

Socio-economic differences in fruit and vegetable consumption among Australian adolescents and adults

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Abstract

Objectives: To determine whether socio-economic groups differ in their fruit and vegetable consumption, and the variety eaten, and whether socio-economic differences are similar for adolescents and adults. The study also examined whether socio-economic groups vary in their reported desire to increase the amount of fruit and vegetables consumed, and the perceived barriers to achieving this.

Design, setting and subjects: The 1995 Australian National Nutrition Survey collected fruit and vegetable intake data from adolescents aged 13–17 years ($n = 654$) and adults 18–64 years ($n = 7695$) using a 24-hour dietary recall. Gross annual household income was used to measure socio-economic position.

Results: Approximately 44% of males and 34% of females did not consume fruit in the 24 hours preceding the survey, and 20% of males and 17% of females did not consume vegetables. Among adolescents and adults, fruit and vegetable consumption was positively related to income. The only exception was vegetable consumption among adolescent males, which did not vary by income. Lower-income adults consumed a smaller variety of fruits and vegetables than their higher-income counterparts. Fruit and vegetable variety did not vary by income among adolescents. Lower-income adults expressed less desire to increase their fruit and vegetable consumption, and were more likely to report that price and storage were barriers to doing so. Socio-economic differences in consumption and variety were more apparent for adults than for adolescents.

Conclusions: In addition to increasing the consumption of fruits and vegetables among the general population, nutrition interventions, programmes and policy aiming to improve diet should target adolescents and adults from low socio-economic groups. Strategies should address price and storage barriers.

Keywords

Fruits
Vegetables
Socio-economic position
Variety
Barriers

In Western countries, cardiovascular disease (CVD) and cancer account for the greatest proportion of mortality, and dietary factors are believed to play a substantial role in their aetiologies¹. Epidemiological evidence has demonstrated inverse associations between fruit and vegetable intake and the risk of CVD and some cancers^{2–5}. Antioxidants and non-nutrient components of fruits and vegetables are thought to be protective and contribute to lower risks of these diseases^{2–4}. Nutrition guidance around the world is consistent in recommending eating more fruit and vegetables for both children and adults^{1–3}. Many of these guidelines also recommend that people ‘choose a variety of fruits and vegetables’, to increase their intake of protective factors¹.

The burden of CVD and cancer is not equally distributed among people from different socio-economic backgrounds, with adults of low socio-economic position (SEP) experiencing the greatest morbidity and mortality from chronic disease^{6–10}. Differences in dietary intake are

believed to contribute significantly to these inequalities, and it may be that protective factors obtained from greater fruit and vegetable intake play an especially important role^{9,11}.

Many public health policies and programmes have sought to decrease socio-economic inequalities in food consumption¹². Crucial factors that may influence their success is the willingness of lower socio-economic groups to change their food intake and the barriers they perceive in doing so¹³. No known studies have looked at how these factors vary between socio-economic groups in the Australian population.

The aims of this study are to determine whether socio-economic groups differ in their fruit and vegetable consumption, and if these socio-economic relationships are similar for adolescents and adults. This study also examines whether socio-economic groups vary in their desire to increase the amount of fruit and vegetables consumed, and the perceived barriers to doing so.

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Method

The data used in this study were collected by the Australian Bureau of Statistics (ABS) as part of the 1995 Australian National Nutrition Survey (NNS) and are used with permission from the ABS. Detailed information on the sample selection, scope and coverage, data collection and processing of the NNS has been published elsewhere¹⁴. Only a brief overview is provided here.

Sample design

The NNS was conducted on a sub-sample of participants from the 1995 Australian Health Survey (AHS). Selected AHS participants gave consent to be re-contacted for the NNS. Sampling for the NNS was based on a multi-stage area sample of households, ensuring adequate representation of urban and rural areas across all States and Territories of Australia. Two people per household were randomly selected to take part in the urban areas, and three people per household in the rural areas. After excluding refusals, non-contacts and other non-responding groups, the sample size for the survey was 13 858 (61% response rate)¹⁴.

Data collection and survey instrument

Data were collected by face-to-face interviews using qualified dietitians trained in the NNS interview procedure. Persons aged 18 years or older were personally interviewed. Adolescents 15–17 years old were interviewed by themselves with their assent, and the consent of a responsible adult. For adolescents younger than 15 years, a responsible adult was interviewed on their behalf. A range of questionnaires was administered during the interview, including a 24-hour dietary recall and a questionnaire on demographic characteristics, food habits and perceptions. To account for seasonal and day-of-the-week variation, interviews were conducted on all days of the week throughout a 12-month collection period.

Fruit and vegetable consumption and variety data were obtained from the 24-hour dietary recall. The multiple-pass 24-hour recall procedure used in the US Continuing Survey of Food Intakes of Individuals¹⁴ was employed in this study to ensure accurate recall and description of items consumed.

Fruit and vegetable consumption and variety (dependent measures)

Participants were coded as either 'consuming' or 'not consuming' fruit or vegetables based on their responses to the 24-hour dietary recall. Fruit consumption included pure fruit juices and raw, cooked, canned, frozen or dried fruits. Vegetables included all raw, cooked, canned, frozen or dried vegetables and legumes. Fruit and vegetables in mixed dishes (e.g. fruit pies, spaghetti sauce) were not included in these analyses as they are generally minor ingredients, and are not significant contributors to intakes

of anti-oxidants and other protective nutrients¹⁵. Fruit and vegetables in mixed dishes have also been excluded by other researchers examining socio-economic differences in fruit and vegetable consumption^{16,17}. Similar to other studies^{13,16,18}, potatoes were excluded from the vegetable category as they may obscure potentially important associations between SEP and vegetable consumption. Lower socio-economic groups generally eat more potatoes than higher socio-economic groups; however, potatoes are lower in protective factors and often eaten in higher-fat dishes in comparison to other vegetables¹.

Variety was measured as the number of different types of fruits or vegetables reported in the 24-hour recall. Different types of the same fruits and vegetables did not constitute different varieties. For example, red and green apples were considered as one variety: 'apples'. It is acknowledged that any measurement of variety is arbitrary. The measurement used in this study attempts to capture the different contents of nutrient and non-nutrient factors in different types of fruits and vegetables. Each variety of fruit or vegetable consumed was given a score of 1. In mixed fruit and vegetable dishes, such as salads, a conservative score of 2 was given, assuming the item would contain at least two types of fruit or vegetables. In some cases, the food code indicated how many types were in the dish, for example 'orange–mango juice', and these were scored accordingly. Scores were summed for fruit and vegetables for each participant, and square-root-transformed to obtain an approximate normal distribution.

Desire to increase fruit and vegetable consumption (dependent measure)

Participants 16 years and older were asked, 'Would you like to change the amount you eat of any of the following foods?' They were then presented with a list of food categories. If they responded 'yes' to fruit and vegetables, they were subsequently asked how they would like to change their intake. Responses were pre-coded as 'increase', 'decrease' or 'not stated'.

Barriers to changing fruit and vegetable intake (dependent measures)

If the participant wanted to change their fruit and vegetable intake, they were asked about barriers preventing them doing so. Responses were unprompted and assigned by the interviewer into one or more of eight pre-coded categories: price, time, storage, availability, quality, don't like, like too much and 'other'.

Socio-economic position

Household income was used as the socio-economic indicator. Household income questions related to cash income and excluded non-cash receipts such as income in kind, capital transfers and capital gains and losses. Participants 15 years of age or older were asked about income received from their own business (after the

deduction of business expenses), investments, wages or salary, government, family and insurance payments, superannuation and any other sources over the last financial year before tax was deducted. This was summed for each member of the household, and coded into 17 income categories prior to the release of the NNS data file. These were grouped into quintiles (AUS\$): \$0–22 499; \$22 500–37 499; \$37 500–52 499; \$52 500–74 999; and \$75 000+.

Statistical analysis

Of the 13 858 persons in the original sample, those aged 12 years or younger ($n = 2079$, 15%) and 65 years or older ($n = 1960$, 14%) were excluded from these analyses. Participants whose household income was negative, not known or pre-coded as 'not applicable' on the data file (households consisting only of full-time students or dependent children living away from home) were also excluded ($n = 1470$, 11%). The final dataset used in these analyses comprised 654 adolescents (13–17 years) and 7695 adults (18–64 years). Only participants who consumed fruit or vegetables were included in the variety analyses. Desire to change fruit and vegetable intake and perceived barriers were not analysed among adolescents due to small sample sizes. Adults who reported wanting to decrease their intake of fruit and vegetables ($n = 3$), or did not state whether they wanted to change ($n = 3$), were excluded from the analyses of barriers.

Logistic regression was used to examine household income differences in fruit and vegetable consumption, desire to increase fruit and vegetable consumption, and

perceived barriers. General linear models were used to examine the associations between income and fruit and vegetable variety. All analyses were adjusted for age (available on the dataset as a categorical variable), and the highest income quintile was used as the reference category. Analyses were conducted using SPSS Version 10.0¹⁹. Statistical significance was considered at $P \leq 0.05$ (two-tailed) for all tests.

Results

Characteristics of the sample

Table 1 shows the sample's demographic characteristics, fruit and vegetable dietary behaviours, desire to increase intake, and perceived barriers. More adolescents than adults did not consume vegetables, and consumed a lower variety of vegetables. Fruit consumption was not noticeably different between adolescents and adults. More females than males consumed fruit. Males and females were similar with respect to their vegetable consumption, fruit and vegetable variety, wanting to increase intake, and perceptions of price, storage and time as barriers.

Fruit and vegetable consumption

Not consuming either fruit or vegetables was inversely related to income for both adolescents and adults. Lower-income groups were more likely to have not consumed fruit or vegetables in the 24 hours preceding the survey (Table 2). The only exception to this trend was vegetable consumption among adolescent boys, which showed

Table 1 Characteristics of the adolescent and adult sample from the Australian National Nutrition Survey

	Adolescents (13–17 years old)		Adults (18–64 years old)	
	Males % (n)	Females % (n)	Males % (n)	Females % (n)
Household income quintile*				
\$75 000+	20 (67)	22 (70)	18 (662)	15 (628)
\$52 500–74 999	17 (58)	18 (56)	18 (654)	16 (647)
\$37 500–52 499	19 (65)	18 (57)	21 (750)	18 (745)
\$22 500–37 499	22 (76)	21 (66)	22 (809)	22 (879)
\$0–22 499	22 (75)	21 (64)	21 (751)	29 (1170)
Fruit and vegetable consumption, % (n)				
Did <i>not</i> consume fruit in previous 24 hours	46 (156)	38 (118)	43 (1574)	34 (1390)
Did <i>not</i> consume vegetables in previous 24 hours	35 (120)	29 (90)	18 (654)	16 (670)
Fruit and vegetable variety†				
Mean fruit variety (SD) in previous 24 hours	1.4 (0.3)	1.7 (0.3)	2.0 (0.4)	2.0 (0.4)
Mean vegetable variety (SD) in previous 24 hours	2.6 (0.5)	2.6 (0.5)	3.2 (0.5)	3.6 (0.5)
Want to increase fruit and vegetable consumption, % (n)			33 (1201)	32 (1315)
Perceived barriers to increasing fruit and vegetable consumption‡, % (n)				
Price			8 (90)	7 (97)
Storage			4 (50)	3 (38)
Time			22 (262)	22 (287)

* Excludes respondents whose household income was negative ($n = 123$), was not known/not stated ($n = 1313$) or not applicable ($n = 34$). Income given in Australian dollars.

† Mean variety is adjusted for age. Variety score for fruit ranged from 1 to 11, and for vegetables from 1 to 16. SD – standard deviation.

‡ Only asked of respondents 16 years and older; therefore results are only shown for 18–64 year age group. Only barriers for which income trends were evident are shown in the table.

Table 2 Odds ratios (95% confidence intervals) for not consuming fruit and vegetables by household income*

Household income (quintile)	Did <i>not</i> consume fruit on previous day				Did <i>not</i> consume vegetables on previous day			
	13–17 years old		18–64 years old		13–17 years old		18–64 years old	
	Males	Females	Males	Females	Males	Females	Males	Females
5 (high)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4	1.6 (0.8–3.5)	1.2 (0.6–2.6)	1.5 (1.2–1.8)	1.6 (1.2–2.0)	0.7 (0.3–1.5)	1.1 (0.5–2.4)	1.4 (1.1–1.9)	1.2 (0.9–1.6)
3	1.4 (0.7–2.9)	1.1 (0.5–2.4)	1.5 (1.2–1.8)	1.6 (1.3–2.0)	0.6 (0.3–1.2)	0.8 (0.4–1.8)	1.2 (0.9–1.5)	1.1 (0.8–1.5)
2	3.5 (1.7–7.0)	2.2 (1.1–4.4)	1.7 (1.4–2.1)	1.9 (1.5–2.4)	0.9 (0.5–1.7)	1.1 (0.5–2.3)	1.6 (1.2–2.1)	1.3 (1.0–1.7)
1 (low)	3.0 (1.5–6.0)	1.3 (0.6–2.7)	2.3 (1.9–2.9)	2.5 (2.0–3.1)	0.8 (0.4–1.6)	1.5 (0.7–3.1)	1.6 (1.2–2.2)	1.6 (1.2–2.1)
<i>P</i> -value†	<0.01	0.21	<0.01	<0.01	0.66	0.62	<0.01	<0.01

*Odds ratios are adjusted for age.

†*P*-value for significance of overall model.

similar odds ratios irrespective of income. Fruit consumption among adults demonstrated a clear inverse dose–response relationship with income. There were no gradients for the remaining relationships, as the main differences were primarily between the highest and lowest or bottom two quintiles. The relationship between household income and fruit and vegetable consumption was statistically significant predominantly among adults.

Fruit and vegetable variety

Income was significantly related to fruit and vegetable variety only among adults (Table 3). Of those who reported eating fruit and vegetables, low-income adults consumed a more limited variety than high-income adults. For fruit variety, the main income differences were between the highest income group and all other income groups. Among adult males, fruit variety demonstrated a positive relationship with income. Income differences in vegetable variety were primarily between the highest- and lowest-income adults. Fruit and vegetable variety was similar for adolescents from different socio-economic backgrounds.

Desire to increase fruit and vegetable intake and perceived barriers

Male and female adults from low-income households were less likely to want to increase their fruit and vegetable intake (Table 4). Availability, quality, taste preference and ‘other’ perceived barriers did not vary by household income (data not presented here). However, price, storage and time were perceived as barriers differently between socio-economic groups. The income relationship was strongest for price, which was more likely to be perceived as a barrier with decreasing household income, and more so among females than among males. Lower-income males and females were also more likely to perceive storage as a barrier to increasing fruit and vegetable consumption. Income was only weakly related to the perception of time as a barrier, with low-income groups being slightly less likely to see this as a barrier than adults from higher income groups.

Discussion

The results of this study show that socio-economic groups differ in their fruit and vegetable intakes. Lower socio-economic groups were less likely to consume fruit or vegetables, and consumed fewer varieties than higher

Table 3 Variety of fruits and vegetables consumed (mean, standard deviation) by household income†

Household income (quintile)	Variety of fruits consumed on previous day‡				Variety of vegetables consumed on previous day§			
	13–17 years old		18–64 years old		13–17 years old		18–64 years old	
	Males	Females	Males	Females	Males	Females	Males	Females
5 (high)	1.5 (0.3)	1.8 (0.4)	2.0 (0.4)	2.2 (0.5)	2.4 (0.4)	2.7 (0.5)	3.4 (0.5)	3.5 (0.6)
4	1.5 (0.3)	1.4 (0.3)	1.9 (0.4)*	1.8 (0.4)*	3.1 (0.5)*	3.0 (0.3)	3.4 (0.5)	3.6 (0.5)
3	1.5 (0.4)	1.7 (0.3)	1.8 (0.4)*	1.9 (0.4)*	2.5 (0.4)	2.8 (0.5)	3.2 (0.5)*	3.4 (0.5)
2	1.4 (0.4)	1.6 (0.3)	1.8 (0.4)*	1.8 (0.4)*	2.8 (0.5)	2.5 (0.4)	3.3 (0.5)	3.4 (0.6)
1 (low)	1.6 (0.3)	1.7 (0.4)	1.7 (0.4)*	1.9 (0.4)*	2.3 (0.5)	2.5 (0.6)	3.1 (0.5)*	3.3 (0.5)*
<i>P</i> -value¶	0.95	0.27	<0.01	<0.01	0.12	0.65	<0.01	<0.01

† Mean variety is adjusted for age.

‡ Variety score for fruit ranged from 1 to 11.

§ Variety score for vegetables ranged from 1 to 16.

¶ *P*-value for significance of overall model.*, *P* ≤ 0.05 in paired comparisons with the fifth (highest) income quintile.

Table 4 Desire to increase fruit and vegetable intake and perceived barriers by household income among 18–64 year olds (odds ratios and 95% confidence intervals)*

Household income (quintile)	Wants to increase fruit and vegetable consumption		Perceived barriers to increasing fruit and vegetable consumption					
	Males	Females	Price		Storage		Time	
			Males	Females	Males	Females	Males	Females
5 (high)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4	1.0 (0.8–1.3)	0.9 (0.7–1.2)	2.4 (0.8–6.8)	4.5 (1.0–21.3)	0.7 (0.2–2.1)	1.0 (0.2–3.9)	0.9 (0.6–1.3)	1.2 (0.8–1.9)
3	0.9 (0.7–1.1)	0.8 (0.7–1.0)	3.3 (1.2–9.1)	8.4 (1.9–36.7)	0.8 (0.3–2.6)	1.6 (0.5–5.6)	0.9 (0.6–1.4)	0.8 (0.5–1.2)
2	0.8 (0.7–1.0)	0.8 (0.7–1.0)	4.5 (1.7–12.2)	11.5 (2.7–49.2)	1.8 (0.7–4.7)	2.1 (0.6–6.7)	0.9 (0.6–1.4)	0.8 (0.5–1.3)
1 (low)	0.7 (0.6–1.0)	0.7 (0.6–0.9)	8.8 (3.4–23.0)	17.9 (4.3–74.5)	3.1 (1.3–7.7)	2.5 (0.8–7.6)	0.6 (0.4–1.0)	0.8 (0.5–1.2)
<i>P</i> -value†	0.05	0.05	<0.01	<0.01	<0.01	0.40	0.44	0.15

*Odds ratios are adjusted for age.

†*P*-value for significance of overall model.

socio-economic groups. They were also less likely to want to increase their fruit and vegetable consumption, and more likely to perceive price and storage as barriers to doing so. Socio-economic differences in fruit and vegetable consumption were generally larger among adults than adolescents.

Previous studies of fruit and vegetable intakes by SEP are difficult to compare because they have used varying dietary intake methodologies, non-identical fruit and vegetable categories, and different socio-economic indicators. These may contribute to inconsistencies in the direction and magnitude of associations reported. However, the findings of this study were consistent with most studies, which have demonstrated that both adolescents and adults from lower socio-economic groups consume smaller quantities of fruit and vegetables compared with their higher socio-economic counterparts^{13,16,20–25}.

Low socio-economic groups have been shown to have a more limited variety of foods in their overall diet than higher socio-economic groups^{26,27}. These studies however did not focus specifically on fruit and vegetables, and the only known study to do so was conducted among elderly people²⁸. This previous study found that socio-economically disadvantaged groups reported consuming a lower variety of fruit and vegetables. Although this current study focused on adults aged 18–64 years, similar results were observed.

Low socio-economic groups may be less likely to want to increase their fruit and vegetable intakes because they perceive more barriers to doing so, or see no need to make changes to their current diet. Some research has shown that low socio-economic groups perceive their diet as being healthy, despite being less consistent with recommendations like dietary guidelines²⁹. The results of this present study are similar to the findings of previous studies in that fruit and vegetables are perceived as being expensive by low socio-economic groups^{29–31}. Low socio-economic groups generally have a more restrictive food budget, and fruit and vegetables may be overlooked in favour of more energy-dense and satisfying foods. Storage

has also been reported as a barrier to making positive dietary changes^{30,31}. Virtually all households in Australia (99.6%) had refrigerators at the time of the survey³²; however, lower socio-economic groups may have had more limited storage space in smaller dwellings like caravans³⁰. Storage may also be perceived as a barrier because fruit and vegetables are perishable, and purchasing them may result in wastage.

Unlike other studies, low socio-economic groups in this study did not report availability and quality as barriers to increasing their fruit and vegetable consumption. Lower socio-economic groups have reported that fruits and vegetables are not readily available in stores that they shop in, and are of a poor quality^{30,31}. These studies were conducted in the United States, and no known study has looked at whether these factors are perceived as barriers within the Australian context. A limitation of the current study was that participants who reported that they did not want to increase their fruit and vegetable intake were not subsequently asked why they did not want to change.

A number of explanations may account for why socio-economic associations for fruit and vegetable consumption were stronger among adults. Firstly, this may reflect cohort effects. The adolescents in this study may have benefited from strategies to decrease socio-economic differences in fruit and vegetable intakes. Secondly, adolescence may not be a time in the life stage in which socio-economic differences in health behaviours are apparent. Socio-economic differences in other health behaviours, such as smoking and alcohol consumption, are not obvious among adolescents, but clear socio-economic gradients are evident among adults³². Influences unique to adolescence, such as body image, increasing independence from parents and establishing one's own identity, also may have contributed to less steep socio-economic gradients among this group³².

Only 61% of the total NNS sampling frame responded to this survey. This is lower than in other national surveys in Australia, and is most likely the result of asking participants who had already completed a detailed health survey to undertake a further study¹⁴. Non-respondents

were more likely to be single, unemployed or high-income earners¹⁴. This suggests that both the lowest and the highest socio-economic groups may have been under-represented in this study, possibly attenuating any socio-economic gradient. Additionally, higher rates of underreporting have been shown among adolescents and adults from low socio-economic backgrounds^{33,34}. Energy underreporters may be more conscious of desirable dietary behaviours and may have a tendency to over-report their fruit and vegetable intakes, in which case socio-economic differences in fruit and vegetable dietary behaviour may be underestimated in this study.

These findings suggest that public health nutrition interventions, programmes and policy should continue to aim to improve the fruit and vegetable consumption of the whole population. However, low socio-economic groups should be specifically targeted in such strategies as they have fruit and vegetable intakes least in accordance with dietary recommendations. Some strategies to decrease socio-economic differences could involve promoting inexpensive ways to increase fruit and vegetable consumption, ensuring that people with low incomes or those receiving government benefits have enough money to purchase healthy foods, by adopting a voucher system for fruit and vegetables for low-income earners and/or promoting ways to store fruit and vegetables to extend shelf-life. Resources to decrease inequalities in fruit and vegetable intakes should be aimed at adolescents and adults, as there is room for improvement in both age groups, and adults indirectly influence the dietary behaviours of adolescents. Further research should explore why low socio-economic groups have less desire to increase their fruit and vegetable intakes, and whether there are additional structural, knowledge and skills barriers inhibiting their intakes.

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References

- Krebs-Smith SM, Scott Kantor L. Choose a variety of fruit and vegetables daily: understanding the complexities. *J. Nutr.* 2001; **131**: 487S–501S.
- Ness AR, Powles JW. Fruit and vegetables, and cardiovascular disease: a review. *Int. J. Epidemiol.* 1997; **26**(1): 1–13.
- Steinmetz KA, Potter JD. Vegetables, fruit, and cancer prevention: a review. *J. Am. Diet. Assoc.* 1996; **96**: 1027–39.
- Nestle M. Fruit and vegetables: protective or just fellow travellers? *Nutr. Rev.* 1996; **54**: 255–7.
- Van Duyn MAS, Pivonka E. Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: selected literature. *J. Am. Diet. Assoc.* 2000; **100**: 1511–21.
- Bennett S. Socioeconomic inequalities in coronary heart disease and stroke mortality among Australian men, 1979–1993. *Int. J. Epidemiol.* 1996; **25**: 266–75.
- Blane D, Hart C, Davey Smith G, Gillis C, Hole D, Hawthorn D. Association of cardiovascular risk factors with socio-economic position during childhood and adulthood. *Br. Med. J.* 1996; **313**: 1434–8.
- Iribaren C, Luepker P, McGovern P, Arnett P, Blackburn H. Twelve year trends in the Minnesota Heart Study: are socioeconomic differences widening? *Arch. Intern. Med.* 1997; **157**: 873–80.
- James WPT, Nelson M, Leather S. The contribution of nutrition to inequalities in health. *Br. Med. J.* 1997; **314**: 1545–9.
- Turrell G, Mathers C. Socioeconomic status and health in Australia. *Med. J. Aust.* 2000; **172**: 434–8.
- Davey Smith G, Brunner E. Socioeconomic differentials in health: the role of nutrition. *Proc. Nutr. Soc.* 1997; **56**: 75–90.
- Lester IH. *Australia's Food and Nutrition*. Canberra: Australian Government Publishing Service, 1994.
- Thompson RL, Margetts BM, Speller VM, McVey D. The Health Education Authority's Health and Lifestyle Survey 1993: who are the low fruit and vegetable consumers? *J. Epidemiol. Community Health* 1999; **53**: 294–9.
- McLennan W. *National Nutrition Survey User's Guide*. Canberra: Australian Government Publishing Service, 1998.
- McLennan W, Podger A. *National Nutrition Survey: Nutrient Intakes and Physical Measurements*. Canberra: Commonwealth of Australia, 1998.
- Billson H, Pryer JA, Nichols R. Variation in fruit and vegetable consumption among adults in Britain. An analysis of the Dietary and Nutrition Survey of British adults. *Eur. J. Clin. Nutr.* 1999; **53**: 946–52.
- Magarey A, Daniels LA, Smith A. Fruit and vegetable intakes of Australians aged 2–18 years: an evaluation of the 1995 National Nutrition Survey data. *Aust. NZ J. Public Health* 2001; **25**(2): 155–61.
- Roos E, Prattala R, Lahelma E, Kleemola P, Pietinen P. Modern and healthy?: socioeconomic differences in the quality of diet. *Eur. J. Clin. Nutr.* 1996; **50**: 753–60.
- SPSS, Inc. *Statistical Package for the Social Sciences, Version 10.0*. New York: SPSS, Inc., 2000.
- Lowry R, Kann L, Collins JL, Kolbe LJ. The effect of socioeconomic status on chronic disease risk behaviours among US adolescents. *J. Am. Med. Assoc.* 1996; **276**: 792–7.
- Hoglund D, Samuelson G, Mark A. Food habits in Swedish adolescents in relation to socioeconomic conditions. *Eur. J. Clin. Nutr.* 1998; **52**: 784–9.
- Steele P, Dobson A, Alexander H, Russell A. Who eats what? A comparison of dietary patterns among men and women in different occupational groups. *Aust. J. Public Health* 1991; **15**: 286–95.
- Bolton-Smith C, Brown CA, Tunstall-Pedoe H. Nutrient sources in non-manual and manual occupational groups. Results from the Scottish Heart Health Study (SHHS). *J. Hum. Nutr. Diet.* 1991; **4**: 291–306.
- Trudeau E, Kristal AR, Patterson RE. Demographic and psychosocial predictors of fruit and vegetable intakes differ: implications for dietary interventions. *J. Am. Diet. Assoc.* 1998; **98**: 1412–7.
- Irala-Estevez JD, Groth M, Johansson L, Oltersdorf U, Prattala R, Martinez-Gonzalez MA. A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables. *Eur. J. Clin. Nutr.* 2000; **54**: 706–14.
- Kant AK, Block G, Schatzkin A, Ziegler RG, Nestle M. Dietary diversity in the US population, NHANES II, 1976–1980. *J. Am. Diet. Assoc.* 1991; **91**: 1526–31.

- 27 Wolfe WS, Campbell CC. Food pattern, diet quality, and related characteristics of school children in New York State. *J. Am. Diet. Assoc.* 1993; **93**: 1280–4.
- 28 Horwath CC. Socio-economic status and dietary habits in the elderly: results from a large random survey. *J. Hum. Nutr. Diet.* 1989; **2**: 173–83.
- 29 Cotunga N, Subar AF, Heimendinger J, Kahle L. Nutrition and cancer prevention knowledge, beliefs, attitudes, and practices: the 1987 National Health Interview Survey. *J. Am. Diet. Assoc.* 1992; **92**: 963–8.
- 30 Reicks M, Randall JL, Haynes BJ. Factors affecting consumption of fruits and vegetables by low income families. *J. Am. Diet. Assoc.* 1994; **94**: 1309–11.
- 31 Treiman K, Freimuth V, Damron D, Lasswell A, Anliker J, Havas S, *et al.* Attitudes and behaviours to fruits and vegetables among low-income women in the WIC program. *J. Nutr. Educ.* 1996; **28**: 149–56.
- 32 West P. Inequalities? Social class differentials in health in British youth. *Soc. Sci. Med.* 1988; **27**(4): 833–58.
- 33 Magarey A, Boulton J. The Adelaide Nutrition Study. 1. Food energy intake through adolescence: including an evaluation of the problem of under-recording, age and sex differences. *Aust. J. Nutr. Diet.* 1997; **51**: 104–10.
- 34 Stallone DD, Brunner EJ, Bingham SA, Marmot MG. Dietary assessment in Whitehall II: the influence of reporting bias on apparent socioeconomic variation in nutrient intakes. *Eur. J. Clin. Nutr.* 1997; **51**: 815–5.