by AHSs. However it is particularly useful if the analyses can differentiate any variations over and above those based on demographic and socio-economic variables. In practice, the large population size of the AHSs within NSW means that there tends to be a high degree of variation within AHSs. These variations are masked by reporting data at an AHS level only, and sample sizes would rarely allow for more refined analyses of patterns within AHSs.

The NSW Health Population Health Surveys have a sampling frame and size that allows comparisons between AHSs, and data is routinely reported at this level. However, other surveys, such as the NSW

school-based surveys, have adopted a representative sampling frame that takes account of rurality and socio-economic status, but not AHS boundaries.

Quality of measures

Data collection using objective measures is labour-intensive, intrusive and expensive, and thus there is a high degree of reliance on self-report in relation to complex weight-related behaviours. Information on the quality of self report measures, such as validity and reliability, is important to guide interpretation of data.

As noted in section 3 in this report, the measurement of weight-related behaviours is difficult, as physical activity and eating are complex behaviours and cannot be accurately represented by a single indicator. There is ongoing research to develop measures that provide a simple indication of patterns of behaviour, such as short nutrition questions on specific food types. However, such indicators should be interpreted cautiously, and in many circumstances it is desirable to use a set of indicators. For example, an indicator of leisure-time physical activity (which only captures a small part of daily energy expenditure) could be supplemented by indicators related to use of active transport and work-related physical activity.

By incorporating an ongoing series of methodological sub-studies, a monitoring system can review and revise measures in ways that control and preserve comparability over time.

Monitoring of environmental factors

As discussed in section 5 of this report, an ideal monitoring approach recognizes the role of environmental factors in influencing behaviours and includes systems for tracking selected factors. However, population monitoring systems are typically based on measurements related to individuals, and there are no existing monitoring systems that cover weight-related environmental factors. Most information on environmental factors has been based on one-off research studies, which means that findings are generally not comparable, because there are a variety of different measurement methods. In NSW, there may be scope for identifying a short set of appropriate indicators and conducting regular audits in selected ('sentinel') locations. There is also some scope for including questions about individuals' home and local environments as part of individual-focussed surveys.

Coordination of national and state monitoring systems

As illustrated in this report, data on the health of the NSW population can be sourced from national and NSW monitoring surveys; and the current mix of national and state-based surveys derives from the specific informational requirements of the different jurisdictions. While national monitoring systems are unlikely to provide frequent or detailed data on NSW population groups, they add most value where they include detailed, objective measures, such as the data from the National Nutrition Survey 1995.

Recently there has been renewed attention on national monitoring surveys, although none of these involve commitment for an ongoing monitoring system, which could generate a repository of high quality data that would provide information on national trends. By contrast, there is currently some risk that there may be a spate of over-surveying in the short-term. This not only carries a high respondent burden, especially for schools and school children, but also some risk that differences in survey results may be exaggerated and misinterpreted, and undermines basic public health messages.

As an ongoing system, the NSW Population Health Survey provides a sound basis for monitoring population health status in general, and risks related to overweight and obesity specifically. It is anticipated that this survey system can continue to be refined, to reflect emerging health priorities and methodological developments, in order to provide good information for health service planning and research studies. The incorporation of supplementary modules, particularly methodological sub-studies will also continue to be valuable. Refer to Appendix 4 for suggested refinements for the NSW Population Health Survey.

However, the NSW Population Health Survey is an omnibus survey and not a comprehensive system for monitoring overweight and obesity, and thus cannot meet all information requirements. There will be ongoing requirements for additional surveys, including the continuation of regular school-based surveys of school students, as conducted in 1985, 1997, 2004 and proposed for 2010. These provide data on long-term trends and use anthropometric measures of height, weight and waist circumference. Similarly, there is value in continuing to investigate and report on patterns of physical activity and nutrition where possible using non-health surveys, such as ERASS, time use surveys and household expenditure surveys. Identifying significant

information gaps is important, and there may be circumstances where the option of initiating new surveys or studies at state level is deemed worthwhile. The importance of monitoring environmental factors is one example where this should be considered, and would involve the development of methods and a structured series of studies on food and physical activity environments, such as environmental audits in selected locations.

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Appendices

Appendix 1. Health Consequences associated with obesity

Table 14. Relative risk of health problems associated with obesity in Adults

Greatly increased (relative risk 2-3)	Moderately increased (relative risk 2-3)	Slightly increased (relative risk 1-2)
NIDDM	Coronary heart disease	Certain cancers (post-menopausal breast cancer, colon cancer)
Hypertension	Gallbladder disease	Reproductive hormone abnormalities
Sleep apnoea	Osteoarthritis (knees)	Polycystic ovary syndrome
Insulin resistance	Hyperuricaemia and gout	Impaired fertility
Breathlessness	Dyslipidemia	Low back pain due to obesity
	Endometrial cancer	Increased anaesthetic risk
		Foetal defects associated with maternal obesity

Source: (NSW Health 2003)

Table 15. Health consequences of obesity in children and adolescents

Pulmonary	
Sleep apnoea	Asthma
Pickwickian syndrome	
Orthopaedic	
Slipped capital epiphyses	Blount's disease (tibia vara)
Tibial torsion	Flat feet
Ankle sprains	Increased risk of fractures
Neurological	
Idiopathic intracranial hypertension (e.g. pseudotumour cerebri)	
Gastroenterological	
Cholelithiasis	Liver steatosis / non-alcoholic fatty liver
Gastro-oesophageal reflux	
Endocrine	
Insulin resistance/impaired glucose tolerance	Type 2 diabetes
Menstrual abnormalities	Polycystic ovary syndrome
Hypercorticism	Inappropriate fast growth and development
Cardiovascular	
Hypertension	Dyslipidemia
Fatty streaks	Left ventricular hypertrophy
Other	
Systemic inflammation/raised C-reactive protein	
Persistence in Adulthood	
Psychosocial problems	

Adapted from (WHO 2000; Lobstein, Baur et al. 2004)

Appendix 2: List of related Australian surveys of weight status and related behaviours

Date	Survey	Method	Target Group/Sample Frame	Range of measures/ indicators	Reporting /level of analysis
CHILDREN					
1985	Australian Health and Fitness Survey	School-based	Australian school children aged 7-15 years (n = 2930)	Weight/height, waist, FMS; Fitness, biomarkers measured. Tobacco smoking, physical activity, mental health and wellbeing	Full report, stratified by sex and age
Continuous since 1996	NSW Population Health Survey	CATI	NSW Child population <=16 yrs	SR height/weight; short questions physical activity, nutrition	
2004	NSW Schools Physical Activity and Nutrition Survey (SPANS)	School-based	NSW school students K,2,4,6,8,10	Weight/height, waist, FMS; Fitness, biomarkers measured. Short questions on nutrition, eating patterns, physical activity (APAQ), ASAQ; school environment.	Full reports State level analysis
2002 AND 2005	NSW School Students Health Behaviours Survey (SSHBS) [data collected for incorporation into Australian Secondary School Student Alcohol and Drug Survey (ASSAD)]	School-based, self-administered questionnaire	All NSW secondary school students in Yrs 7-12 enrolled in school in the period Feb to Jun 2008.	Tobacco smoking, alcohol drinking, substance use, sun protection, eating habits, physical activity, injury, mental health and wellbeing.	Annual CHO; other reports; AHS level
2003	Child and Adolescent	School-based	Western Australian children and	Height, weight, waist girth; Physical activity	Full report; technical reports on physical activity and nutrition

Premier's Physical Activity Taskforce (PATF), Healthway and the Department of Health, Western Australia	Physical Activity and Nutrition Survey (CAPANS)		adolescents (n=2275); primary school years 3, 5, 7 (aged 7-12 yrs), high school years 8, 10, 11 (aged 13-16 yrs).	questionnaire, pedometers + pedometer diary; Food record + food frequency questionnaire	
2003/ 2004 – every 2 years	Growing up in Australia: Longitudinal Survey of Australian children (LSAC)	Household; Teacher	Australian children. Dual cohorts: infant cohort born 2003 (n=5,107); child cohort born 1999 (n=4,983)	Height/weight; Short nutrition questions; small screen activities at home PE at school	Annual reports; discussion papers; data reported for different waves of survey
2004-2006	Children Living in Active Neighbourhoods (CLAN)	School-based	Melbourne children aged 5-6 and 10-12 yrs (n=486) and their families	Detailed information about local neighbourhoods (e.g. presence of parks and playgrounds, road networks, presence of cycling tracks), using GIS and audit instruments. Relationship between family environment and children's activity	Scientific publications and reports
2006	Healthy kids Queensland survey	School-based	Queensland school students, grades 1,5,10 (n=3691); aged 5-17 yrs	Height/weight, weight circumference; FF; 24-hour food records; PA short questions; pedometer; active transport	State level analysis.
2007	Children's nutrition and physical activity survey	Household (CAPI) + CATI	Australian children 2-16 years N= 4,487	Weight/height, waist; food intakes, pedometers, physical activity (MARCA)	Data will be weighted to take into account age, sex, and school sector and will account for differences in selection probabilities as well as adjusting for non-response at the school and student level. The data

					will then be used to produce descriptive reports where summary results are shown by certain demographic characteristics such as school sector, age sex, socioeconomic status. The data will also be used in multivariate analysis to examine associations between health parameters such as health status and risk factors.
2009	Cancer Council survey	Web-based, school-based	Nationally representative, approx. 20,000 secondary school students, Yrs 8-11 from over 200 schools. Stratified two-stage probability sample, school selected first, then class groups selected withing schools. 3 school sectors – Govt, Catholic, Independent	Food intake, dietary habits, physical activity, sedentary behaviours, barriers and enablers of physical activity, school food and activity environment; height, weight and waist circumference.	National and state level reports
ADULTS					
(1988, 2000)	The Dubbo Study Prospective longitudinal community study of health in elderly.	Clinic-based medical examination plus survey administered by a trained interviewer. Follow-up surveillance for 5 years initially.	All non-institutionalised men and women aged 60 yrs (born before 1 Jan, 1930) and over living in Dubbo; identified from records of 21 G.P. in Dubbo area and electoral roll. Baseline n=1693 men, 2167 women	Anthropometric measurements, resting blood pressure, heart rate, cholesterol, triglycerides, calcium, glucose concentrations. Life satisfaction, social support, depression, self-esteem, medical history, physical activity, self-rated health,	Scientific papers

		Phase 2 began in 2000.		functional health. Admission and discharge data from local hospitals and Dubbo Nursing Home. Death records monitored.	
(1999-2000, 2004-2005)	AUSDIAB	Population-based, physical examination, interviewer-administered questionnaires.	Australian general population aged 25 yrs or older; 42 randomly selected urban and rural areas based on census collector districts in six states and NT. ACT was included as an additional site in the follow-up to accommodate participants who moved there since baseline.	Blood sampling (cholesterol, high-density lipoprotein cholesterol (HDL-C), triglycerides, plasma glucose), oral glucose tolerance test, urine sample (test for urine creatinine); height, weight, BMI, waist circumference, blood pressure. Previous diagnosis of diabetes and CVD, physical activity, smoking	Baseline and follow-up reports
(1996, 1998, 2001, 2004, 2007)	Women's Health Australia. The Australian longitudinal study on women's health.	Individual surveys sent in mail every 3 years to each age cohort	Australian women (18-23, 45-50, 70-75 yrs) randomly selected from Medicare database in April 1996. N>40,000 responded to Survey 1 in 1996. Actual numbers enrolled in longitudinal study: n=14,247 Younger women (18-23 yrs), n=13,716 Mid-age	Physical activity (vig, mod, walk, work-related, leisure-time), sedentary behaviours, weight, height, desired weight, dieting behaviour, weight/shape dissatisfaction, fruit & veg consumption, alcohol consumption	Annual report, technical reports, 10-yr achievement report, topic-based reports

			<p>women (45-50 yrs), n=12,432 Older women (70-75).</p> <p>Response rate among Younger women at Survey 2 in 2000 (69%), Survey 3 in 2003 (65%), Survey 4 in 2006 (67%).</p> <p>Response rate among Mid-age women at Survey 2 in 1998 (91%), Survey 3 in 2001 (84%), Survey 4 in 2004, Survey 5 in 2007.</p> <p>Response rate among Older women at Survey 2 in 1999 (91%), Survey 3 in 2002 (85%) and Survey 4 in 2005 (84%).</p>		
Since 2006, ongoing until fulfil target sample size	45 and up	Individual surveys sent by post, follow up every 5 years	Target sample size of 250,000 men and women aged 45 yrs and over from the general population of NSW, randomly sampled from Medicare database; over sampling of those aged over 80 yrs	Height, weight, BMI, smoking, alcohol consumption, fruit & veg consumption, other dietary information, physical activity, medical history (e.g., high blood pressure, diabetes, cancer)	Scientific publications and reports

Appendix 3. Measurement protocols for weight and height, waist and hip circumferences, adapted from (WHO 1995)

1) Direct Measurements

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, e.g. 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.

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.

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

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

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

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

Waist 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

Hip circumference

- use a flexible but inelastic (non-stretchable) graduated tape measure
- the subject should wear light clothing with non-restrictive 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

Appendix 4.

Suggested refinements for NSW Population Health Survey

- Inclusion of short questions on SSR in Child Health Survey
- Inclusion of short questions on sitting time in Adult Health Survey
- Routine reporting of adult data by age sub-groups
- Detailed geo-mapping of selected data items, in order to investigate links with environmental features
- Inclusion of selected questions on health literacy
- Inclusion of selected home food availability assessment questions used by Campbell et al

Suggested supplementary studies

- Methodological study to investigate the potential for monitoring children's physical activity using pedometers, where this includes comparisons with other measures
- Study on a sub-sample of adults to collect anthropometric measures
- Detailed nutrition surveys on large sub-samples of adults and children
- Methodological study to develop short questions on sitting time in adults
- Study on a sub-sample of adults to provide detailed data on food consumption patterns
- Methodological work to develop a short set of questions on health literacy