

# Getting it Right

■ How to use the data from the **1995 National Nutrition Survey**



Commonwealth Department of  
Health and  
Aged Care



**Getting it right:-**  
**how to use the data from the**  
**1995 National Nutrition Survey**

Prepared by  
Ingrid HE Rutishauser

Australian Food and Nutrition Monitoring Unit

This publication is a National Food and Nutrition Monitoring and Surveillance Project,  
funded by the Commonwealth Department of Health and Aged Care

This publication is one in a series of reports to be released from the National Food and Nutrition Monitoring and Surveillance Project, Funded by the Commonwealth Department of Health and Aged Care

' Commonwealth of Australia 2000

This work is copyright. It may be reproduced in whole or in part for study or training purposes subject to the inclusion of an acknowledgment of the source and no commercial usage or sale. Reproduction for purposes other than those indicated above, require the prior written permission from the Commonwealth available from AusInfo. Requests and inquiries concerning reproduction and rights should be addressed to the Manager, Legislative Services, AusInfo, GPO Box 1920, Canberra ACT 2601.

# Contents

Contents .....	i
List of Figures .....	iii
List of Tables .....	iii
Abbreviations .....	iv
Overview .....	v
Purpose .....	v
Scope .....	v
Outline .....	v
1. Glossary .....	1
2. Dietary methods used in the 1995 NNS .....	4
2.1 Introduction .....	4
2.2 24-hour recall .....	4
2.3 Food frequency .....	6
2.4 Food-related questions .....	7
3. Explanatory notes on published NNS tables .....	9
3.1 Introduction .....	9
3.2 Eating patterns .....	9
3.2.1 Eating location .....	10
3.2.2 Food habits .....	11
3.2.3 Meal patterns .....	12
3.2.4 Money to buy food .....	13
3.3 Food intake .....	14
3.3.1 Intake of major food groups .....	15
3.3.2 Intake of sub-major food groups .....	16
3.3.2.1 Mean intake .....	17
3.3.2.2 Median intake .....	17
3.4 Nutrient intake .....	19
3.4.1 Nutrient intake by population sub-group .....	20
3.4.1.1 Why both mean and median tables? .....	21
3.4.2 Food sources of nutrients .....	23
3.4.3 Distribution data for adjusted nutrient intakes .....	24
4. Factors which need to be considered in using the data .....	25
4.1 Introduction .....	25
4.2 Effect of sampling .....	25
4.2.1 Survey weights .....	25
4.2.2 Relative standard error .....	26
4.3 Self-reported dietary data .....	27
4.4 Nutrient derivation .....	28
4.5 Adjustment for within-person variation .....	29
5. Use of data to fulfill survey objectives .....	31
5.1 Introduction .....	31
5.2 Monitoring intakes against Dietary Guidelines .....	31

5.3 Comparing nutrient intakes with the RDIs .....	33
5.3.1 Underestimation of self-reported intakes .....	33
5.3.2 Definition of an RDI .....	34
5.3.3 Not all RDIs are equal .....	34
5.3.4 RDIs relate to ‘usual’ intake .....	35
5.3.5 Fixed cut-off or probability comparisons .....	36
5.4 Comparison of data from the 1995 NNS with other national surveys .....	37
5.5 Development of food regulations and policy .....	39
5.6 Associations between dietary data and data from the NHS .....	39
6. References .....	41

## List of Figures

Figure 2.1 Effect of multiple days of observations on the apparent distribution of nutrient intake (Hegsted, 1972) .....	6
Figure 3.1 Examples of one-day intake distributions for selected nutrients (DCSH, 1987) .....	22
Figure 4.1 Comparison of one-day and adjusted (usual intake) distribution for protein (NRC, 1986) .....	30
Figure 5.1 Application of an empirical approach to assessment of the adequacy of protein intake in adult men (Beaton, 1994) .....	37
Figure 5.2 Application of probability approach to assessment of the adequacy of iron intake in adult women (Beaton, 1994) .....	37

## List of Tables

Table 2.1 Characteristics of the dietary data obtained in the 1995 NNS .....	5
Table 2.2 Food-related questions used in previous national surveys .....	8
Table 3.1 Major food groups used in the 1995 and the 1983/85 dietary surveys .....	15
Table 3.2 Number of individuals actually surveyed in the 1995 NNS by age by sex .....	16
Table 3.3 Comparison of mean and median portion weights, 1995 .....	18
Table 4.1 Activity level expressed as a multiple of basal metabolic rate (NHMRC, 1991) .....	27
Table 5.1 Percent of persons aged 19 years and over reporting specified food habits in the 1995 NNS (ABS unpublished data) .....	31
Table 5.2 Mean fruit intake in grams per 24 hour calculated from 24-hour recall data tabulated by short question response category, gender and age .....	32
Table 5.3 Mean vegetable intake in grams per 24 hour calculated from 24-hour recall data tabulated by short question response category, gender and age .....	33
Table 5.4 Observed and adjusted distributions for folate intake in women of childbearing age .....	35
Table 5.5 Methodological differences, between the 1995 NNS and earlier surveys conducted in 1983 and 1985, likely to influence data comparisons .....	38

## Abbreviations

ABS Australian Bureau of Statistics  
ADG Australian Dietary Guidelines  
ANSURS Australian Nutrition Survey System  
ANZFA Australian and New Zealand Food Authority  
BMI Body mass index  
BMR Basal metabolic rate  
CDH Commonwealth Department of Health  
COFA Composition of Foods Australia  
CURF Confidentialised unit record file  
DHFS Department of Health and Family Services  
EAR Estimated average requirement  
EI/BMR Energy intake/basal metabolic rate ratio  
FFQ Food frequency questionnaire  
HFS Health and Family Services  
IEFS Institute of European Food Studies  
IFIQ Individual food intake questionnaire  
LRNI Lower reference nutrient intake  
NDSA National Dietary Survey of Adults  
NDSS National Dietary Survey of Schoolchildren  
NHF National Heart Foundation  
NHFRFPS National Foundation Risk Factor Prevalence Surveys  
NHMRC National Health and Medical Research Council  
NHS National Health Survey  
NNS National Nutrition Survey  
NSW New South Wales  
NT Northern Territory  
PAL Physical activity level  
QLD Queensland  
RDI Recommended dietary intake  
RNI Reference nutrient intake  
RPS Recipe processing system  
RSE Relative standard error  
SA South Australia  
SE Standard error  
SEIFA Socioeconomic indices for areas  
TAS Tasmania  
VIC Victoria  
WA Western Australia

## Overview

### Purpose

This publication provides information on where to find, and how to use, the dietary information available from the 1995 National Nutrition Survey. It is intended not only as a guide for nutritionists and dietitians, but also for others who may wish to use the information from the 1995 NNS in the course of their work but are not familiar with the details of the survey or with the characteristics of dietary data.

The purpose of this publication is to provide a concise guide to the nature, limitations and appropriate interpretation and applications of the dietary data available from the 1995 National Nutrition Survey (NNS).

*Getting it Right* is not a replacement for the *National Nutrition Survey Users' Guide* (Cat No 4801.0) (ABS, 1998a) or the *Information Paper National Nutrition Survey, Confidentialised Unit Record File 1995* (Cat No 4807.0) (ABS, 1998b). The publication is intended to be used in conjunction with the ABS documentation and, where appropriate, with other information about the conduct of the NNS produced by the then Department of Health and Family Services (DHFS, 1995) and by the Australian and New Zealand Food Authority (ANZFA, 1989) on the methods used to collect, code and assign nutrient values to the food intake data obtained in the NNS.

### Scope

The guide covers all the dietary data potentially available from the NNS. These include the data available in the 1995 NNS Confidentialised Unit Record File (CURF) produced by the Australian Bureau of Statistics in July 1998 and that described in the survey publications released to date (ABS, 1997, 1998c and 1999). The published reports from the NNS, produced jointly by the ABS and the then Commonwealth Department of Health and Family Services, can be obtained through ABS and AGPS bookshops located in each State and Territory or by mail order from the ABS National Mail Order Service, PO Box 10, Belconnen, ACT 2616 (02 6252 5249). Information about the process for applying for a public use CURF can be obtained from: The Director, Library Services, Australian Bureau of Statistics, Unit 5, Ground floor, Cameron Offices, Chandler Street, Belconnen ACT 2616. Phone: (02) 6252 6610 Fax: (02) 6252 6906 e-mail: [library@abs.gov.au](mailto:library@abs.gov.au)

### Outline

The guide is divided into six sections. The first section consists of a comprehensive glossary of terms relevant to the dietary data in the NNS. Terms related to non-dietary data have also been included where these relate to, or are necessary for, the interpretation of the dietary data. The Australian Food and Nutrition Monitoring Unit gratefully acknowledges permission from the Director, Health Section, Australian Bureau of Statistics to reprint glossary material originally prepared for the joint ABS/DHFS publications from the NNS. The glossary will primarily be useful to readers who do not already have access to the NNS publications or to the CURF.

The second section of this guide describes the different types of dietary data available from the NNS and the various attributes of the data that influence interpretation and use of the data. It is not intended as an introduction to dietary methodology for non-nutritionists but simply sets out the scope and limitations of the dietary data available from the NNS. Relevant references are included for readers who require more information on dietary methodology.

The third section of the guide is devoted to an explanation of the derivation, content and interpretation of the dietary data tabulations in the NNS publications (ABS, 1997, 1998c and 1999). The purpose of this section is twofold. Firstly by describing in detail the full range of published information already available from the NNS it provides both a basis for, and a useful guide to, possible further analysis. Secondly the material provided in this section allows users of the published tables to check that they have not only accessed the relevant table but also interpreted the data appropriately.

The fourth section of the guide deals with methodological issues directly relevant to interpretation of the food and nutrient intake from the 1995 NNS 24-hour recall data. These include issues related to sampling; use of the ratio of energy intake to basal metabolic rate (EI/BMR) as a guide to the level of under-reporting and the approach used to derive, from one-day intake data, approximations to the distribution of usual nutrient intake for population sub-groups. This section is essential reading for all users of the dietary data from the NNS.

Section 5 deals with specific applications of the data from the 1995 NNS. In particular those relating to the stated survey objectives. These include:

- monitoring intakes against Dietary Guidelines for Australians;
- comparing nutrient intakes with RDIs; assessing changes in dietary habits and nutrient intakes since 1983 and 1985;
- providing information for developing and food policy and food regulations;
- monitoring nutrition related health goals and targets; and
- providing information on the interrelationships between, health, social, economic and nutrition variables.

Also covered in section five are issues relating to the comparability of dietary data between nutrition surveys such as sampling strategy, timing, data-collection procedures and secular changes in the food supply and in the nutrient composition database.

The guide concludes with a list of useful publications and relevant articles from the scientific literature.

# 1. Glossary

The text of glossary items in this section is re-printed from existing publications produced by the Australian Bureau of Statistics (ABS, 1997; 1998a, 1998c and 1999) with permission from the Director of the Health Section of the Australian Bureau of Statistics.

**ANSURS** The Australian Nutrition Survey System is an automated food coding system used for entering food and beverage intake data from the 24-hour recall.

**Basal metabolic rate** BMR is the amount of energy expended at rest over a given period of time. BMR has been predicted for National Nutrition Survey participants aged 10 years and over from their weight, age and sex (see appendix 4 in Cat No 4805.0). BMR has been expressed as megajoules per 24 hours.

**Body mass index** Based on height and weight as measured by the interviewer. Body mass index (BMI) is body weight in kilograms divided by the square of height in metres ( $\text{kg}/\text{m}^2$ ). The groups used are those recommended by the World Health Organisation (1995).

---

#### BODY MASS INDEX

---

Underweight or thinness:	<18.5
Normal or acceptable weight range(a)	18.5-<20
	20-<25
Overweight	25-<30
Obesity	$\geq 30$

(a) The normal or acceptable range has been split to enable comparison with NHMRC categories.

---

The measuring scales only measured weights up to 140 kilograms. People over this weight have been classified as obese.

**Combination foods** Combination foods are those where two or more components are combined, usually just prior to consumption, and eaten as a single unit eg bread and butter. Each item of the combination has a separate food record on the CURF but all items in a given combination have a common value in the combination sequence number field.

**Eating occasion** Each food or beverage reported in the 24-hour recall is assigned to an eating occasion. This information is not available for plain drinking water. Participants selected the name of the eating occasion from a list provided by the interviewer. The list contained the following options:

- breakfast;
- lunch and brunch;
- dinner; and
- other (this included food and/or beverage break, supper, other extended consumption, not stated and don't know).

Energy intake to BMR ratio (EI/BMR)	The ratio of energy intake over a 24-hour period to BMR predicted on the basis of weight, age and sex. This ratio provides an estimate of the level of physical activity and has also been used to develop cut-off limits for implausibly low intakes.
Estimation procedure	Estimates from the survey were derived using a complex estimation (weighting) procedure which ensures that survey estimates conform to independent population estimates of the Australian population for the third quarter of 1995. Specifically the estimates conform to Australian age by sex estimates and Australian State by part of State estimates.
Food Codebook Database	This database was part of ANSURS. The Food Codebook Database contained information used to code the type and amount of each food/beverage that was reported in the 24-hour recall.
Food codes	<p>Foods and beverages consumed in the 24-hour dietary recall were allocated eight-digit codes to uniquely identify each food. The first four digits can be used to categorise foods and beverages into a hierarchical classification system. This classification has been published in the <i>National Nutrition Survey Users' Guide</i> Cat No 4801.0. Digits five to seven are simply unique identifiers and the last digit indicates whether the food is a modifiable recipe (value of '2') or a single item food/unmodifiable recipe (value of '1').</p> <p>There are two fields that indicate the food code. Most food records contain an 8-digit code in the field FOODCOD1. However modified recipes have a 6-digit code in FOODCOD1 and the 8-digit code of the base recipe in FOODCOD2. For most purposes the 8-digit code of the modified recipes is suitable for categorising foods, as the recipe modifications while altering nutrient composition did not alter the nature of the food/beverage.</p>
Food frequency questionnaire	This was used to collect information on usual intake of selected foods and vitamin/mineral supplements. Respondents aged 12 years and over were asked to complete this qualitative questionnaire, which collected usual frequency of consumption of 107 food items and 11 vitamin and mineral supplements over the past 12 months.
Food groups	<p>Foods and beverages reported in the 24-hour recall can be categorised to varying levels of detail. This classification was based on those used in the 1983 dietary survey of adults, with modifications done in consultation with experts.</p> <p>The major food groups are similar to those used in the National dietary survey of adults: 1983 and the National dietary survey of schoolchildren (aged 10-15 years): 1985. However, there are differences in the classification systems between the surveys.</p>
Individual food intake questionnaire (IFIQ)	Individual food intake questionnaire, also referred to as the 24-hour recall. See 24-hour recall.
Major food group	The broadest level of output data on food consumption available from the National Nutrition Survey. See appendix 2 in <i>National Nutrition Survey Foods Eaten</i> (Cat No 4804.0) for more details.
Mean	The estimated value consumed by the population on average.

Median	The estimated value at which half the population consumed more and half the population consumed less.
Part of state	Capital city is the capital city statistical division for each state/territory. Rest of the state is the remaining areas in each state/territory. For some states and territories, the rest of state definition differs on the CURF.
Prompt card	A card used to assist respondents to understand concepts and definitions relating to specific survey questions.
Recipe Database	This database was part of ANSURS. It stored information about the ingredients of recipe foods and was used by the recipe processing system in ANSURS to calculate nutrient values for recipe foods, taking into account changes in moisture, vitamins and minerals as a result of cooking.
Recipe foods	Recipe foods consist of several ingredients mixed/cooked together (eg chocolate cake or macaroni cheese). Within ANSURS, the term 'recipe' refers specifically to foods which consist of other foods in the Food Codebook Database and which consequently can have their recipe modified during coding to take account of specific types of ingredients, such as the kind of fat used.
Relative standard error	The standard error of an estimate expressed as a percentage of the estimate. The relative standard error is a useful measure in that it provides an immediate indication of the percentage errors likely to have occurred due to sampling, and thus avoids the need to refer also to the size of the estimate.
Standard error	A measure of the variability that may occur by chance in values derived from a survey because a sample rather than an entire population is surveyed. There are about 2 chances in 3 that a sample estimate will differ by less than one standard error from the figure that would have been obtained if a full census had been conducted, and about 19 chances in 20 that the difference will be less than 2 standard errors from the true population value.
Sample count	Number of survey respondents.
Sub-major food group	The second and lower level of the output data on food consumption available from the National Nutrition Survey. See appendix 2 in <i>National Nutrition Survey Foods Eaten</i> (Cat No 4804.0) for more details.

## 2. Dietary methods used in the 1995 NNS

### 2.1 Introduction

The diet-related information available from the NNS includes three different types of data:

- a quantitative 24-hour recall of all food and beverages consumed (for all participants);
- the average frequency (but not quantity) of consumption of 107 different types of foods and eleven vitamin and mineral supplements in the 12 months prior to the NNS (for respondents aged 12 years and over); and
- short questions about usual diet and meal patterns including questions on; practices relating to the use of fruits, vegetables, milk, fats, salt and trimming of fat from meat; desired changes and barriers to change in intake of fruits and vegetables, breads and cereals and food high in fat and a question about enough money to buy food.

The questions relating to usual type of diet, meal patterns and salt use were asked of all respondents. Questions relating to usual intake of fruits and vegetables, type of milk, type of fat and trimming of meat were asked of respondents aged 12 years and over and the questions relating to desired changes in food intake and money for food were only asked of respondents aged 16 years and over.

These three types of dietary information differ in a number of respects that are important in relation to their interpretation and use. This section gives a brief description of the procedure used to collect each type of data (including relevant references where available) and the specific attributes of the data that influence their interpretation and use. Readers requiring a general introduction to dietary methodology may find it helpful to consult either Mackerras (1991) or the chapters on dietary methodology in Gibson (1990).

### 2.2 24-hour recall

The 24-hour recall data constitute the primary source of dietary data available from the NNS. They are available for all respondents and provide quantitative information on food and beverage intake from the NNS.

The 24-hour recall data were obtained by means of a face-to-face interview, with the respondent or an appropriate proxy, in the respondent's home. The interview was conducted by a nutritionist/dietitian specifically trained in the details of the 24-hour recall procedure used for the NNS. The sequence of interview questions and prompts used was adapted, with permission from the Agricultural Research Service of USDA, from the interview procedure developed by the USDA for the Continuing Survey of Food Intakes by Individuals 1994-96 in the USA.

The interview procedure used for the 1995 NNS recall is described in detail on pages 13-16 of the *National Nutrition Survey Users' Guide* (Cat No 4801.0) (ABS, 1998a). A current review of the 24-hour recall procedure and its strengths and limitations is provided by Buzzard (1998).

**Table 2.1 Characteristics of the dietary data obtained in the 1995 NNS**

Specific attributes	Type of dietary data		
	24-hour recall	Food frequency	Food-related questions
Source	Respondent or surrogate	Respondent	Respondent
Context	Face to face interview	Self-completed questionnaire	Face to face interview
Time-frame	Previous 24-hours	Previous 12 months	Unspecified - often 'typical' or 'usual'
Nature of data	Quantitative	Semi-quantitative	Qualitative
- type	Continuous	Categorical	Categorical
- scale	Interval	Ordinal	Ordinal and nominal
Can provide information on:	Intake of specific foods Intake of food constituents Food combinations eaten together Meal patterns Methods of food preparation Source of foods eaten Place where foods eaten Time when foods eaten	Frequency of use of: - individual foods - groups of foods - vitamin and mineral supplements	Food habits Beliefs Attitudes
Face validity check	EI/BMR	24-hour data by category	24-hour data by category

From table 2.1 it is evident that 24-hour-recall data provide both a range of different kinds of information about food and nutrient intake as well as quantitative data on food and nutrient intake. The major limitations of 24-hour-recall data stem from the fact that these data rely on self-reporting and relate only to a single period of 24 hours for each individual.

The fact that self-reports of food intake are dependent on the ability of respondents to describe accurately the types and amounts of foods consumed is widely recognised. The ability of individuals to provide accurate reports has, however, been difficult to quantify in practice particularly in the context of national surveys.

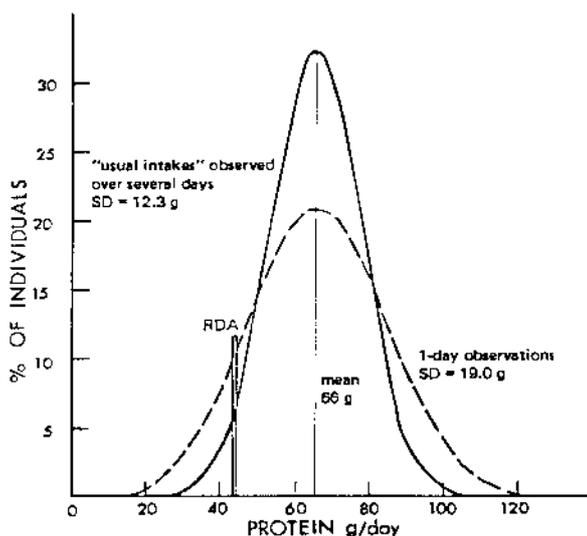
The application of the doubly-labelled-water method (Black, 1993) to the assessment of energy intake in free-living human individuals, however, has now made it possible, at least, to estimate the extent to which self-reported energy intake is likely to be in error. While the cost of the doubly-labelled-water method precludes its use in large surveys it is nevertheless possible, on the basis of the general principles of energy physiology, to make some assessment of the extent to which the food intake data obtained for a group of individuals of any given age and sex are likely to reflect the group's usual level of energy expenditure (Black, 1991) by relating energy intake to basal metabolic rate. The use of this ratio is discussed further in section 4.

The second major limitation of 24-hour recall data is that it cannot be used to describe the 'usual' average intake of individuals but only the 'usual' average intake of groups. The former requires sufficient information on each individual to be able to describe the intake that is characteristic for each individual over a period of time. The latter, however, only requires that the individuals sampled are representative of the relevant population group with respect to any characteristics likely to affect intake.

Relevant characteristics include not only demographic factors such as age, sex, ethnicity, socio-economic status and geographic location, but also time-related variables such as day of the week and season. These factors, were taken into account in the sampling strategy used for the selection of the NNS sample.

It should be noted, however, that while the mean or median intake of a single 24-hour recall from an appropriately sampled group can provide a reliable estimate of the average 'usual' intake of the group, the distribution of 24-hour intakes does not represent the distribution of the 'usual' intakes of the individual members of the group. Figure 2.1 provides an example of the difference in distribution of intakes for the same group when based on a single 24-hour recall and when based on average intake over several days. The way in which this limitation of the 24-hour recall data was addressed in the NNS is described in section 4.

**Figure 2.1 Effect of multiple days of observations on the apparent distribution of nutrient intake (Hegsted, 1972)**



### 2.3 Food frequency

Because a single 24-hour recall cannot be used to characterise the intake of individuals the NNS included a food frequency questionnaire. The purpose of this questionnaire was to provide semi-quantitative information on the usual frequency of intake of a wide range of foods by individuals. The questionnaire used for the NNS was compiled from questionnaires previously used in Australia (Baghurst, 1981; Ireland 1994) but is not directly comparable with any previous questionnaire.

In their simplest form food frequency questionnaires (FFQ) consist of a list of foods and/or groups of similar foods and a range of frequency responses usually ranging from 'rarely or never' to 'six or more times per day'. This is the format adopted in the NNS FFQ. The time period to which the frequency responses relate can vary from as little as a month to a year or longer. In the NNS the reference period used was the last 12 months to try to ensure that seasonal foods were covered irrespective of the time the questionnaire was completed.

The NNS FFQ did not include standard serving sizes or reference portions except for bread and some fruit. For bread and some fruits the frequency represents the number of standard portions consumed. For all other foods the frequency response represents the number of times the food was consumed. As a consequence it is not possible to use the responses to the FFQ, to estimate how much food individuals consumed without making assumptions about the average size of portion consumed. One possible approach is to use the data from the 24-hour recall to derive average portion weights for each of the foods listed on the FFQ and to use this information in conjunction with the frequency data to derive estimates of 'usual' intake.

While the information required from the respondent in a FFQ is less detailed than in a 24-hour recall the task nevertheless requires adequate long-term memory and the ability to average information over time and from different contexts eg foods eaten separately and as major components of mixed dishes. Sempos (1992) considers that the task of completing a FFQ is considerably more complex for the respondent than a 24-hour recall and it is not unlikely that some people completing the NNS FFQ had difficulty in recalling their frequency of intake for all foods on the FFQ and averaging it over a period of 12 months.

The primary purpose of FFQs is to provide information that reflects longer-term food-use in individuals but it is clearly difficult to establish how well in fact they do this. Correlations with other dietary methods usually range only between 0.3 and 0.7 (Kaaks, 1997; Willett, 1998). Comparison of food intake data, for the same people, obtained with a FFQ and from 12 days of weighed food intake records covering the same 12 month period (Wheeler 1995), found that the variability between individuals was greater with the FFQ data than for mean intake over 12 days. This would not be expected (figure 2.1) unless the FFQ data are subject to errors different from those associated with the weighed intake data. In absolute terms, however, the FFQ gave higher median intakes for energy and nutrients both for men and women and suggested that FFQ data may be less influenced, than the weighed intake data, by the tendency for subjects to under-report intake.

Because most of the FFQ data from the 1995 NNS provide information only on how often, and not on how much, food was eaten it is not possible to use the FFQ data to derive nutrient intakes without making assumptions about the quantity of food associated with each unit of frequency. As a consequence it is to be expected that any results obtained for nutrient intakes obtained in this way will depend to a considerable extent on the specific assumptions that are made. The principal use of the NNS FFQ data is likely to be for the purpose of categorising individuals into groups according to their longer-term intake of different types of foods for food regulatory purposes or in order to look at relationships with demographic characteristics, indices of health-status and food patterns (Baghurst, 1999).

## **2.4 Food-related questions**

The main purpose of the short food-related questions in the NNS was to provide information on food habits relevant to the Australian Dietary Guidelines (eg salting of food, trimming of meat, type of milk and spreading fat used and barriers to changing intake of fruits, vegetables, cereals and fatty foods), on meal patterns and on where food is obtained and eaten.

With a few exceptions the food-related questions were specifically developed for the NNS and had not been used in previous surveys.

The main exceptions are questions which were used previously, although not always in exactly the same format (table 2.2), in National Heart Foundation Risk Factor Prevalence Surveys conducted in 1980, 1983 and 1989 (NHF, 1982, 1985 and 1990) or in the 1985 National Dietary Survey of Schoolchildren (DCSH, 1988 and 1989).

**Table 2.2 Food-related questions used in previous national surveys**

Survey	Question
<b>Addition of salt:</b> NHFRFPS 1980	Do you add salt to your food after it is cooked? (not at all, sometimes, only after tasting, always)
NHFRFPS 1983 and 1989	Do you add salt to your food after it is cooked? (rarely or never, sometimes, almost always or always)
1995 NNS	How often do you add salt to your food after it is cooked. Is it never or rarely, sometimes or usually?
<b>Usual type of diet:</b> 1980 NHRFPS	Are you on a fat modified diet to control blood fat? Are you on a diet to control your weight? Are you on any other special diet?
1983 and 1989 NHFRFPS	Which of the following best describes your usual way of eating? (no special diet, vegetarian, weight reduction diet, diabetic diet, fat modified diet to lower blood fat, other)
1995 NNS	Which one of the following best describes your usual way of eating? (no special way of eating, vegetarian, weight reduction diet, fat modified diet to lower blood fat (cholesterol), other)
<b>Trimming of fat from meat:</b> 1980 and 1989 NHFRFPS	How often do you eat the fat on meat? (usually, sometimes, rarely or never)
1995 NNS	How often is the meat you eat trimmed of fat either before or after cooking? (never/ rarely, sometimes, usually, don't eat meat)
<b>Type of milk used:</b> 1980 and 1989 NHFRFPS	How much of the following dairy products do you usually have in a week? (full-cream milk, skim milk, low-fat milk)
1995 NNS	What type of milk do you usually consume? (whole, low/reduced-fat, skim, evaporated or sweetened condensed, none of the above, don't know)
<b>Breakfast:</b> 1985 NDSS	Do you usually eat something before starting school? (usually means four or more times a week)
1995 NNS	How many days a week do you usually have something to eat for breakfast (rarely or never, 1 to 2 days, 3 to 4 days, 5 or more days, don't know/varies/depends)

The responses to these questions, for which the format and the response categories have remained essentially the same between surveys, can be used for comparisons between the 1995 NNS and the earlier NHFRFPS after taking into account differences in survey design which could affect the outcome (eg demographic and geographic distribution and season).

The remaining food-related questions in the NNS cannot, at this point in time, be used to look at trends over time. However, it is possible to obtain some useful information about the performance of at least some of these questions by comparing the responses with the more detailed data available from the 24-hour recall and the FFQ. For example the response categories to questions such as:

*How many serves of vegetables do you usually eat each day? (a 'serve' = ° cup cooked vegetables or 1 cup of salad vegetables); and*

*How many serves of fruit do you usually eat each day? (a 'serve' = 1 medium piece or two small pieces of fruit or 1 cup of diced pieces)*

can be compared with the sum of the frequency responses for vegetables and fruit obtained from the FFQ and with the more detailed food intake data available from the 24-hour recall to see how well the short questions reflect differences in intake.

## 3. Explanatory notes on published NNS tables

### 3.1 Introduction

The purpose of this section of the guide is to provide a brief description of the published data and, where applicable, information on how the values have been derived. Data from the published tables have been included in this section primarily to enable readers to check that they are looking at the correct table and interpreting its content appropriately. In this guide the published tables have been grouped by type of dietary information (eating patterns, food intake and nutrient intake) and where appropriate in alphabetical order of the topic covered by the table or series of tables.

To assist with location of individual tables the catalogue number of the ABS publication in which the table is to be found and its number within that publication are given for each table described. The references tables are from the three publications *National Nutrition Survey Selected Highlights Australia 1995* (Cat No 4802.0), *National Nutrition Survey Foods Eaten Australia 1995* (Cat No 4804.0) and *National Nutrition Survey Nutrient Intakes and Physical Measurements Australia 1995* (Cat No 4805.0).

All values in the published tables are population estimates derived from the sample survey data, by standard ABS procedures, to represent as closely as possible the distribution of the Australian population in 1995 with regard to age, sex and geographic location by part of State.

These estimates, like all data derived from sample surveys, are subject to sampling error. When this sampling error is considered to be large enough to warrant caution in using a value it is preceded in the table by one or more asterisks. One asterisk indicates that the standard error (SE) of a value, expressed as a percentage of the value or as a relative standard error, is between 25 and 50% and two asterisks that it is greater than 50%.

In practical terms estimates preceded by asterisks are simply less reliable, than those not preceded by asterisks. For example for a table value with an RSE of 50% there is a two in three chance that the *true population value* lies within the range given by the estimated value  $\pm 50\%$  whereas if the RSE is only 5% there is a two in three chance that it lies within the much narrower range of the estimated value  $\pm 5\%$ .

### 3.2 Eating patterns

Nine tables from the 1995 NNS provide information on eating patterns. All of these tables are to be found in the publication *National Nutrition Survey Selected Highlights, Australia 1995* (Cat No 4802.0) (ABS, 1997).

### 3.2.1 Eating location

Three tables provide information on food eaten at home and away from home:

*Table 12 Persons: Where food and beverages consumed by age and sex;*  
*Table 13 Total energy intake (kJ): Proportion of energy by eating location by age by sex; and*  
*Table 14 Contribution of fat to energy intake: Eating location by age by sex.*

The data in all three tables are derived from the 24-hour-recall component of the individual food intake questionnaire that was completed by all NNS respondents (see section A in appendix 3 of 4801.0 for details). The data in the tables are grouped by:

Gender: males, females and all persons

Age in years: 2-3 4-7, 8-11, 12-15, 16-18 19-24, 25-44, 45-64, 65 and over, 19 and over.

For each age by sex group three values are given in each table. The first relates to food consumed at home, the second to food consumed away from home but obtained from home (eg packed lunch) and the third to food consumed away from home and obtained away from home (eg restaurant, canteen or take-away meals).

The values in table 12 represent the percentage of people in each age by sex group who consumed some food/beverages in each of these situations in the 24 hours prior to the interview. With the exception of 19-24 year-olds more than 95% of all other age groups ate some food at home and between 55 and 75% of all age groups, except those aged 65 years and over, ate some food away from home that had not been brought from home.

The values in table 13 represent the percentage of the 24-hour energy intake (kJ) which was eaten at home and away from home. Table 13 shows that for all age/sex groups more than half of the 24-hour energy intake (55 to 88%) was consumed at home while between 10 and 38% of the 24-hour energy intake was eaten and obtained outside the home.

The values in table 14 represent the percentage of the 24-hour energy intake that was derived from fat in food eaten at home and in food eaten away from home. The values were derived by estimating the energy provided by total fat consumed (37 kJ/g) as a percentage of the total energy consumed in each eating situation. The percentage of energy derived from fat in all food eaten in the 24-hour period is also given for each age by sex group. This value is in bold type and erroneously labelled total fat from energy in the published table.

Table 14 shows that food eaten and obtained away from home tended to contain a higher percentage of energy from fat (eg 36.1% for females aged 19 years and over) than food eaten away from home but brought from home (eg 28.5% for females aged 19 years and over). Despite this obvious difference, the percentage of energy intake from fat in food eaten at home and from all food consumed during the 24-hour period, however, differed by less than 1% for all age by sex groups because most food was eaten at home.

### 3.2.2 Food habits

Two tables provide information on food habits:

*Table 11 Persons: Self-reported type of diet by age and sex; and  
Table 18 Persons aged 16 years and over: Desired change in amount of  
selected foods consumed by age and sex.*

The data in both tables are derived from the Food-related questions component of the NNS (see section C in appendix 3 of 4801.0 for details). Not all of these questions were considered appropriate for all respondents. For example questions on desired changes in food intake were not asked of children aged 15 years or under.

Table 11 provides information on respondents' answers to the question:

*Which one of the following - best describes your usual way of eating?*

The values given in the table represent the percentage of each age by sex group whose response could be coded to one of the pre-coded options listed on the prompt card used in association with this question (ie *no special way of eating, vegetarian, weight reduction diet, diabetic diet, fat modified diet to lower blood fat (cholesterol) and other*).

The data in table 11 are grouped as follows:

Gender: males, females and all persons

Age in years: 2-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over.

Over 9% of children and about 35% of those aged 19 years and over reported that their usual way of eating involved a special diet. The type of diet most commonly reported by those aged 45 years and over was a fat-modified diet (>20%), while for younger individuals it was a diet 'other' than one of those listed on the prompt card.

Table 18 provides information on respondents' answers to the question:

*Would you like to change the amount you eat of any of these foods?* ('these foods' referred in turn to breads and cereals, fruit and vegetables and foods high in fat). Individuals who responded yes to any of these options were then asked a further question relevant to the group of foods in question eg *.....would you like to eat more or less of this group?*

The data in table 18 are grouped by:

Gender: males and females

Age in years: 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over.

Three separate values are given in the table for each age by sex group. These are the percentage of persons in the group not desiring to change the amount consumed, the percentage who want to eat more, and the percentage who want to eat less of the foods in question.

Table 18 shows that, on average, less than 10% of the population aged 19 years and over wanted to increase their intake of bread and cereals while around 30% wanted to increase their intake of fruits and vegetables and about 25% to decrease their intake of high fat foods. The proportion wanting to make any of these changes was highest for those aged 19-24 years.

### 3.2.3 Meal patterns

Three tables provide information on meal patterns.

*Table 15 Eating occasion by broad food groups by age by sex;*  
*Table 16 Persons: Number of times food is usually consumed per day by age and sex;*  
and  
*Table 17 persons: Number of times per week usually has breakfast.*

The data in table 15 are derived directly from the 24-hour recall interview whereas the data in tables 16 and 17 are derived from the food-related questions component of the NNS (see section C in appendix 3 of 4801.0 for details).

Table 15 sub-divides the NNS respondents into two sub-groups; those for whom the survey day was a weekday (10,541) and those for whom the survey day was a weekend day (3,317).

For each of these two sub-groups, the values in the table represent the percentage of each age by sex group who, at each of the following eating occasions (breakfast, brunch/lunch, dinner and other) consumed some food/beverage from each of the eleven major food groups listed. For each food reported in the 24-hour recall interview all respondents were asked to select from a prompt card one of the following names to describe the eating occasion (breakfast, brunch, food and/or beverage break such as morning tea, afternoon tea, snack, lunch, dinner, supper or other). For each of the four eating occasions listed in the table the percentage of the group who consumed any food/beverage at that eating occasion is also shown in bold type.

The data in table 15 are grouped as follows:

Day of survey: Monday-Friday, Saturday and Sunday

Gender: male and female

Age in years: 2-11, 12-18, 19-24, 25-64, 65 and over.

Table 15 shows that on weekdays breakfast was consumed by 95% or more of children (aged 2-11 years) and adults aged 65 and over but by only 76% of 19-24 year-olds at the weekend. Brunch/lunch was also consumed on weekdays by over 90% of children (aged 2-11 years) and those aged 65 years and over but at the weekend by only 70% of females aged 19-24 years. With two exceptions, both at the weekend (dinner - males aged 65 and over and other meals - females aged 19-24 years), more than 90% of all age by sex groups consumed some food/beverage at dinner and at 'other' eating occasions.

Table 16 provides information on respondents' answers to the question:

*Including snacks how many times do you usually have something to eat in a day including evenings?*

Each response was coded to one of the following pre-defined categories: once, two to four times, five to six times, seven or more times and don't know/varies/depends. The values in the table represent the percentage of each by sex group whose response could be coded to one of the four specified frequency categories. The final line in bold type includes all responses including don't know/varies/depends.

The data in both tables 16 and 17 are grouped by:

Gender: males, females and all persons

Age in years: 2-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over.

More than 75% of children and adolescents aged 12-15 years, but only 45% or less of those aged 25 years and over, reported usually eating five or more times per day. About one percent of those aged 25-64 usually reported eating only once per day.

Table 17 provides information on respondents' answers to the question:

*How many days per week do you usually have something to eat for breakfast?*

Each response was coded to one of the following pre-defined categories: rarely or never, 1 to 2 days, 3 to 4 days, 5 or more days, and don't know/varies/depends. The values in the table represent the percentage of each age by sex group whose response could be coded to one of the four specified frequency categories. The final line in bold type includes all responses including don't know/varies/depends.

Over 90% of children and 95% of those aged 65 years and over, but less than 60% of males aged 19-24 years, usually ate breakfast on five or more days per week. Almost 15% of those aged 19-24 years rarely or never ate breakfast.

### **3.2.4 Money to buy food**

Table 19 provides data which contributes to estimates of 'food insecurity' (Radimer, 1992).

*Table 19 - Persons aged 16 years and over: Whether ran out of food and had no money to buy more by age by sex*

The data in table 19 are derived from a single question asked of individuals aged 16 years and over as part of the food-related questions component of the NNS (see section C in appendix 3 of 4801.0 for details).

Table 19 specifically provides information on respondents' answers to the question:

*In the last 12 months were there any times that you ran out of food and you couldn't afford to buy more?*

Three values are given in the table. The values represent the percentage of respondents who had, at some time during the last 12 months, run out of food and had no money to buy more; the percentage who had not run out of food at any time during the last 12 months and the percentage who did not respond to the question.

The data in table 19 are grouped by:

Gender: males, females and all persons

Age in years: 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over.

Table 19 shows that in general age trends for this question were similar for both males and females. The age group who most frequently reported having run out of food at some time during the last 12 months was the group aged 19-24 years (9.9%) while only 1.1% of those aged 65 years and over had done so. Demographic and 24-hour recall data from the NNS can provide additional information on individuals who gave a positive response to this question but not on why respondents had run out of food.

### 3.3 Food intake

There are four tables on food intake in *National Nutrition Survey Selected Highlights, Australia 1995* (Cat No 4802.0) (ABS, 1997) and 21 additional tables on food intake in *National Nutrition Survey Foods Eaten, Australia 1995* (Cat No 4804.0) (ABS, 1999). All the data in these tables are derived directly from the 24-hour recall interview and therefore available for all NNS respondents. The four tables in 4802.0 all provide information on food intake at the major food group level whereas those in 4804.0 provide more detailed information on food intake at the sub-major food group level.

The major food groups used in the 1995 NNS are similar, but not all directly comparable with those used in the *1983 National Dietary Survey of Adults* and the *1985 National Dietary Survey of Schoolchildren*. The main differences are shown in table 3.1. In most, but not all, cases the differences arise because a group used in 1983/85 was divided into two groups for the 1995 NNS eg cereals and cereal products.

**Table 3.1 Major food groups used in the 1995 and the 1983/85 dietary surveys**

1995 NNS	1983/1985 Dietary Surveys	1983/85 differences from 1995
Cereals and cereal products	Cereal and cereal products	Included cereal-based products and dishes
Cereal-based products and dishes		
Fruit products and dishes	Fruits	Excluded fruit dishes containing cereal
Vegetable products and dishes	Vegetables	Excluded vegetable dishes containing cereal Included legumes and legume products
Legumes and pulse products and dishes		
Milk products and dishes	Milk and milk products	Excluded milk substitutes eg soy
Meat, poultry and game products and dishes	Meat and meat products	
Fish and seafood products and dishes	Fish, seafood and products	
Egg products and dishes	Eggs	
Snack foods	Snack foods	
Sugar products and dishes	Sugars, jams, honey, syrups	
Confectionery	Confectionery	
Seed and seed products and dishes	Nuts and seeds	
Fats and oils	Fats	
Soup		
Savoury sauces and condiments	Condiments, flavourings, soups	Included soups, beverage flavourings and yeast and meat extracts
Infant formulae and foods		
Special dietary foods		
Miscellaneous	Miscellaneous	Excluded beverage flavourings and yeast and meat extracts
Non-alcoholic beverages	Non-alcoholic beverages	Excluded plain drinking water
Alcoholic beverages	Alcoholic beverages	

### 3.3.1 Intake of major food groups

The four tables in 4802.0 that provide information on food intake at the major food group level are:

*Table 1 Persons: Proportion who consumed from major food groups by age by sex;*  
*Table 2 Mean daily food intake (g): amount consumed from major food groups by age by sex;*  
*Table 3 Mean daily food intake for persons aged 19 years and over (g): major food groups by State by sex; and*  
*Table 4 Mean daily food intake for persons aged 19 years and over (g): major food groups by part of State by sex.*

The values in table 1 represent the percentage of persons who consumed some food/beverage from the major food groups listed in the table and those in table 2 the mean intake of each major food group expressed as grams per head per 24 hours. The values in both tables are grouped by:

Gender: males and females

Age in years: 2-3, 4-7, 8-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over

**Table 3.2 Number of individuals actually surveyed in the 1995 NNS by age by sex**

Age group (years)	Sample count (number)	
	Males	Females
2-3	170	213
4-7	415	384
8-11	385	354
12-15	349	304
16-18	215	218
19-24	485	575
25-44	2140	2385
45-64	1554	1752
65 and over	902	1058

The final line in table 1 (labelled total persons) represents the estimated population in each age by sex sub-group in Australia in 1995 and not the number of people actually surveyed which is referred to in all ABS NNS publications as the sample count. The sample count for all the age by sex groups shown in table 1 is given above (table 3.2) to illustrate why it is not feasible to sub-divide age by sex groups during childhood and adolescence by characteristics such as geographic location, season and day of the week.

Sample counts for the population sub-groups relevant to other food intake tables (State, rural, remote and metropolitan areas, part of State, region of birth, SEIFA quintile of relative socio-economic disadvantage, day of week and season) are given in appendix 1 of Cat No 4804.0.

Table 1 shows that the only major food groups consumed by 85% or more of all age by sex groups were cereals and cereal products, milk products and dishes and non-alcoholic beverages. Other major food groups consumed by at least 50% of all age sex groups were cereal-based products, vegetables and legumes, meat and poultry, sugar products and dishes and fats and oils.

Table 2 shows that the mean 24 hour intake of food and beverages ranged from just under 2kg in 2-3 year-olds to over 4kg in males aged 19-44 years of age. Except in children, for whom milk and dairy products contributed 15-30% of total intake by weight, non-alcoholic beverages accounted for around 50% of the total intake.

Table 3 shows similar data on food intake for adult males and females by State and table 4 mean food intake for adult males, females and all persons by Capital city and rest of State. While there are differences by geographic location these are generally much smaller than those observed between younger and older adults.

### 3.3.2 Intake of sub-major food groups

Details of the foods included in the 106 sub-major food groups used in the 1995 NNS are given in appendix 2 of *National Nutrition Survey Foods Eaten Australia 1995* (Cat No 4804.0) and appendix 1 of *National Nutrition Survey Users' Guide* (Cat No 4801.0) provides additional information about the foods within each of the sub-major food groups.

The 21 tables in *National Nutrition Survey Foods Eaten Australia 1995* provide information on food intake for all major and for selected sub-major food groups for adult males, females and all persons by age (tables 1-3). The remaining tables provide information only for adults aged 19 years and over grouped by State and Territory

(tables 4-6), by geographic region (tables 7-9), by region of birth (tables 10-12), by quintile of the index of relative socio-economic disadvantage (tables 13-15), by day of week (tables 16-18) and by season of the year (tables 19-21). Note that while in all these tables intake is described as 'daily' intake all the data relate to only one day for each individual and it is more appropriate to think of the data as intake 'over a period of 24 hours' ie per day.

### **3.3.2.1 Mean intake**

Each group of three tables has the same structure. The first table in each set provides information on mean intake for the relevant population sub-groups expressed in grams per day per person, the second table provides information on the median intake of consumers in the group expressed in grams per day per consumer and the third table provides information on the percentage of the group who consumed the relevant foods in the 24 hours prior to the survey.

Information on mean daily intake is provided in tables 1, 4, 7, 10, 13, 16 and 19. This information is primarily useful for making comparisons of food intake between groups since the mean for a group provides a reliable, although not necessarily valid, estimate of the average 'usual' intake in a group.

The mean tends to be the statistic most commonly used to describe food intake in groups, even though it may not always be the most appropriate measure, because values for mean intake of individual foods can be aggregated.

For example, for cereals and cereal products it is possible to sum the mean values for the three breakfast cereal sub-groups (breakfast cereals plain single source, breakfast cereals mixed sources and breakfast cereal hot porridge type) to obtain a value for the mean intake of all types of breakfast cereals. It is also possible to obtain the values for the mean intake of sub-major food groups not shown separately in the tables, by deducting the sum for all listed sub-major groups from the mean value for the relevant major food group.

In all the food intake tables the values in '*italics*' represent mean intake for the major food groups and include all foods in the major food group and not simply those in the sub-major categories shown in the table.

### **3.3.2.2 Median intake**

Information on median daily intake is provided in tables 2, 5, 8, 11, 14, 17 and 20. The tables of median intake, unlike the tables of mean intake which average values over both consumers and non-consumers, show the median intake of consumers only. That is the median values represent the median or middle value of observed intakes only for those individuals who actually consumed one or more foods from the food groups shown in the table.

The main value of these tables is in providing information on the actual level of intake of different types of foods. Unlike the values in the mean intake tables median intake values cannot be aggregated over food groups because the consumers in each major and sub-major food group are not always the same individuals. Median, rather than mean, intake was calculated for consumers because the intake distribution for most foods is skewed

upwards. Notable exceptions are evident for intake of vegetables and vegetable products (relatively unskewed) and for some less commonly consumed foods such as legumes, fish, eggs and snack foods (downward skew). The degree of skewness is reflected in the magnitude of the difference between the mean and the median.

For the purpose of comparisons, either of different types of foods eaten by consumers or of the same types of foods eaten by consumers in different population sub-groups, it is generally more useful to be able to compare the amount eaten by at least 50% of consumers (median intake) than to compare the average or mean intake of consumers. Mean values, are influenced to a greater extent than medians by the distribution of individual intake values and these distributions tend to vary considerably from food to food. Table 3.3 illustrates the difference between mean and median portion weights in grams for some commonly consumed foods based on data from the *1995 National Nutrition Survey*. For the foods shown the ratio of mean to median ranges from over 2 for milk to around 1.1 for potatoes.

**Table 3.3 Comparison of mean and median portion weights, 1995**

Food	Number of observations	10 centile (g)	Mean (g)	Median (g)	90 centile (g)
Milk	32445	5	95	41	258
Bread	19238	27	64	62	112
Beef & veal	2646	26	103	81	202
Potatoes	5323	40	132	119	244

Although not released in the published ABS tables, it is possible from the CURF to calculate centiles other than the median eg the 90 centile of intake for consumers (refer table 3.3). Such values are of particular interest to regulatory agencies for assessing maximum and minimum likely exposure limits, for specific substances in foods, for different types of foods and in different population sub-groups.

Information on the proportion of persons consuming specified foods is provided in tables 3, 6, 9, 12, 15, 18 and 21. The main purpose of these tables is to show the variation in the proportion of people consuming specific foods. Values range from close to 100% for non-alcoholic beverages for all population sub-groups to less than 10% for legume and pulse products and dishes in the majority of population sub-groups.

As with the tables which relate to the median food intake of consumers individual percentages for food groups cannot be summed to give the percentage for the relevant food group since not all consumers will have eaten foods from all sub - groups within a food group.

It is common to find one or two asterisks preceding at least some values in each of the food intake tables. These asterisks draw attention to values which have particularly large sampling errors as described earlier in this guide (see section 3.1, page 9) because they are based on a small number of observations.

Users of the data should note that the sampling errors associated with most values in the food intake tables are generally higher than those for other data in the NNS publications and vary between food groups because not all respondents contributed information for each food. Information on the relative standard errors (RSE) for mean intake of the major food groups is provided in appendix T2, for median intake of the major food groups in appendix T3 and for the mean intake of the sub-major food groups in appendix T4 of *National Nutrition Survey Foods Eaten Australia 1995* (Cat No 4804.0).

These appendices clearly illustrate the effect of sample size on the RSE. Users should note that these appendices show the RSEs for population estimates of the number of persons and not for sample counts (see table 3.2, page 16). Note that the RSEs are smaller for the mean estimates than for the median estimates for the same food group.

For example for a published value based on an estimated population of 50,000 persons the RSE for mean intake of non-alcoholic beverages is 9.0% (T2 on page 119 of Cat No 4804.0) while for median intake it is 11.5% (T3 on page 121 of Cat No 4804.0). Similarly for a given population size the RSEs vary between food groups. For example for a value based on an estimated population of 50,000 persons the RSE for median intake of cereals and cereal products is 17.9% but 31.5% for legume and pulse products (T3 on page 120 of Cat No 4804.0). These differences in the RSEs reflect differences in the distribution characteristics of the food intake data for different types of foods.

### 3.4 Nutrient intake

There are five tables on energy and nutrient intake and on intake of vitamin and mineral supplements in *National Nutrition Survey Selected Highlights Australia 1995* (Cat No 4802.0) and 89 tables relating to nutrient intake in *National Nutrition Survey Nutrient Intakes and Physical Measurements, Australia 1995* (Cat No 4805.0) (ABS, 1998).

The tables on nutrient intake include in 4802.0 are:

*Table 5 Total energy intake (kJ): Proportion obtained from major food groups by age by sex;*  
*Table 6 Mean daily energy and nutrient intake: Age by sex; and*  
*Table 9 Mean percent contribution to energy intake: Protein, fat, carbohydrate and alcohol by age by sex*

The data in all nutrient intake tables are derived from the 24-hour recall component of the individual food intake questionnaire (IFIQ) which was completed by all NNS respondents (see section A in appendix 3 of 4801.0 for details). The data in tables 5, 6 and 9 are grouped by:

Gender: males and females and all persons (table 9 only)

Age in years: 2-3, 4-7, 8-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over

Table 5 provides information by age and sex on the total energy intake in kJ and the proportion of total energy intake derived from each of the major food groups. Only four of the major food groups - cereals and cereal products, cereal-based products and dishes, milk products and dishes and meat and meat products - each contribute on average 10% or more of total energy intake for the majority of age by sex groups.

Tables 6 and 9 provide information on average energy and nutrient intake (table 6) and on the percentage of energy intake (table 9) contributed by each of the macronutrients. Energy intakes show a twofold range from just over 6MJ per day in 2-3 year-old females to 13.5MJ per day in 16-18 year-old males. The range of observed intakes for macronutrients is generally similar to that for energy but for micronutrients the observed range of intakes tends to be less than the twofold range observed for energy in the same age by sex groups.

*Table 7 Mean daily energy and nutrient intake: Persons aged 19 years and over by State by sex;*

*Table 8 Mean daily energy and nutrient intake: Persons aged 19 years and over by part of State by sex; and*

*Table 10 persons aged 19 years and over: vitamin and mineral supplements taken the day before the interview by age by sex.*

Tables 7 and 8 provide information on energy and nutrient intake categorised by State and part of State for adults aged 19 years and over. The differences in energy and nutrient intake by State and part of State are relatively small compared to those observed with age and sex. For example in adult men the largest difference in mean energy intakes is between Tasmania (10.7MJ) and WA (11.5MJ) and in women between Tasmania (7.0MJ) and the ACT (8.3 MJ). A clue to the reason for the largest differences being observed between the States/Territories with the smallest populations is that the sampling errors for these States are higher. The effect of sampling on the reliability of the published estimates is discussed further in section 4.2.

Table 10 provides information on the percentage of adults aged 19 years and over who took one or more vitamin and/or mineral supplements (multivitamins, multivitamins with iron, vitamin A, vitamin B, vitamin C, vitamin E,  $\beta$ -carotene, calcium folic acid, iron and multivitamins with zinc). Table 10 also provides information on the percentage of adults who did not take any vitamin or mineral supplements on the day prior to the interview. Note that the second line of values in table 10 labelled multivitamins with iron should read multivitamins with zinc.

Table 10 shows that a higher percentage of adult women than men took supplements and that the proportion who had taken a supplement on the previous day increased with age; from 13% of males aged 19-24 years to 19% of males aged 65 years and over and from 21% at 19-24 years to 33% at 45-64 years in females.

The 89 nutrient intake tables in 4805.0 are divided into three groups. The first group (tables 1-36) provides information on macro- and micro-nutrient intake for a range of population sub-groups. For each population sub-group covered by the tables there are separate tables for males and females and for mean and median nutrient intake.

### **3.4.1 Nutrient intake by population sub-group**

The most comprehensive set of tables is that for nutrient intake by age group. The eight tables in this set, from 4805.0, include:

*Table 1 Mean daily energy, moisture and macronutrient intake;*

*Table 2 Median daily energy, moisture and macronutrient intake;*

*Table 3 Mean contribution of macronutrients to energy intake;*

*Table 4 Median contribution of macronutrients to energy intake;*

*Table 5 Mean daily vitamin and mineral intake;*

*Table 6 Median daily vitamin and mineral intake;*

*Table 7 Mean daily intake of dietary fibre, vitamins and minerals per 1000kJ energy; and*

*Table 8 Median daily intake of dietary fibre, vitamins and minerals per 1000kJ energy.*

In each of these tables the values are grouped by:

Gender: males, females and all persons

Age in years: 2-3, 4-7, 8-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over

Tables 1 and 2 provide information on total energy and moisture (includes all water from foods and beverages), protein, total, saturated, monounsaturated and polyunsaturated fat, cholesterol, total carbohydrate and sugars and starch, dietary fibre and alcohol. In addition these tables include information on the energy intake to BMR ratio for persons aged 10 years and over.

This ratio provides an indication of the level of energy intake relative to basal metabolic rate (BMR). A value of one indicates that energy intake is equal to basal energy expenditure while a value of 1.5 indicates an energy intake that is 50% greater than basal energy expenditure and consistent with only a light level of activity. Tables 1 and 2 show that the mean energy to BMR ratio is less than 1.5 for all adult age groups except males aged 19-24 years. The derivation of this ratio and its application are discussed in more detail in section 4.

Tables 3 and 4 provide information on the mean and median percentage contribution of individual macronutrients to total energy intake for all the macronutrients in tables 1 and 2. In general the contribution of both protein and alcohol increases with age while that of carbohydrate decreases with age. The percentage energy from fat remains relatively constant but there is a shift from saturated to mono- and poly-unsaturated fat in older age groups.

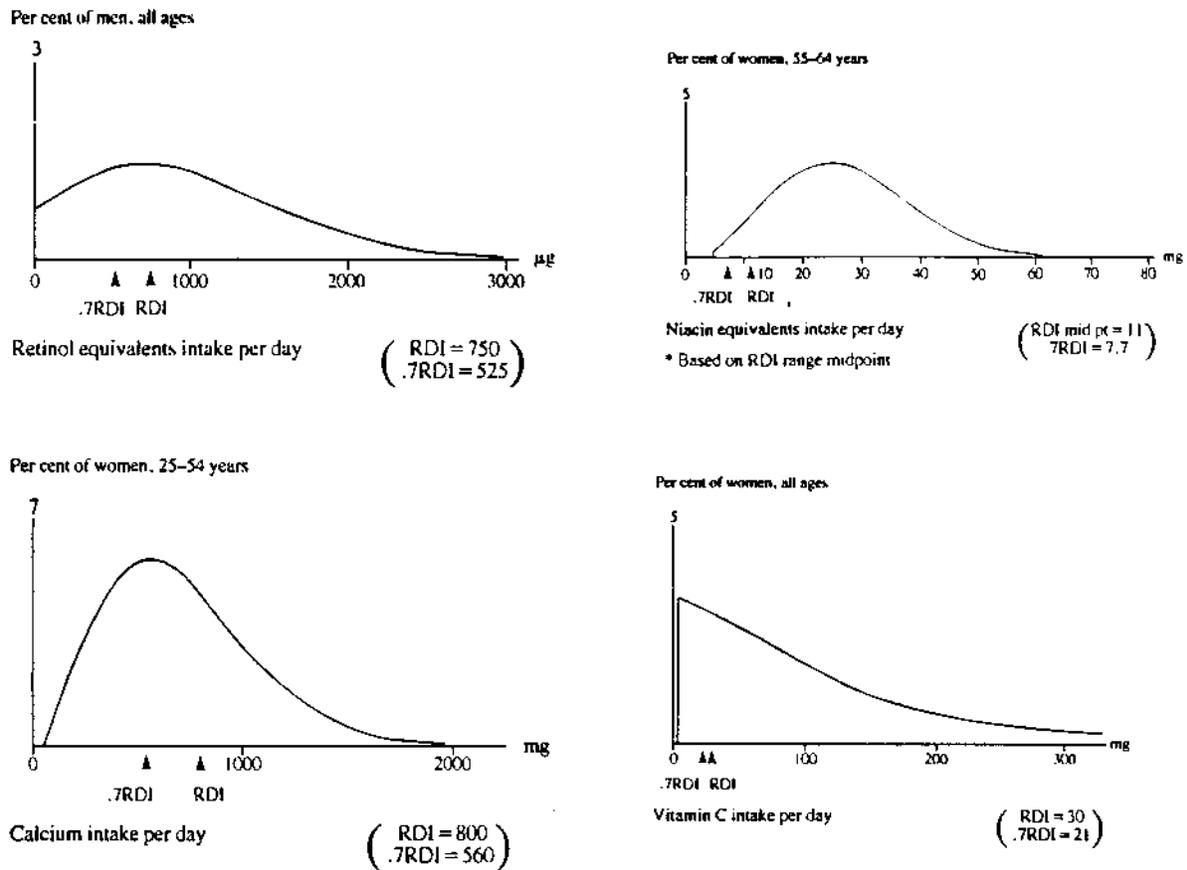
Tables 5 and 6 provide information on the mean and median intake of vitamins and minerals. The vitamins include total, preformed and pro-vitamin A, thiamin, riboflavin, niacin expressed in terms of niacin equivalents, folate and vitamin C. The minerals include calcium, phosphorus, magnesium, iron, zinc and potassium. Sodium was deliberately omitted from the NNS because of the difficulty of establishing intake from dietary data.

Tables 7 and 8 provide information on the mean and median concentration of dietary fibre and vitamins and minerals per 1000kJ of energy intake. This measure is sometimes referred to as nutrient density.

### **3.4.1.1 Why both mean and median tables?**

Tables of both mean and median nutrient intake values are provided in the publications to enable users to decide which of the two values is more relevant for their purpose. As has already been indicated mean intake values are much more dependent than medians on the nature, in particular the degree of skewness, of the intake distribution. Moreover the distributions are known to vary markedly between nutrients and may also vary between population sub-groups. Therefore, means may not always be the most appropriate measure for comparisons of intake either between nutrients or between different population sub-groups. Figure 3.1 illustrates the variation observed in the distribution of intakes for some key nutrients with data obtained in the *1983 National Dietary Survey of Adults*.

**Figure 3.1 Examples of one-day intake distributions for selected nutrients (DCSH, 1987)**



Nutrients that have a markedly skewed distribution such as retinol can have a mean that is considerably greater than the median. For example in the 1995 NNS the median intake of vitamin A, expressed in terms of retinol equivalents, for males aged 19 years and over, was 941µg while the mean intake was 1312µg (40% greater than the median). For nutrients that have a relatively symmetric distribution of intakes, such as protein, the difference between mean and median intake is much smaller.

For comparisons between nutrients the median is preferable since it always has the same interpretation - that is it always represents the mid-point of the intake distribution in terms of the proportion of individuals who consume more or less than this amount. The principal reason for using mean rather than median nutrient intakes is for the purpose of aggregating sub-categories of nutrients. For example the mean intake of saturated fat, monounsaturated fat and polyunsaturated fat can be added to give the total fat intake for the group as can the mean energy contribution of different macro-nutrients.

Since different nutrients cannot be aggregated, and since intakes for most nutrients are not symmetrically distributed, it is generally more appropriate to describe their distribution characteristics in terms of percentiles than in terms of the mean and standard deviation. This approach is commonly used for anthropometric measurements such as height and weight but conventionally has not been widely used for nutrients. The provision of median intakes in the ABS publications is an attempt to change this situation.

The remaining tables in this group cover macro- and micro-nutrient intake by State and Territory (tables 9-12), geographic region (tables 13-16), region of birth (tables 17-20), index of relative socio-economic disadvantage for areas or SEIFA (tables 21-24), weekday/weekend (tables 25-28), season (tables 29-32) and body mass index or BMI (tables 33-36) for persons aged 19 years and over. For each of these characteristics there are four tables:

*Mean daily energy, moisture and macronutrient intake;*  
*Median daily energy, moisture and macronutrient intake;*  
*Mean daily vitamin and mineral intake; and*  
*Median daily vitamin and mineral intake.*

While the captions for all these tables refer to the mean or median ‘daily’ intake it should be remembered that daily in fact represents the intake for single 24-hour periods averaged over persons and not the intake of the same individual averaged over a number of days. Since the sampling procedure for the NNS was designed to provide a representative sample of each population sub-group, the mean and median intakes obtained from a single 24-hour intake, however, can provide an estimate of the ‘usual’ mean/median intake for the group. The distribution of one-day intakes, however, does not represent the distribution of ‘usual’ intakes for individuals (see section 3.4.2 below and section 2, page 4). One-day intake distributions have not been published for the 1995 NNS data specifically to avoid the misinterpretation which occurred when they were published for the 1983 *National Dietary Survey of Adults* (DCSH, 1987) and the 1985 *National Dietary Survey of Schoolchildren* (DCSH, 1989).

### 3.4.2 Food sources of nutrients

Twenty-seven tables in *National Nutrition Survey Nutrient Intakes and Physical Measurements, Australia 1995* (Cat No 4805.0) provide information on the major food sources of energy, moisture and each of the macro- and micro-nutrients included in tables 1-36. The information in each of these tables (tables 37- 63) is grouped by:

Gender: males and females

Age in years: 2-11,12-18 and 19 years and over

The values shown in these tables represent the percentage of the total nutrient intake that is contributed by specified groups of foods. The food groups shown in the tables are those which contributed at least 1.5% of the total nutrient intake for one or more age by sex group. The number of food groups in each table varies with the nutrient in question.

Tables for nutrients which are widely distributed in foods include data for a larger number of major and sub-major food groups than do those which tend to be concentrated in one or two major food groups such as starch, vitamin C and calcium.

Users should note that the food groups in these tables are not necessarily directly comparable with the food groups used in the surveys conducted in 1983 and 1985 (DCSH, 1986 and 1988). A comparison of the main differences is given in table 3.1 above. As with other food intake tables ‘*italics*’ are used to identify values which represent the total percentage contributed by a major food group.

### 3.4.3 Distribution data for adjusted nutrient intakes

Twenty-six tables (tables 64-89) provide information on the distribution of nutrient intakes obtained after adjusting the distribution of one-day intakes for within-person variation as described by Sempos et al (1991). The purpose of adjusting for within-person variation is to enable one-day intake data to be used to model the distribution of intakes that would have been obtained had it been possible to study each individual over an extended period of time (see section 2.2, pages 4-6).

A distribution of 'usual' intake for the population is much more useful for assessing the likely extent of nutrient inadequacy or excess than is the distribution of one-day intakes which is likely to over-represent the proportions of individuals in the population both with particularly low or high intakes.

Distributions of adjusted data are provided for energy, moisture and each of the macro- and the micro-nutrients included in tables 1-36, except for alcohol, for which there were insufficient data to derive a reliable adjustment factor.

Each table gives values for the 10, 25, 50, 75 and 90 centile of nutrient intake. The data are grouped by:

Gender: males, females and all persons

Age in years: 2-3, 4-7, 8-11, 12-15, 16-18, 19-24, 25-44, 45-64, 65 and over, 19 and over

The main purpose of these tables is to enable a reliable estimate to be made of the proportion of the population in different age by sex groups who are likely to be at risk of nutrient deficiency or excess. Users should note that the proportion of the population who has an intake which is below the recommended dietary intake (RDI) does not represent the proportion at risk of nutrient inadequacy since, by definition, the RDI is set at a level which exceeds the requirements of almost all healthy individuals in the population.

In order to derive an estimate of the proportion likely to be at risk it is necessary to consider not only what the RDI represents - in effect recommended dietary intake for what? - but also how each RDI was derived. While it is customary to assume that all RDIs are set at two standard deviations above the mean requirement this is by no means always the case. RDIs for nutrients for which there are relatively few data on the individual variation in requirements may include larger allowances for individual variation than do nutrients for which there is more data such as protein.

Another factor that needs to be considered is whether the RDI is based on a double 'worst case' scenario. This applies particularly to nutrients such as iron, zinc and calcium, for which the bio-availability is influenced both by the individual's nutrient status and by his diet. It is not unusual for the RDIs for such nutrients to be based on a double 'worst case' scenario ie both the lowest expected dietary bio-availability and the lowest expected level of nutrient absorption that has been observed in adequately nourished individuals. This can lead to RDIs that exceed the amount of nutrient consumed by most people despite the absence of any evidence of widespread nutrient inadequacy eg zinc in Australia.

## 4. Factors which need to be considered in using the data

### 4.1 Introduction

There are several possible influences that need consideration when using the dietary data obtained from the 1995 NNS. These include: the effect of sampling, the effect of self-reporting of intake, the derivation and accuracy of the nutrient data and the basis and limitations of the adjustments made to the 1995 NNS data for within-person variation. In this section the impact of each of these factors, on the data, is discussed and guidance provided on how each may affect interpretation.

### 4.2 Effect of sampling

The NNS was conducted using a multi-stage area sample to select private dwellings and a sub-sample of participants in those dwellings was then selected for the survey. As the survey was conducted on only a sample of all households and members of those households, it is important to take account of the method of sample selection when deriving estimates from the unit record file. This is particularly important as a person's chance of selection in the survey varied, depending on the State/Territory and region in which they lived. If these chances of selection are not accounted for, by use of appropriate weights, the results will be biased (ABS, 1998b).

#### 4.2.1 Survey weights

Estimates from the survey are derived using survey weights to take account of a person's probability of selection in the sample from their region, adjustments for under-enumeration at the age, sex, and part of State level and other factors which affected response.

There are six different weights in the NNS data file. The two survey weights relevant to most dietary analyses are:

- Main survey weight (IFIQWT), which contains a weight for each person in the sample; and
- FFQ weight (FFQWT), which contains a weight for each person aged 12 years and over who completed a usable FFQ.

The other survey weights provided in the NNS data file are required only for analyses which relate dietary data with SF36 data obtained in the course of the 1995 National Health Survey.

When estimates for population sub-groups are derived from the CURF it is essential that they are calculated by adding the person weights in each category, not just by counting the number of people falling into each category. If each person is counted only once then no account is taken of the fact that a person's chance of selection in the survey varied from region to region and the resulting estimates may be seriously biased (ABS, 1998b).

## 4.2.2 Relative standard error

All estimates from the 1995 NNS are subject to sampling error. Although information on the extent of sampling error is not given in the published tables this does not mean that it can be ignored and tables of relative standard errors (RSE) are provided for most estimates in appendices.

In the tables themselves values not preceded by an asterisk have calculated RSEs that do not exceed 25% and 95% confidence intervals no wider than the published value  $\pm 50\%$ . More precise RSE values and confidence intervals can be derived, when the number of persons contributing to the estimate is known.

In many of the published tables the range of estimates for a given parameter with age, sex, or other socio-demographic and temporal characteristics of interest is small. For example the range in mean energy and nutrient intakes observed between States and Territories is generally only of the order of 1 to 1.2 that is the highest mean is only about 20% greater than that of the State with the lowest mean. The widest range of nutrient intakes is that observed with age which is of the order of 1 to 2.

What this means in terms of interpretation of the data is that many of the apparent differences between population sub-groups in the published tables are likely to be within the expected range of sampling error and do not necessarily represent differences of biological or social significance.

When evaluating differences between population sub-groups it is always necessary to take into account the RSE of the estimate before concluding that there is real difference between two groups. As an example in table 17 of *Nutrient Intakes and Physical Measurements* (Cat No 4805.0) the mean intake of total sugars for adult males from East Asia is 103.9g while that of adult Australian born males is 137.9g over 24 hours.

The question we need to ask is. Does this difference reflect more than sampling error? The box below illustrates the process to be followed in order to determine the answer to this question. In order to do this it is necessary to consult both the information provided in appendix 1 and in the Technical Notes section of *Nutrient Intakes and Physical Measurements* (Cat No 4805).

Appendix 1 in 4805.0 provides population estimates for the number (sample) of persons who contributed to the intake estimates. For males born in East Asia the figure is 197,446 (~200,000) and for males born in Australia the figure is 4,798,981 (~5,000,000).

Table T2 in the technical notes section of the same publication shows the calculated RSEs for mean nutrient estimates. For sugars the RSE for a population estimate of ~200,000 persons is 5.3% and for a population estimate of ~5,000,000 it is 1.0%.

With this information we can calculate the 95% confidence interval for each estimate of mean sugar intake. This is given by the mean  $\pm 2$  SE. For adult males from South East Asia 5.3% of 103.9g is 5.5g and the 95% confidence interval for the mean estimate is therefore 103.9g  $\pm 2$  (5.5g) or from 92.9 to 114.9g.

Similarly for adult males born in Australia 1% of 137.9g is 1.4g and the 95% confidence interval for the mean estimate is therefore 137.9g  $\pm 2$  (1.4g) or from 135.1 to 140.7g.

We can also estimate the SE and the 95% confidence interval for the *difference* between the two means (137.9g – 103.9g). The SE of the *difference* is given by  $\sqrt{[5.5]^2 + [1.4]^2}$  and equal to 5.7g and the 95% confidence interval for the *difference* between the two means is given by the *difference*  $\pm 2$  SE or 34g  $\pm 2$  (5.7g) and is from 22.6g to 45.4g.

Taking sampling error into account it is evident firstly that the 95 percent confidence intervals for the two estimates clearly do not overlap and secondly that the 95% confidence interval for the difference between the two means does not include zero. One may, therefore, conclude that the difference in sugar intake between the two population sub-groups is unlikely to be due solely to sampling error.

Note: SEs are available from the ABS on request for estimates for which RSE tables have not been published (mainly median values).

### 4.3 Self-reported dietary data

It is well known that self-reports of food intake can vary considerably from what is actually consumed. Both underestimation and overestimation of intake have been reported but on average both short-term records and recalls of intake have been found to underestimate food intake in most groups in which it has been possible to make a comparison either with the 'observed intake' or with an independent measure of intake such as energy expenditure measured by doubly-labelled water (Black, 1993).

The effect of underestimation on nutrient intake clearly depends not only on the extent to which food intake is underreported but also on which foods are underreported. To date most validation studies have focussed on identifying underreporting of energy and protein or nitrogen intake since there are few independent markers of nutrient intake that are feasible for use in nutrition surveys (Bingham, 1995).

One practical way to assess the likelihood of underreporting of food intake in large nutrition surveys is to compare the self-reported level of energy intake in adults with an estimate of the energy required to maintain basal metabolism on the assumption that weight is stable. Energy intake divided by basal metabolic rate (EI/BMR) in weight stable individuals provides a measure of the level of energy expenditure or physical activity level (PAL) which is defined as the ratio of energy expenditure to basal metabolic rate. The table below taken from NHMRC (1991) illustrates the PAL ratios, for adults and children over the age of 10 years, associated with different levels of physical activity ranging from bed rest to very heavy manual labour.

**Table 4.1 Activity level expressed as a multiple of basal metabolic rate (NHMRC, 1991)**

Activity level	Daily energy expenditure as multiples of BMR			
	Males		Females	
	Average	Range	Average	Range
Bed rest	1.2	1.1-1.3	1.2	1.1-1.3
Very sedentary	1.3	1.2-1.4	1.3	1.2-1.4
Sedentary/maintenance	1.4	1.3-1.5	1.4	1.3-1.5
Light	1.5	1.4-1.6	1.5	1.4-1.6
Light-moderate	1.7	1.6-1.8	1.6	1.5-1.7
Moderate	1.8	1.7-1.9	1.7	1.6-1.8
Heavy	2.1	1.9-2.3	1.8	1.7-1.9
Very heavy	2.3	2.0-2.6	2.0	1.8-2.2

These values can be compared directly with the EI/BMR values given in NNS tables that provide information on energy intake. For adolescent males and young adults aged 19-24 years intake data from the 24-hour recall gave average EI/BMR ratios of 1.7-1.8 and for adolescent females and young adults aged 19-24 years EI/BMR

ratios of 1.4-1.6 or values consistent with light to moderate and light levels of energy expenditure respectively. For adults aged 19 years and over, however, the average ratio was only 1.5 for males and 1.3 for females consistent, if taken at face value, with light and very sedentary levels of activity respectively.

While the average energy expenditure level of Australian adults is unlikely to be greater than light -moderate it is also unlikely that it is only sedentary to very sedentary. Estimates of average energy intake from the NNS 24-hour recall may, therefore, underestimate energy intake by about ~ 0.2BMR or 1-1.5MJ per day. Although it is not possible to determine the effect of underestimation of energy intake on intake of individual nutrients it is likely that in general nutrient intake is also underestimated.

Information on the proportion of adolescents and adults whose 24-hour energy intake was less than 0.9BMR (a value outside the lower 95% confidence interval for energy intake on one day in a weight stable individual undertaking light activity (Goldberg, 1991)) is provided on page 142 in appendix 4 of 4805.0. For adults aged 19 years and over the percentage with an EI/BMR ratio of <0.9 was 11.9% in males and 20.6% in females.

Appendix 4.3 in *National Nutrition Survey Nutrient Intakes and Physical Measurements Australia 1995* (page 146 in Cat No 4805.0), provides additional information on the nutrient intakes of adults aged 19 years and over grouped according to EI/BMR (<0.9 or 0.9 and greater). Compared to the total population, women whose EI/BMR was 0.9 or greater had vitamin and mineral intakes which were 6-15% higher and men's intakes which were 5-10% higher. These differences are similar to those observed for macronutrient intake.

#### 4.4 Nutrient derivation

The nutrient data were derived from the food intake data obtained in the 1995 NNS using a nutrient composition database developed by ANZFA. The primary sources for this database were data from *Composition of Foods Australia* (ANZFA, 1989) and from unpublished food composition data commissioned by ANZFA. The database also includes data from the following sources listed in decreasing order of contribution to the nutrient database:

- Australian scientific literature;
- Food industry data;
- 5th edition of McCance and Widdowson's *The Composition of Foods* and supplements;
- United States and New Zealand food tables; and
- Other data.

The procedures used to derive the nutrient values for the foods reported in the NNS are described in detail in Chapter 8 of the *National Nutrition Survey Users' Guide 1995* (pages 34-43 in Cat No 4801.0). It should be noted that all folate values were derived from overseas and not from Australian data. McCance and Widdowson's *The Composition of Foods* was the primary source for the folate data.

Descriptive data on all foods and beverages consumed by survey participants were obtained and recorded according to a standard protocol as part of the individual food intake questionnaire interview. The level of detail that could be obtained, however, depended on the individual subject and consequently not all foods consumed were fully described by participants. For such foods the nutrient values assigned were derived from a composite based on estimates of the relative consumption/market share of similar, but fully described, foods.

Nutrient data for many commercial and simple cooked foods were calculated by ANZFA according to a standard procedure that allowed for changes in moisture, vitamin and mineral content with cooking. The nutrient composition of recipe foods was calculated by a recipe processing system (RPS) as part of the ANSURS automated food coding system developed for the survey. The RPS applied standard nutrient retention factors and in some instances allowed for the substitution of specific ingredients such as the type of fat used in preparation. The effect of the standard factors used by the RPS, on mean nutrient estimates, has not been evaluated nor has the effect of incomplete description of foods by participants.

With the exception of folate, the nutrient database for the 1995 NNS was derived essentially from Australian food composition data. The main database-related sources of error are thus likely to arise, either from incomplete or inappropriate description of foods by survey participants or from the use of inappropriate ingredients and nutrient adjustment factors in manufactured and home-prepared foods and difficult to estimate.

#### 4.5 Adjustment for within-person variation

The published food and nutrient intake estimates from the 1995 NNS focus on mean or median intakes and not on the distribution of individual intakes. This is quite deliberate because the 1995 NNS was designed to provide reliable estimates of mean or median intake for the Australian population and for specified population sub-groups within it, but not designed to provide reliable information on the food and nutrient intake of individuals.

Nevertheless a reliable estimate of the distribution of the 'usual' food and nutrient intakes in the population and in specified sub-groups of the population is of interest for a number of reasons which are discussed further in section 5. In order to obtain such an estimate it is necessary to be able to separate day-to-day within-person variability in food and nutrient intake from the underlying between-person variation in intake that is the measure of interest.

An estimate of day-to-day variation in intake within individuals can only be obtained from multiple (minimum two) days of information in the same individuals. For this purpose a 10% sample of the NNS participants (~ 1,500) were asked to complete a second 24-hour recall interview usually within 10 days of the first interview but on a different day of the week. These data were then used to derive, by an analysis of variance procedure described on page 124 of the explanatory notes section of Cat No 4805.0, an estimate of between-person variance and of residual or within-person variance for energy and each nutrient except alcohol.

Because patterns of food and nutrient intake differ with age and sex separate analyses of variance were carried out for the age groups: 2-11 years; 12-24 years; 25-44 years; 45-64 years and 65 years and over to determine the between-person variance and from this the between-person standard deviation. Nutrient intakes for retinol, pro-vitamin A and total vitamin A intake were log transformed prior to analysis of variance in order to approximate a normal distribution. The box below shows how each individual's 24-hour recall intake was adjusted using the between person standard deviation.

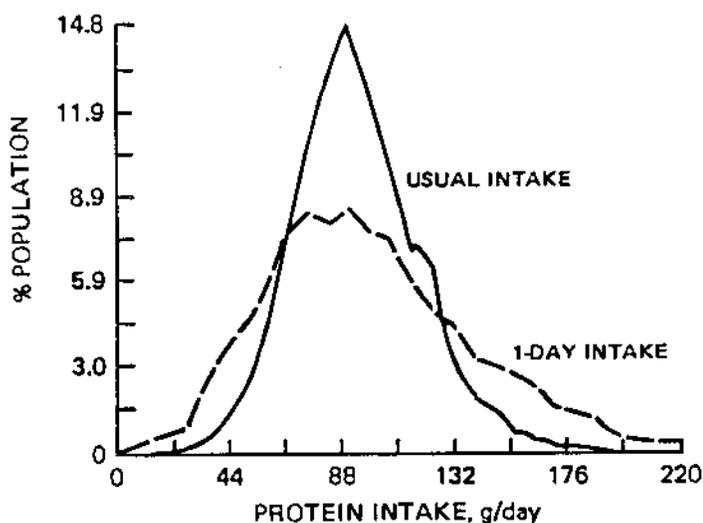
Each individual's day 1 intake was adjusted as follows:

Individual adjusted value = Group mean + (group mean – individual value) x ( $S_b/S_{obs}$ )

where  $S_b$  = is the between-person standard deviation estimated from the replicate sample and  $S_{obs}$  = is the observed standard deviation for day 1 intakes for the age group.

In effect each individual's 24-hour recall intake was shifted towards the group mean by an amount proportional to the ratio of the between person standard deviation in the replicate sample: to the observed standard deviation in the survey sample. It should be noted, however, that individual adjusted values do not represent 'usual' intake values for individuals. The distribution of 'adjusted' individual intakes simply provides a better approximation to the distribution of intakes that would have been observed in the population had it been possible to estimate each individual's intake for a longer period of time (see figure 2.1, page 6). Figure 4.1 below illustrates the effect of adjusting a sample of 1-day protein intakes for within person variation. The base of the distribution is narrower and a smaller proportion of the population has a 'usual' intake which is extremely low or extremely high.

**Figure 4.1 Comparison of one-day and adjusted (usual intake) distributions for protein (NRC, 1986)**



Theoretically the same adjustment procedure could have been applied to the food intake data to obtain an 'adjusted' distribution of intakes for individual foods. However, except for a few foods consumed on most days by virtually all members of the population, the amount of data available from the 10% replicate NNS sample would have been inadequate for this purpose.

## 5. Use of data to fulfill survey objectives

### 5.1 Introduction

The specific objectives identified for the NNS were to:

- monitor intakes against the Dietary Guidelines for Australians, compare nutrient intakes with the RDIs, and assist in future revisions of the RDIs;
- assess changes in dietary habits and nutritional status since 1983 and 1985 and provide a basis for comparisons to future regular surveys;
- assist with the development of and monitor the impact of Australia's Food and Nutrition Policy; monitor health goals and targets for nutrition and diet-related disease; assist in future revision of national health Goals and Targets;
- assist with the development of food policy and regulations related to food safety and composition; assist in the provision of information related to food production, manufacture and sales;
- provide information on the interrelationship of health, social, economic and nutrition variables in selected population subgroups for policy development; and
- provide a basis for nutrition promotion strategies (ABS, 1998).

This section looks at how the dietary data from the NNS can be used to address the major components of these objectives.

### 5.2 Monitoring intakes against Dietary Guidelines

The NNS data provide a range of data that can be used for this purpose. Several of the food-related questions described in section 2 can be used to provide information relevant to the Australian Dietary Guidelines (ADG) and in some cases to monitor trends over time. Table 5.1 below shows some ADG related data available from the 1995 NNS. If the same questions, as were used in the 1995 NNS, are used in future population-based surveys, population trends in these food habits could be obtained at relatively little cost, not only at National and State but also at the local level.

**Table 5.1 Percent of persons aged 19 years and over reporting specified food habits in the 1995 NNS (ABS unpublished data)**

Type of information	NSW	VIC	QLD	SA	WA	TAS	NT	AUS
<b>Type of milk usually consumed:</b>								
Low/fat red/skim	37.4	47.4	39.2	51.2	44.9	36.5	25.8	42.8
<b>Frequency of trimming meat fat:</b>								
Usually	72.0	74.8	70.6	70.7	72.9	68.1	63.4	72.2
<b>Frequency of adding salt after cooking:</b>								
Never/rarely	57.2	60.9	49.1	64.4	59.0	57.6	56.2	57.5
<b>Number of serves of fruit each day:</b>								
Two or more	49.3	52.8	50.7	47.9	53.0	32.4	38.7	50.4
<b>Number of serves of vegetables each day:</b>								
Four or more	17.9	19.1	21.0	15.7	18.8	19.1	15.6	18.6

Concerns are often raised that simple questions on food habits are interpreted differently or even misinterpreted by many people. The 1995 NNS provides the opportunity to assess whether such concerns are warranted by allowing comparisons to be made between the data obtained from a number of short food-related questions and that obtained from the more detailed 24-hour recall interview.

From table 5.1 it would be expected that on average, fruit intake would be lower in Tasmania than in Western Australia. Table 4 in *Food Eaten Australia 1995* (page 41 in Cat No 4804.0), confirms that this is indeed the case ie average fruit intake in persons aged 19 years and over was 118g in Tasmania compared with 155g in Western Australia. While table 5.1 illustrates State differences in food habits it is possible also to look at age, sex and socio-economic and temporal differences in food habits and to determine whether the observed trends based on the simple food-related questions are in fact borne out by the 24-hour recall data.

As another check on the validity of the information obtained from simple food-related questions it is possible to establish whether persons who reported usually consuming more serves of fruits and vegetables did in fact, on average, do so on the NNS survey day.

Tables 5.2 and 5.3 provide data on average fruit and vegetable intake (based on the 24-hour recall data) classified by the number of serves of fruit and vegetables per day (based on responses to the short food-related questions) (Rutishauser, 1999).

Two conclusions are evident from these tables. Firstly, on average, persons who reported usually consuming more serves of fruit and vegetables also had, on average, a greater mean 24-hour recall intake. Secondly, however, the average amounts of fruit and vegetables consumed on the survey day did not equate with the amounts expected (based on serve equivalents of 150g fruit and 75g vegetables).

For example, the average fruit intake for females aged 45 years and over who reported that they usually ate 2-3 serves per day was 202 grams, which is well below the expected 300 to 450g. The average fruit intake associated with a usual intake of 2-3 serves per day was, in fact, only equivalent to 1-1.5 standard serves while the average amount associated with a usual intake of 4 or more serves per day was equivalent only to 1.5-2.5 serves. Overestimation of fruit intake in terms of serves appeared to be greater by adolescents than by adults.

**Table 5.2 Mean fruit intake in grams per 24 hour calculated from 24-hour recall data tabulated by short question response category, gender and age**

Group	Short question response category in serves* per day			
	Age (years)	1 or less (<150g)	2-3 (300-450g)	4 or more (>600g)
Mean fruit intake from 24-hour recall (g)				
<b>Females</b>	12-18	51	136	237
	19-44	65	164	377
	45+	95	202	388
<b>Males</b>	12-18	37	136	266
	19-44	54	182	352
	45+	88	228	420

\*In Australian recommendations 1 serve of fruit is equivalent to ~150g

The pattern was different for vegetables. A usual intake of 1 serve or less of vegetables per day was associated with an average intake which was equivalent to 2-3 standard serves while a usual intake of 4 or more serves per day was associated with an average intake equivalent to 3-5 serves. It would appear that persons who eat fewer vegetables on average consume larger servings than those who eat a greater variety. This analysis did not separate potatoes from other types of vegetables and this may explain part of the difference since potatoes account for about a third (89g) of the average daily vegetable intake of Australian adults aged 19 years and over.

**Table 5.3 Mean vegetable intake in grams per 24 hour calculated from 24-hour recall data tabulated by short question response category, gender and age**

Group	Short question response category (serves*/day)			
	Age (years)	1 or less (<75g)	2-3 (150-225g)	4 or more (>300g)
Mean vegetable intake from 24-hour recall (g)				
Females	12-18	160	202	231
	19-44	179	229	299
	45+	189	244	312
Males	12-18	202	255	300
	19-44	223	300	390
	45+	213	307	388

\* In Australian recommendations 1 serve of vegetables is equivalent to ~75g

## 5.3 Comparing nutrient intakes with the RDIs

While at first sight it seems both reasonable and straightforward to compare average population intakes of nutrients with the relevant RDI in order to assess the likely extent of nutrient inadequacy or excess in the population a number of factors need to be considered which are often overlooked. The purpose of this section is to draw attention to these factors.

### 5.3.1 Underestimation of self-reported intakes

The fact that self-reported intakes often underestimate food and in turn nutrient intake, not only in individuals but also at the group level (Black, 1991), is clearly an important factor to consider when making comparisons of actual with recommended nutrient intakes.

A practical approach to assessing the extent of this problem in national surveys - use of the ratio of energy intake to BMR - has already been described in section 4 and values obtained for this ratio from the 1995 NNS have been used to make some assessment of the likely underestimation of energy and nutrient intakes in adults. These estimates suggest that on average nutrient intakes are likely to be underestimated by between 5 and 15%.

### 5.3.2 Definition of an RDI

The second point that needs consideration is the definition of current Australian RDIs.

“Recommended Dietary Intakes (RDIs) are the levels of intake of essential nutrients considered, in the judgement of the National Health and Medical Research Council, on the basis of available scientific knowledge to be adequate to meet the known nutritional needs of practically all healthy people” (NHMRC, 1991).

In effect RDIs are defined to exceed the known needs of practically all healthy people. They are recommendations that are primarily intended, and useful, for planning the diets of population groups and not primarily intended as diagnostic criteria for assessing the level of dietary inadequacy or excess in the population as a whole or in sub-groups of the population. RDIs are based on the average requirements of individuals but are not synonymous with the average requirements of individuals. The average physiological requirement is often more clearly defined than the RDI and for this reason is a better starting point for the evaluation of nutrient intakes than is the RDI itself.

The first committee to explicitly acknowledge this was the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy in the United Kingdom in their report entitled *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom* (DHSS, 1991). This report introduced not only a new nomenclature for nutrient intake recommendation - ‘dietary reference values’ - which is much less likely to be misleading than existing terms such as Recommended Dietary Intake and Recommended Daily Allowance but also introduced the concept of multiple reference levels:

- EAR - Estimated Average Requirement of a group - about half of the group will usually need less and the other half more;
- LRNI - Lower Reference Nutrient Intake - an amount that is enough for only a few people in a group; and
- RNI - Reference Nutrient Intake - an amount that is enough or more than enough for ~97% of a group.

### 5.3.3 Not all RDIs are equal

The second point to consider is adequate for what? In practice most RDIs are based on the amount needed either to prevent the occurrence of a specific sign or symptom of nutrient inadequacy or to maintain a given level of tissue stores in the longer term. While we tend to think of RDIs as equal it is probably inappropriate to do so since the average amount of iron required to prevent anaemia cannot be equated with the average amount of vitamin C required to maintain a given pool of vitamin C.

Having said this it is important to point out that the estimated average requirement rather than the RDI is a better starting point for the assessment of nutrient adequacy because it usually involves fewer assumptions. Often while committees have access to data on the average requirement for the amount of nutrient required to maintain one or more specified physiological functions there are either few or insufficient data to clearly define the distribution of requirements.

Consequently the standard deviation or allowance for individual variation used to determine the RDI is either a 'guesstimate' or based on the coefficient of variation observed for a nutrient such as protein for which there are more data. Current Australian RDIs (NHMRC, 1991) for individual nutrients can be calculated to range from 120% of the EAR to as much as 200% of the EAR. A simple comparison of average intake with the RDI is thus not necessarily comparable across nutrients and may provide misleading information on the nutrients for which the risk of adverse effects is greatest in the population.

### 5.3.4 RDIs relate to 'usual' intake

A final important consideration in making a comparison with the RDI is that the nutrient intake that is compared with the RDI should represent 'usual' or long term intake for the group or the individual. Although RDIs are expressed on a per day basis this is for convenience only and not because the specified amounts are in fact required every day. As discussed in section 2 the 1995 NNS provides reliable information on the usual mean/median nutrient intake for the population and for population sub-groups it cannot provide reliable information on the usual intake of individuals even after adjustment for within-person variation.

In order to be able to make statements about the proportion of the population who are likely to have inadequate intakes in the longer term it is necessary to have access to reliable information not only on the mean or median intake but also on the distribution of 'usual' intake in the population.

As described in section 4 an estimate of this distribution has been obtained for all nutrients except alcohol by 'adjusting' the observed distribution of one-day intakes from the 1995 NNS for within-person variation using data obtained from the 10% sample of participants who were interviewed on a second day.

**Table 5.4 Observed and adjusted distributions for folate intake in women of childbearing age**

Age group		Centile				
		10	25	50	75	90
Females:						
19-24 years	Observed	121	174	246	342	455
	Adjusted	164	188	224	260	311
25-44 years	Observed	125	176	246	333	438
	Adjusted	166	189	218	254	296

Table 5.4 shows that while median intake of folate differs by only 20µg between the observed and adjusted data (218-246µg), 10th centile intake differs by 40µg, and 90th centile intake by over 100µg. The proportion of women whose folate intake is below 400µg, the amount recommended for all women of childbearing age in order to minimise the risk of neural tube defects, consequently also differs depending on whether adjusted or unadjusted (observed) data are used for the assessment. Based on the observed distribution for folate intake, in 1995 between 90 and 75% of women did not meet the recommendation, while based on the adjusted distribution virtually all women did not meet the recommended intake of 400µg.

### 5.3.5 Fixed cut-off or probability comparisons

Traditionally population comparisons of intakes with RDIs have been made on the basis of the proportion with intakes below the RDI or some fraction of the RDI - often 70%.

The basis for the use of 70% is not well defined but in effect 70% of the RDI approximates the EAR when the coefficient of individual variation used to determine the RDI is 20% ie  $EAR/RDI = 100/140 = 70\%$ .

The proportion of the population whose usual intake falls below the RDI is not synonymous with the proportion at risk of nutrient inadequacy since by definition the requirement of almost all members of the population is less than the RDI (see box below).

#### **Definition of Recommended dietary intakes (NHMRC, 1991)**

Recommended dietary Intakes (RDIs are the levels of intake of essential nutrients considered, in the judgement of the National health and Medical Research Council, on the basis of available scientific knowledge to be adequate to meet the known nutritional needs of practically all healthy people. The RDIs are *derived* from estimates of requirements for each age/sex category and incorporate generous factors to accommodate variations in absorption and metabolism. They therefore apply to group needs. RDIs exceed the actual nutrient requirements of practically all healthy persons and *are not synonymous with requirements*.

It has been demonstrated empirically that, the proportion of individuals with *usual* intakes below the EAR provides a general approximation to the expected prevalence of inadequate intakes provided that the distribution of requirements is reasonably symmetrical (NRC, 1986).

Given that the information about individual variation in requirements is inadequate for many nutrients, the proportion of the population with an intake below the EAR can be used to provide a first approximation to the extent of nutrient inadequacy in a population group.

When information on the distribution of requirements is available it is possible to apply a 'probability' approach to the data to estimate the extent of nutrient inadequacy. The use of this approach is based on the following assumptions:

- nutrient intake and nutrient requirements are not strongly correlated;
- the distribution of nutrient requirements is known; and
- the distribution of usual intakes is known.

When this information is available it is possible to estimate the probability that a given level of intake is below the requirement of a random individual. Figure 5.1 taken from Beaton (1994) illustrates the empiric approach applied to the assessment of protein intakes in adult men and figure 5.2 illustrates the probability approach applied to the assessment of iron intakes in adult women.

Figure 5.1 Application of an empirical approach to assessment of the adequacy of protein intake in adult men (Beaton, 1994)

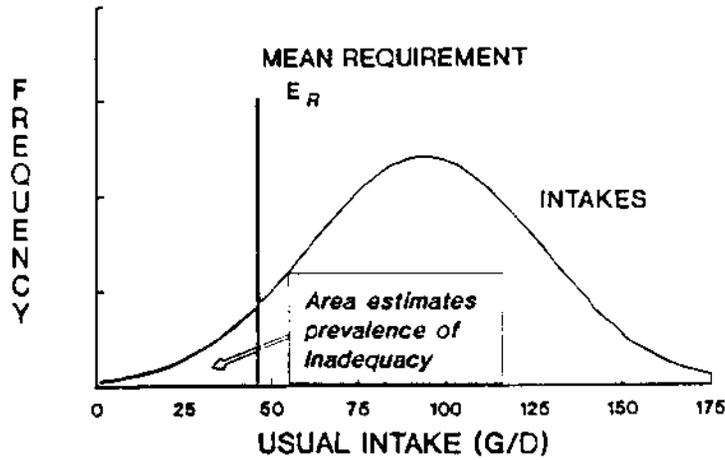
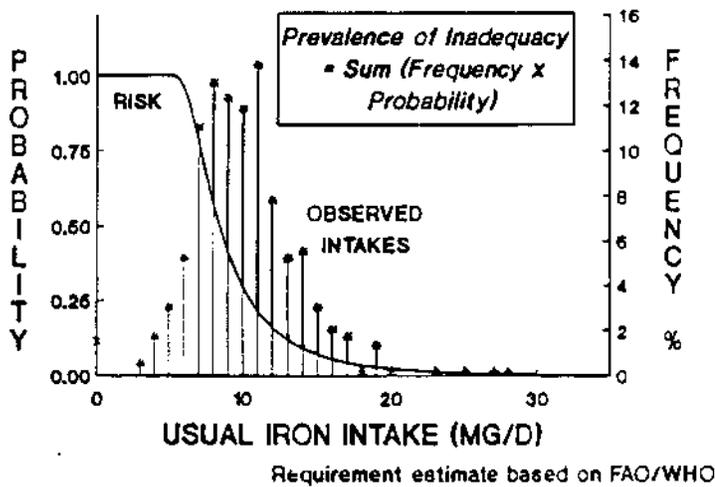


Figure 5.2 Application of probability approach to assessment of the adequacy of



iron intake in adult women (Beaton, 1994)

#### 5.4 Comparison of data from the 1995 NNS with other national surveys

Nominated objectives for the 1995 NNS included the assessment of changes in dietary habits and nutritional status since 1983 and 1985 and use of the 1995 NNS as a basis for comparisons with future surveys.

One of the most important tasks identified by the Australian Food and Nutrition Monitoring Unit, based at The University of Queensland, is to assess both the overall and individual impact of the various methodological differences on apparent change in food and nutrient intake over time. Those with a particular interest in comparisons over time and between surveys are encouraged to contact the project team for further information.

While the assessment of change over time is clearly important for monitoring progress in relation to diet-related goals and targets; for evaluating food and nutrition policy and for the development of future policy initiatives it is crucial that in doing so true change is distinguished from change arising as a consequence of changes in survey methodology.

It is tempting to assess change simply by comparing the results from the 1995 NNS with those from the earlier national dietary surveys of adults in 1983 and of schoolchildren in 1985. Such comparisons may be misleading because of methodological differences between the surveys that are outlined in table 5.5.

At the time of writing the detailed analysis required to distinguish real changes in food and nutrient intake from those based on ‘face value’ comparisons of the results of the surveys has not been carried out. It is, therefore, not possible to provide any specific data on the methodological differences which have the greatest impact nor to provide any estimates of the size of the impact.

It is, however, possible to caution policy makers not to jump to conclusions on the basis of unadjusted comparisons of the data and to encourage all those with access to the CURF to explore methods for assessing both the overall and the individual impact of the various differences in methodology.

If the 1995 NNS is to serve as basis for future comparisons it will clearly be important to ensure that those aspects of the survey methodology that can have a major impact on the assessment of ‘true’ change over time are clearly identified and standardised in future surveys

**Table 5.5 Methodological differences, between the 1995 NNS and earlier surveys conducted in 1983 and 1985, likely to influence data comparisons**

<b>Nature of difference</b>	<b>1995 NNS</b>	<b>1983 National dietary survey of adults</b>	<b>1985 National dietary survey of schoolchildren</b>
Sampling frame	Private dwellings in a sub-sample of CDs for 1995 NHS	Electoral rolls for areas within 16km of capital city NHF centre	All Australian schools
Geographic coverage	All States and Territories	State capital cities	All States and Territories
Sample size	13,858	6,255	5,224
Age of sample	2 years and older	25-64 years	10-15 years
Survey period	February 1995 - March 1996	May - November 1983	May - October 1985
Dietary method	24-hour recall interview at home with standard measures and size guides	24-hour recall interview at centre with food models and standard measures	24-hour record at home and at school with standard household measures
Food database	Developed by ANZFA/HFS 1995-6	Developed by CDH1983	Developed by DHCS 1983-85
Nutrient database	COFA 1989-95 plus additional data	Modified British data (Paul & Southgate, 1978)	Modified British data (Paul & Southgate, 1978)
Food coding	Automated centrally at data entry (ANSURS)	Manual mainly (~75%) by interviewers	Manual centrally by DCSH nutritionists

## 5.5 Development of food regulations and policy

The data from national nutrition surveys play an important role in providing information for food regulatory authorities. Two purposes for which such data are particularly important are regulations governing the addition of nutrients to foods and regulations governing the permitted levels of non-nutrient additives and contaminants in foods. In both instances information on high level consumers of specific foods, both in the short and longer term, is of particular interest.

Survey data that are based only on one-day of intake from each individual pose problems similar to those discussed in relation to comparisons with the RDI particularly for foods and additives/contaminants for which longer-term intake is of primary interest. Individuals whose intake is high on one day may or may not maintain the same level of intake in the longer term and without information on longer-term intake the real long-term level of intake cannot be established with any degree of accuracy.

Intake in the longer-term depends not only on the average amount of food consumed by different population sub-groups, which can be accurately determined from a one-day survey, but also on the frequency of consumption and the proportion of people in each sub-group who are in fact consumers of the food, neither of which can be established from a one-day intake survey.

While regulators tend to err on the side of safety in the levels of intake used for regulatory purposes, systematic overestimation of the intake of high level consumers is likely to be counter productive and to lead to unnecessarily stringent regulations.

Food intake that is representative of an individual's longer-term intake is both expensive and problematic to obtain from a representative sample of the population since it requires multiple days of information to be obtained from each individual. A recent Institute of European Food Studies report (IEFS, 1998) has investigated the possibility of combining short-term information on quantitative intake in individuals with longer-term information on the frequency of consumption by consumers as a means of overcoming the shortcomings of one-day intake data required for regulatory purposes. The applicability of this approach deserves further study in Australia.

It is likely that more realistic estimates of the longer-term intake of consumers, for regulatory purposes, could be obtained by combining quantitative estimates of food intake for population sub-groups from the 1995 NNS 24-hour recall with information on the longer-term frequency of consumption and the proportion of consumers derived from a FFQ. Since the FFQ used for the 1995 NNS was not specifically designed with this kind of regulatory application in mind it may be necessary to obtain the frequency data for relevant foods from other sources such as household-based omnibus surveys conducted by the ABS or individual States and Territories.

## 5.6 Associations between dietary data and data from the NHS

The ability to study relationships between diet-related data and health-related data in the same individuals was an important reason for conducting the 1995 NNS on a sub-sample of NHS participants. The NHS provided additional socio-demographic information on NNS participants (labour force status, education, income and housing) as well as information on general health and wellbeing; on a wide range of health-related conditions;

on consultations with health professionals and on the use of health services and medications. Unique identifiers enable NNS and NHS data for the same individuals to be linked in order to explore a wide range of relationships in population sub-groups of particular interest for the purpose of developing evidence-based policy and nutrition strategies.

In exploring relationships between the NHS and NNS data it is important to remember that the NHS information on health status relates to health status at the time of the NHS and to information on the use of health services and medications during defined periods of time prior to the NHS interview, while the quantitative food and nutrient intake data relate only to intake on the day prior to the NNS interview.

Some diet-related measures such as the food-related questions, which provide information on usual dietary practices, and the FFQ, which provides information on the frequency of intake of specified foods over the previous 12 months, can be used to classify individuals according to their food habits in order to determine whether different long-term food practices are associated with differences in health status.

Conversely it is not appropriate, and quite possibly misleading, to classify individuals on the basis of their intake of food and nutrients on a single day, for comparison with a measure of nutritional status. Measures of nutritional status such as body mass index or the presence or absence of a condition such as diabetes are not determined by food intakes on a single day.

It is appropriate, however, to compare the average food and nutrient intake for groups classified according to measures that are characteristic of the individual in the longer term. Such measures include:

- presence or absence of specific conditions such as diabetes;
- category of body mass index, weight or height;
- self-assessed health status;
- SEIFA quintile or other demographic characteristics;
- smoking or other risk factor status measured over a period of time; and
- the use of health services/health professionals.

## 6. References

Australian Bureau of Statistics 1997, *National Nutrition Survey Selected Highlights Australia 1995*, Catalogue No. 4802.0, ABS, Canberra.

Australian Bureau of Statistics 1998a, *National Nutrition Survey Users' Guide 1995*, Catalogue No. 4801.0, ABS, Canberra.

Australian Bureau of Statistics 1998b, *Information Paper, National Nutrition Survey, Confidentialised Unit Record File 1995*, Catalogue No. 4807.0, ABS, Canberra.

Australian Bureau of Statistics 1998c, *National Nutrition Survey Nutrient Intakes and Physical Measurements Australia 1995*, Catalogue No. 4805.0, ABS, Canberra.

Australian Bureau of Statistics 1999, *National Nutrition Survey Foods Eaten Australia 1995*, Catalogue No. 4804.0, ABS, Canberra.

Australia and New Zealand Food Authority 1989, *Composition of Foods Australia*, Volumes 1-7, AGPS, Canberra.

Baghurst KI 1999, Red meat consumption in Australia: intakes, contributions to nutrient intake and associated dietary patterns, *European Journal of Cancer Prevention*, 8:185-191.

Baghurst KI & Baghurst PA 1981, the Measurement of Usual Dietary Intake in Individuals and Groups, in *Transactions of the Menzies Foundation*, 3: 139-160.

Beaton GH 1994, Criteria of an Adequate Diet, Chapter 83 in *Modern Nutrition in Health and Disease* 8<sup>th</sup> edn, Eds, RE Shils, JA Olson & M.Shike, Lea & Febiger, Philadelphia, Volume 2, pp.1491-1505.

Bingham SA, Cassidy A, Cole TJ, Welch A, Runswick SA, Black AE, Thurnham D, Bates C, Khaw KT, Key TJA & Day NE 1995, Validation of weighed records and other methods of dietary assessment using the 24 hour urine nitrogen technique and other biological markers, *British Journal of Nutrition* 73:531-550.

Black AE, Prentice AM, Goldberg GR, Jebb SA, Bingham SA & Coward WA 1993, Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake, *Journal of the American Dietetic Association* 93:572-579.

Black AE, Goldberg GR, Jebb SA, Livingstone MBE, Cole TJ & Prentice AM 1991, Critical evaluation of energy intake data using fundamental principles of energy physiology: 2 Evaluating the results of published surveys, *European Journal of Clinical Nutrition* 45:583-599.

Buzzard M 1998, 24-hour dietary recall and food record methods, Chapter 4 in *Nutritional Epidemiology* 2<sup>nd</sup> edn, ed W Willett, Oxford University Press, Oxford.

Commonwealth Department of Health 1986, *National dietary survey of adults:1983 no.1 Foods consumed*, AGPS, Canberra.

Department of Community Services and Health 1987, *National dietary survey of adults:1983 no.2 Nutrient intakes*, Commonwealth Government Printer, Canberra.

Department of Community Services and Health 1988, *National dietary survey of schoolchildren (10-15years): 1985 no.1 - Foods consumed*, AGPS, Canberra.

Department of Community Services and Health 1989, *National dietary survey of schoolchildren (10-15years): 1985 no.2 Nutrient intakes*, AGPS, Canberra.

Department of Health and Social Security 1991, *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom, Report on Health and Social Subjects 41*, HMSO, London.

Department of Human Services and Health and Australian Bureau of Statistics 1995, *National Nutrition Survey 1995, Interviewer Instruction Manual*, AGPS, Canberra.

Department of Human Services and Health and Australian Bureau of Statistics 1995, *National Nutrition Survey 1995, Food Instruction Booklet*, AGPS, Canberra.

Gibson RS, 1990, *Principles of Nutritional Assessment*, Oxford University Press, Oxford.

Goldberg GR, Black AE, Jebb SA, et al. 1991, Critical evaluation of energy intake data using fundamental principles of energy physiology; 1 derivation of cut-off limits to identify under recording, *European Journal of Clinical Nutrition* 45:569-581.

Hegsted DM 1972, Problems in the use and interpretation of the Recommended Dietary Allowances, *Ecology of Food and Nutrition* 1:255-265.

Institute of European Food Studies 1998, *The effect of survey duration on the estimation of food chemical intakes*, IEFS, Dublin.

Ireland P, Jolley D, Giles G, O'Dea K, Powles J, Rutishauser I, Wahlqvist M & Williams J 1994, Development of the Melbourne FFQ: a food frequency questionnaire for use in an Australian prospective study involving an ethnically diverse cohort, *Asia Pacific Journal of Clinical Nutrition* 3:19-31.

Kaaks R, Slimani N & Riboli E 1997, Pilot phase studies on the accuracy of dietary intake measurements in the EPIC Project: overall evaluation of results, *International Journal of Epidemiology* 26(Suppl.1):S26-36.

Mackerras D 1991, *Interpreting dietary data*, Xyris Software, Highgate Hill.

National Heart Foundation of Australia 1982, *Risk Factor Prevalence Study Report No.1 - 1980*, NHF, Canberra.

- National Heart Foundation of Australia 1985, *Risk Factor Prevalence Study Report No.2 - 1983*, NHF, Canberra.
- National Heart Foundation of Australia 1990, *Risk Factor prevalence Study Survey No.3 - 1989*, NHF and Australian Institute of Health, Canberra.
- National Health and Medical Research Council 1991, *Recommended Dietary Intakes for use in Australia*, AGPS, Canberra.
- National Research Council 1986, *Nutrient Adequacy*, National Academy Press, Washington, DC.
- Paul AA & Southgate DAT 1978, *McCance and Widdowson's The Composition of Foods*, 4<sup>th</sup> revised edn, HMSO, London.
- Radimer KL, Olson CM, Greene JC et al. 1992, Understanding hunger and developing indicators to assess it in women and children, *Journal of Nutrition Education* 24:36S-44S.
- Rutishauser IHE 1999, Monitoring fruit and vegetable intake: an evaluation of two simple questions, in *Weighing the Evidence, Proceedings of the Pacific Partners in Nutrition Conference*, Auckland New Zealand September 1999, p.180.
- Sempos CT, Looker AC, Johnson CL & Woteki, CE 1991. The importance of within-person variability in estimating prevalence. Chapter 9 in *Monitoring Dietary Intakes*, ILSI Monographs, ed I Macdonald, Springer-Verlag, Heidelberg.
- Sempos CT, Briefel RR, Flegal KM, Johnson CL, Murphy RS & Woteki CE 1992, Factors involved in selecting a dietary survey methodology for national nutrition surveys, *Australian Journal of Nutrition and Dietetics* 49:96-101.
- Wheeler C, Rutishauser I, Conn J & O'Dea K 1994, Reproducibility of a meal-based food frequency questionnaire. The influence of format and time interval between questionnaires, *European Journal of Clinical Nutrition* 48:795-809.
- Wheeler C, Rutishauser IHE & O'Dea K 1995, Comparison of nutrient intake data from two food frequency questionnaires and weighed records, *Australian Journal of Nutrition and Dietetics*, 52:140-148.
- Willett W 1998, Food frequency methods, Chapter 5 in *Nutritional Epidemiology* 2<sup>nd</sup> edn, ed W Willett, Oxford University Press, Oxford.