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VOLUME SEVEN: DATA LINKAGES

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The 2007 Australian National Children's Nutrition and Physical Activity Survey

Volume Seven: Data Linkages

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FOREWORD AND ACKNOWLEDGEMENTS

Dietary intake is a key determinant of health and wellbeing, and overall intake is directly or indirectly related to many chronic diseases in the Australian population. Dietary intake in childhood and adolescence is particularly important not only because of its impact on immediate health, but also because of its impact on physiological development and possible influence on future dietary patterns.

Dietary behaviour is a complex activity encompassing what foods and drinks are consumed, how they are prepared, how much is consumed and with what, and where food and drinks are consumed. The meaning of dietary intake in terms of nutrients consumed is important to assess aspects of dietary adequacy and overconsumption. This description of how the population of Australian children and adolescents consume food and drink will be useful to the public and private sector in assessing how dietary intake is changing, and in working towards improving dietary intake. The information will be of practical use to government policy makers, health professionals, the food and beverage industry and health advocates. Healthy life-long eating habits are important for all Australians.

This publication is one of a series of eight publications which presents data on food and beverage consumption, nutrient intake and physical activity by the Australian population aged 2–16 years. The data are derived from the 2007 Australian National Children's Nutrition and Physical Activity Survey (ANCNPAS) which collected information on food and nutrition, body size and physical activity.

The 2007 ANCNPAS was jointly funded by the Australian Food and Grocery Council, the Commonwealth Department of Health and Ageing and the Commonwealth Department of Agriculture, Fisheries and Forestry. The survey was conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) through its Preventative Health National Research Flagship, and the University of South Australia. The survey fieldwork was undertaken by I-view Pty Ltd. In particular the following persons are thanked for their contribution:

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1. BACKGROUND INFORMATION

1.1 Introduction

The 2007 Australian National Children's Nutrition and Physical Activity Survey (ANCNPAS) was conducted between February and September of 2007. Complete datasets from a total of 4487 children aged 2–16 years from across all Australian states and territories were obtained in the survey following parental consent, after being randomly selected to participate on a household basis. Children residing in very remote areas or in households without a fixed telephone line were not included in the survey.

This survey collected the following data:

- demographics, including sex, age, state/territory of residence, child's country of birth, parent(s)/carer(s) education level, household income and Indigenous status,
- dietary consumption, including all foods, beverages and dietary supplements consumed using two 24-hour three-pass dietary recalls,
- physical activity and sedentary behaviours using four 24-hour recalls,
- pedometer data measured over six days,
- anthropometric, including height, weight and waist measurements, and
- food habit information by questionnaire.

The first 24-hour dietary recall was undertaken during a computer assisted personal interview (CAPI) with a trained interviewer in the participant's home, followed by the second recall 7–21 days later during a computer assisted telephone interview (CATI). Life in New Zealand dietary recall software (LINZ24©) and a food model booklet were used to assist in recording detail about items consumed.

Nutrient intakes were estimated from the food, beverage and dietary supplement data using the AUSNUT2007 food composition database developed for this survey by Food Standards Australia New Zealand.

Comprehensive details of the survey methodology and procedures are provided in the 2007 User Guide (CSIRO et al. 2010), available for download from the Australian Social Sciences Data Archive (ASSDA) website (http://www.assda.edu.au/). The User Guide should be referred to in conjunction with this report.

The purpose of this set of analyses was to examine the relationship of body fatness with a range of variables measured in the 2007 ANCNPAS. Body fatness was represented by adjusting measured Body Mass Index (BMI) for age and sex in order to allow for variation in body morphology in children. This was achieved by defining a variable for each respondent that was the ratio of BMI to the overweight lower limit described by Cole et al. (2000). The overweight lower limit is specific for sex and age in years for children (Cole et al. 2000).

The variables used in the regression were weighted to represent the Australian population.

1.2 Related reports

The summary findings from the survey have been previously reported (CSIRO et al. 2008). This is the seventh report in a series of eight related volumes reporting results from the 2007 ANCNPAS.

Collectively, the eight volumes provide extensive tabulations and analyses on children's current food and nutrient intakes (including supplement use); food, nutrition and physical activity practices; physical measures; demographic characteristics; together with significant linkages between these fields. Supplementary to this work, further analyses were conducted to explore children's estimated acute and chronic dietary exposure to food sourced chemicals.

Volumes one to eight are outlined below.

Volume 1: Foods Eaten

Volume one describes the reported consumption of food and beverages by children using one day 24-hour dietary recall, presented for males, females and all children by age group (2–3, 4–8, 9–13 and 14–16 years). Results are reported within food categories for mean intakes (all children and consumers only); proportion consuming; average portion size consumed; and intake by time of day, place of consumption and meal occasion.

Volume 2: Nutrient Intakes

Volume two describes the nutrient intake by children based on reported food and beverage consumption excluding dietary supplements. Results are presented for males, females and all children by age group (2–3, 4–8, 9–13 and 14–16 years). One day 24-hour dietary recall data is used to report mean and median nutrient intakes and nutrient density for direct comparison with foods consumed (volume 1 of this report series, CSIRO 2011), including the proportion of nutrient intake by food group, time of day, place of consumption and meal occasion. Usual nutrient intake was estimated using two days of 24-hour dietary recall to report the percentile distribution of daily nutrient intakes.

Volume 3: Dietary Supplements Consumed

Volume three describes the reported consumption of dietary supplements by children, presented for males, females and all children by age group (2–3, 4–8, 9–13 and 14–16 years). Data from two days of 24-hour dietary recall are presented in this report to describe the proportion of children consuming dietary supplements; the proportion of total nutrient intake from such supplement use; and the mean and median nutrient intakes for consumers versus non-consumers.

Volume 4: Physical Activity

Volume four describes the physical activity (PA) practices of children, presented for males, females and all children by age group (2–3, 4–8, 9–13 and 14–16 years). Physical activity practices were collected as four 24-hour recalls of PA and sedentary behaviours (9–16 year olds only) and six days of objective pedometer data (5–16 year olds only). Specifically, results include average PA level; average moderate and/or vigorous PA; time spent on non-sedentary, sedentary and screen based activities; and average number of steps and walking distance travelled.

Volume 5: Physical Measures

Volume five describes children's physical measurements, presented for males, females and all children by age group (2–3, 4–8, 9–13 and 14–16 years). Physical measures reported include average height, weight and waist circumference, and the proportion of children by weight status (underweight, normal, overweight and obese) according to international standards of age- and sex- specific BMI cut offs.

Volume 6: Demographics

Volume six describes children's reported consumption of food, beverages and dietary supplements, nutrient intakes, physical activity, and physical measures presented by demographic breakdown. Six demographic variables are presented in volume six, including state of residence; country of birth; highest education level of parent; household annual income grouping; remoteness indicator; and BMI classification. Results are presented for all children (not by age or sex sub-groupings due to small cell sizes for some of the demographic variables).

Volume 7: Data Linkages (this volume)

Volume seven describes the relationship of body fatness with a range of variables measured in the survey including selected nutrient intakes, physical activity practices, and demographics.

Volume 8: Dietary exposure to food sourced chemicals

Volume eight describes children's estimated acute and chronic dietary exposure to food sourced chemicals from reported food and beverage consumption as well as the effects of seasonality on food intake and estimated chemical exposure since the last National Nutrition Survey in 1995.

2. SUMMARY OF FINDINGS

The children's relative BMI (adjusted for age and sex) was found to have a negative association with daily exercise (such as pedometer steps and walking distance), highest education level of parent/carer, and household income. Relative BMI had a negative association with percentage of energy consumed as sugar, and a positive association with sodium intake density. Relative BMI was also found to have a positive association with mean time spent in front of screens per day. Children with too little or too much sleep were more likely to be overweight.

All regression analyses used weighted data to represent the Australian population.

No significant difference was found in relative BMI between residents of metropolitan and non-metropolitan regions of Australia.

In terms of the percentage of children who were categorised overweight or obese:

- 35% of children from households where the highest education level of either parent/carer was year 11or less were obese or overweight, compared to 18% of children where at least one parent had a post graduate diploma or higher (Table 4.3).
- 28% of children from lower income households (<$52,000 per year) were obese or overweight, compared to 20% of children from higher income households (>$104,000 per year) (Table 4.2).
- 29% of physically inactive children (< 7400 steps/day) were obese or overweight, compared to 15% of more active children (>15962 pedometer steps/day) (Table 4.12).
- 27% of physically inactive children (<4 km pedometer walking distance/day) were obese or overweight, compared to 18% of very active children (10–25 km pedometer walking distance/day) (Table 4.13).
- 28% of physically inactive children (< 1.44 Physical Activity Level in METs) were obese or overweight, compared to 21% of more active children (>1.84 METs) (Table 4.15).
- 30% of children who spent over 5.3 hours/day (319 minutes/day) in front of a screen were overweight or obese compared to 18% of children who spent less than 1.5 hrs/day (94 minutes/day) in front of a screen (Table 4.20).
- 23% of children who slept within ½ hour of average sleep time/day were obese or overweight compared to 29% of children who slept either more than one hour above or one hour below the average sleep time per day (Table 4.19).
- 23% of children who were in the lowest decile of sodium intake density were obese or overweight, compared to 30% of children who were in the highest decile of sodium intake density (Table 4.9).

2.1 Multivariate linear regression analysis

2.1.1 Exercise, sleep, screen time and demographic variables

Pedometer steps ($p<0.001$), highest education level of either parent/carer ($p<0.05$) and household income ($p<0.05$) were found to be jointly related to relative BMI by stepwise regression. This means that once household income, highest education of either parent/carer and average daily pedometer steps were included in a linear model, none of the other exercise, sleep, screen time or other demographic variables improved the prediction of relative BMI. However, only 2% of the variance in relative BMI is explained by pedometer steps, highest education level of either parent/carer and household income.

2.2 Other noted relationships between variables

- Highest education level of either parent/carer and household income were correlated.
- Households with a higher income tended to have at least one parent/carer with a higher level of formal education.
- Children with parent/carers who attained a lower level of formal education spent more time in front of screens ($p<0.001$, almost one hour more per day).
- Children from households with a lower income spent more time in front of screens ($p<0.001$, 38 minutes more per day).
- There was no evidence that highest education level of either parent/carer was related to physical activity.
- Household annual income was statistically significantly related to physical activity.

3. METHODS

The purpose of this analysis was to describe the cross-sectional relationship of body mass index BMI (as a surrogate of body fatness) with a number of different variables. Linear regression was used to model the relationships using the ratio of the BMI to Cole's age and sex defined overweight lower limit (called the relative BMI) as the response variable to correct for sex and age (Cole et al. 2007). The percentage of children who were classified as overweight or obese is easily derived from this ratio (i.e. it is the percentage where ratio ≥ 1.0), and is shown in the tables and figures for ease of interpretation.

On distributional graphs, data is often presented as 10% groupings (deciles) across horizontal axis – however linear relationships were determined on the underlying continuous data. Where all children are included in the distribution, each decile includes about 449 children. For graphs depicting children eight years of age and under, there are about 229 in each decile. The relationship of nutrient intake data with relative BMI was dichotomised by age because dietary intake for children eight years of age and younger was recalled by caregivers, while older children recalled their food intake themselves. Generally graphs are displayed with the same scale on the vertical axis so that the slopes can be compared across the different predictor variables (i.e. dietary intake, exercise and demographic factors).

Reported household income and highest education level of either parent/carer were found to be significantly related to BMI. These were therefore included as covariates in multiple regression models. The linear relationships with the categorical data graphically shown in Figures 4.1 to 4.30 were considered suitable for estimating the respective relationships with relative BMI.

3.1 Adjustment of BMI for age and sex

BMI was considered to be a particularly important end-point because of its utility as a surrogate for body fatness in population surveys. It is important to correct BMI for age and sex as the relationship of BMI to body fat changes markedly with age for children (Figure 3.1). This section explains the correction made to adjust for sex and age differences in the relationship of BMI to body fat.

The BMIs from the 2007 Australian National Children's Nutrition and Physical Activity Survey followed the expected pattern for children as documented by Cole et al. (2000) of having a minimum at around age 5–6 years and increasing with age (see Figure 3.1). Median BMIs for males and females are shown for each age in decimal years on Figure 3.1. Cole et al.'s overweight lower limit cut off for males and females are also shown. The median BMIs from this survey follow a pattern with age which is very similar to Cole et al.'s overweight lower limit cut offs (Cole et al. 2000). Before the age of eight years, females have a lower median BMI compared to males. From eleven to sixteen years of age, girls had a greater median BMI than boys and similarly the Cole et al.'s overweight lower limit was higher than for 11–16 year old boys.

Adjusting BMI for age and sex in children is difficult, BMI expectations change markedly with age for children. Two options were explored - firstly, BMI less the overweight lower limit cut off described by Cole et al. (2000) and secondly the ratio of BMI to Cole et al.'s overweight lower limit. The ratio of BMI to Cole et al.'s overweight lower limit had more intuitive meaning, and also had more consistent variance with age of the respondent.

Therefore the ratio of the BMI relative to the age and sex specific normal to overweight lower limit as described by Cole et al. (2000) was used as the predictor in analyses as a way of accounting for age and sex differences in the relationship of BMI to body fatness. Throughout this volume, this ratio is termed the 'relative BMI'.

Figure 3.1 BMI for all children in comparison to Cole et al.'s normal to overweight lower limit (cut off) for boys and girls.

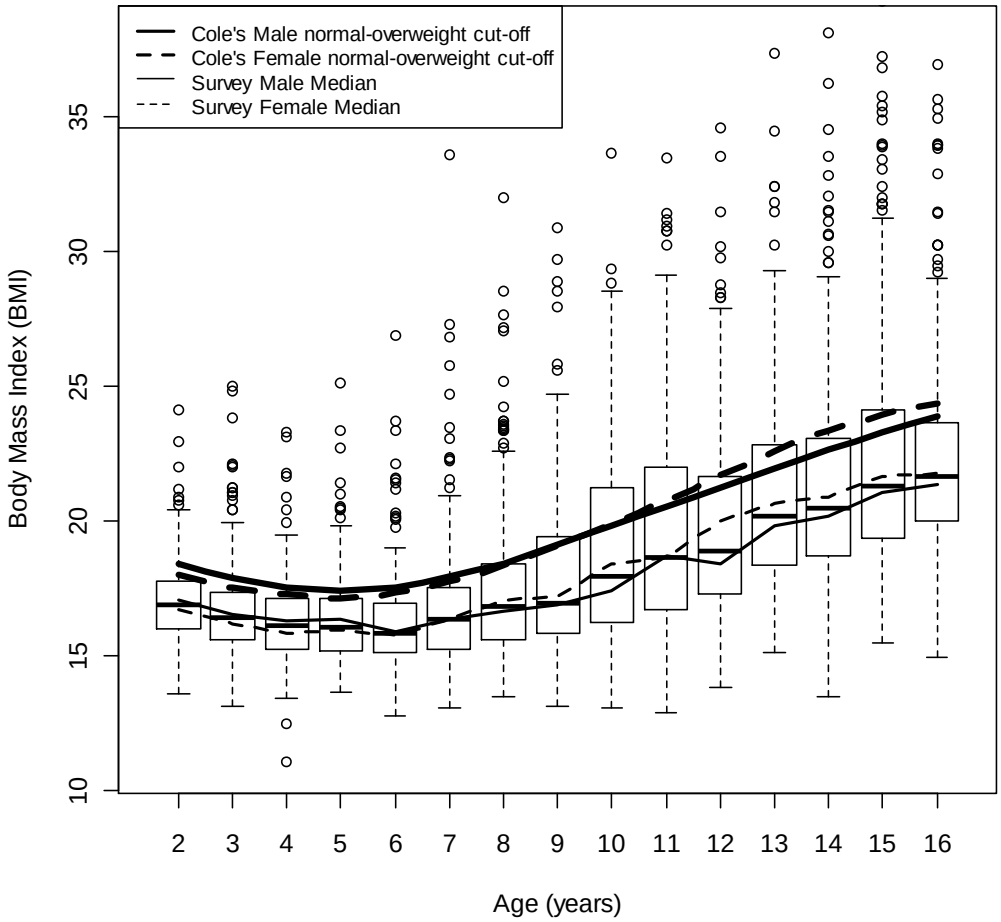


Figure 3.2 Relative BMI for all children: the ratio of BMI to Cole's age and sex specific overweight lower limit (cut off).

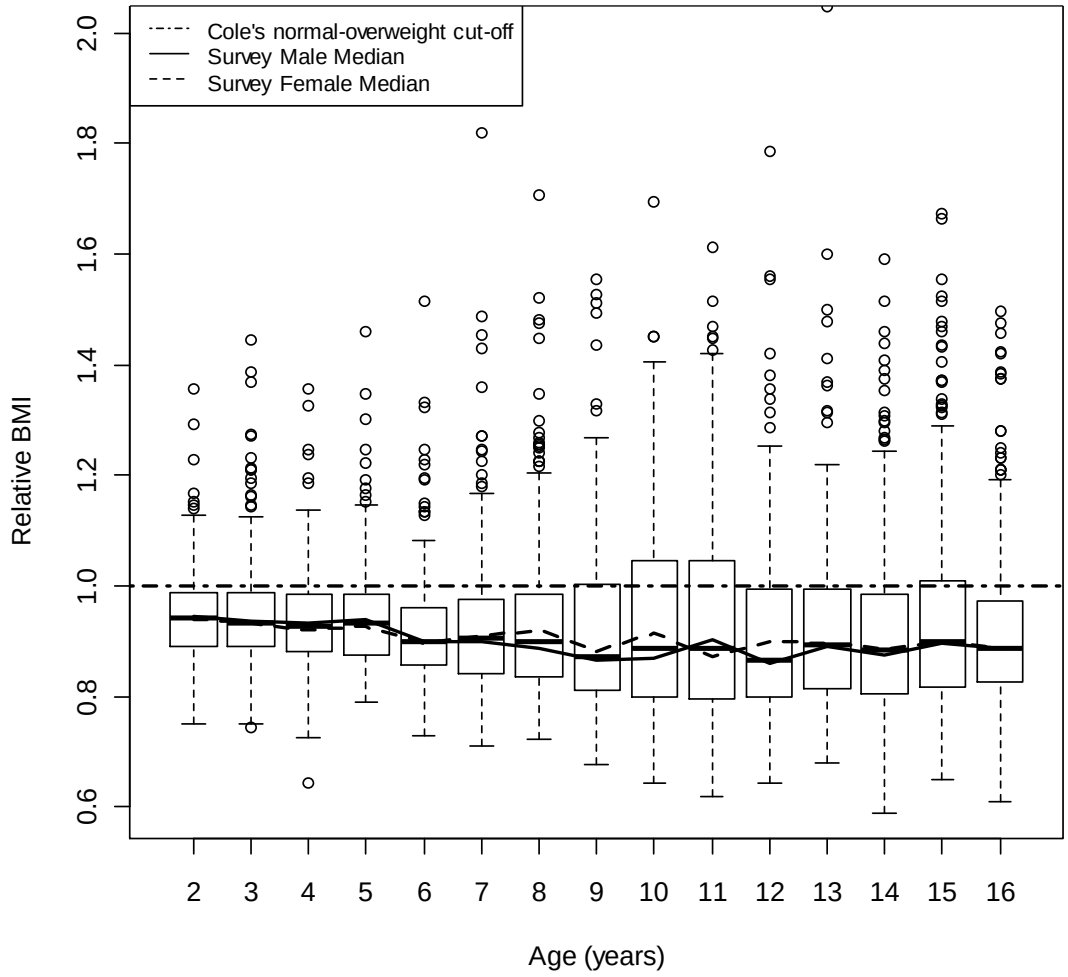


Figure 3.2 shows the distribution of resultant relative BMI. It is clear that the expectation across the age range is more consistent, as shown by more consistent median lines and top of boxes. Box height depicts the inter-quartile ranges (25 percentile–75 percentile) for each age. This relative BMI allows for comparisons across ages and sex and allows for examining relationships with other activity and nutrient variables. As shown in Figure 3.2 the median relative BMI is reasonably consistent across males and females.

The following summary statistics are presented to aid in interpretation of the relative BMI data. The overall median relative BMI is 0.913. This means that 50% of children had a BMI less than 91.3% of the overweight lower limit described by Cole et al. (2000). The mean relative BMI is 0.932. This means that on average, children in this survey had a BMI that was 93.2% of their age and sex specific overweight lower limit. Seventy seven percent of children had a BMI less than the Cole et al.'s overweight lower limit (i.e. had a relative BMI less than one). Therefore, 23% were classified as overweight or obese.

Other statistically valid adjustments could have been used. The log(BMI)-log(Cole et al.'s overweight lower limit cut off) was considered, but it is somewhat complicated to interpret and gave very similar results to the selected "relative BMI".

3.2 Variables used

The analyses of relative BMI in this report were undertaken with the following survey variables.

Physical activity

Pedometer step count (5–16 year old children only)

Pedometer walking distance (km) (5–16 year old children only)

MARCA[1] Minutes of moderate-to-vigorous physical activity (9–16 year old children only)

MARCA Minutes of sedentary activity (9–16 year old children only)

MARCA Minutes of screen time (9–16 year old children only)

MARCA Minutes of sleep (9–16 year old children only)

Nutrient intake (CAPI data)

Estimated dietary energy intake (kJ)

Estimated dietary total and saturated fat intake (g)

Estimated dietary sugar intake (g)

Estimated dietary fibre intake (g)

Estimated dietary calcium intake (mg)

Estimated dietary sodium intake (mg)

Other variables

Age of child

Sex of child

BMI (kg/m2)

BMI classification

Highest education level of either parent/carer

Household income

Level of remoteness

[1] MARCA® is Multimedia Activity Recall for Children and Adolescents self report use of time software (see Explanatory Notes for further detail)

Some demographic variables were not included in the analysis due to having small cell counts in some categories. Country of birth for example had a large majority in a single category (94% of children were born in Australia).

3.3 Possible dietary misreporting by relative BMI

As reported in detail in section 2.2 of Volume 2 Nutrient Intakes (CSIRO 2011), there may be substantial misreporting of dietary intake by BMI category. In this section it was shown that reported dietary energy intake expressed in units of basal metabolic rate was lower with increasing categories of body fatness for all children, and, for 9–16 year olds, 12–24% lower than estimated energy requirement for those in the overweight category, and 33–40% lower than estimated energy requirement for those in the obese category.

Dietary energy intake is derived from reported dietary intake and BMI categorisation is a categorisation based on relative BMI (BMI adjusted for age and sex).

It is not possible to determine whether the dietary energy intake or the estimated physical activity (or both) is reported with error by people who are in the overweight or obese categories. However the interpretation of all analyses that relate BMI category or relative BMI to nutrient intake should only be made after considering that there may be substantial under-reporting of true dietary intake in the overweight and obese categories.

4. RESULTS

4.1 Body mass index (BMI) and demographic variables

4.1.1 The relationship of remoteness indicator with adjusted BMI

There was no statistically significant difference in adjusted BMI between children who lived in metropolitan regions compared with non-metropolitan regions (i.e. rest of state) (p = 0.8).

Table 4.1 Proportion of children (%) in each BMI category by level of remoteness

	Remoteness Indicator[*]	
	METRO	*REST OF STATE*
Underweight	5.2	4.3
Normal	72.6	72.2
Overweight	16.1	18.1
Obese	6.1	5.3
Overweight or Obese	22.2	23.5

[*] refer to appendix 2, Table A2.1 for cell counts

4.1.2 The relationship of annual household income with relative BMI

Annual household income was associated with body mass index category (Chi-squared p<0.001, Figure 4.1) and relative BMI (linear regression p<0.001, Figure 4.2).

Twenty-eight percent of children from the lowest income families (annual household income less than $52,000) were obese or overweight. This contrasts with 20% of children from the highest income families (annual household income $104,000 or greater) being obese or overweight (Table 4.2).

Table 4.2 Percentage (%) in each BMI category by annual household income

	Income grouping			
	<$52,000	$52,000–$77,999	$78,000–$103,999	>$104,000
Underweight	5.2	4.9	4.9	4.5
Normal	66.7	73.0	74.1	75.9
Overweight	20.0	16.2	15.3	16.7
Obese	8.1	5.9	5.7	3.0
Overweight or Obese	28.1	22.1	21.0	19.7

**refer to appendix 2, Table A2.2 for cell counts

Figure 4.1 Percentage overweight or obese by annual household income

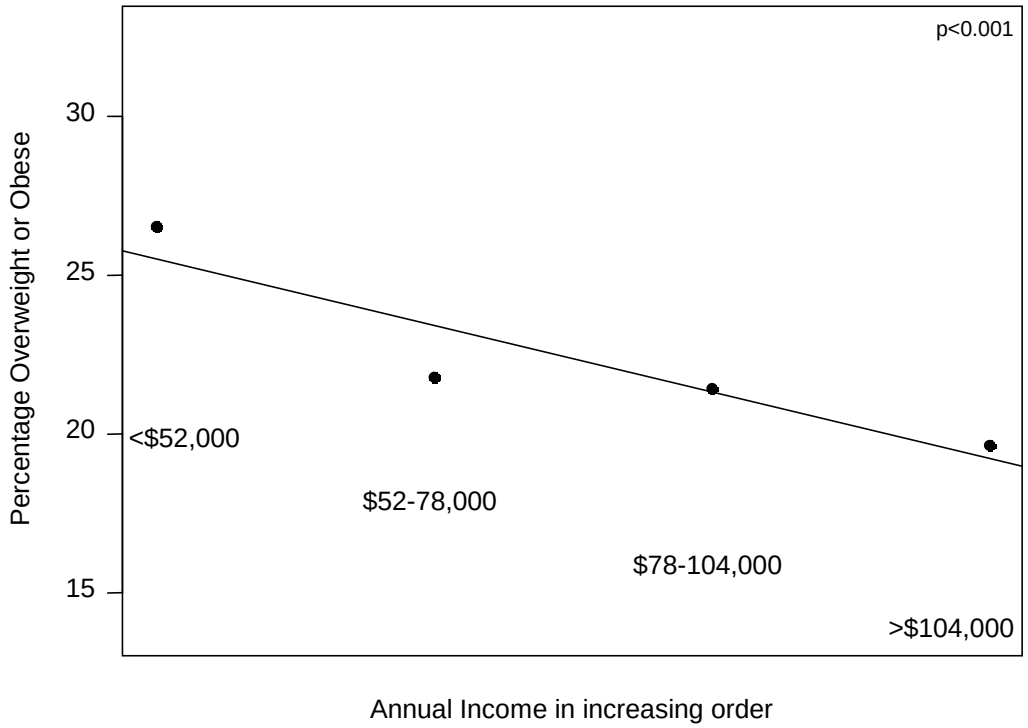
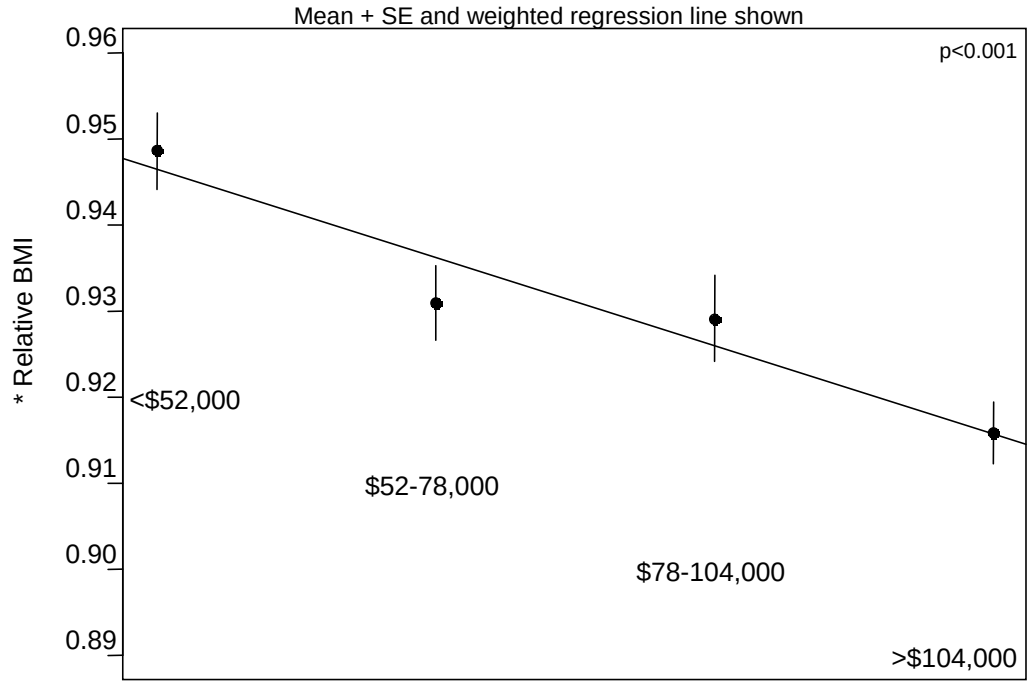


Figure 4.2 Relative BMI by annual household income



* Relative BMI = BMI ratio to Cole's age and sex specific normal to overweight cut-off

4.1.3 Relative BMI by highest education level of either parent/carer

The highest education level of parent(s)/carer(s) was associated with BMI category (Chi-squared p<0.001, Figure 4.3) and relative BMI (linear regression p<0.001, Figure 4.4).

Table 4.3 Percentage in each BMI category by highest education level of either parent/carer

	Highest education level of either parent/carer						
	School year 10 or less	School year 11 or equivalent	Certificate III/IV (including trade certificate)	Advanced diploma, diploma	School year 12 or equivalent	Bachelor degree or Grad Dip	Postgraduate diploma, or higher
Underweight	3.9	1.8	3.7	5.0	6.9	5.8	4.3
Normal	61.7	65.0	71.1	68.7	72.5	75.9	77.2
Overweight	24.8	25.7	17.1	19.4	16.2	14.7	15.4
Obese	9.7	7.4	8.0	7.0	4.4	3.6	3.0
Overweight or Obese	34.5	33.1	25.1	26.4	20.6	18.3	18.4

**refer to appendix 2, Table A2.3 for cell counts

4.1.4 Relative BMI by state/territory of residence

No significant difference was found for relative BMI between States of residence (p=0.15).

Table 4.4 Percentage (%) in each BMI category by state/territory of residence

	State/territory of the respondent's residence							
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Underweight	4.0	4.6	8.9	5.3	4.6	5.7	5.2	3.0
Normal	79.0	72.5	76.0	74.2	71.2	74.9	69.3	75.6
Overweight	12.9	16.7	13.8	14.9	17.2	14.4	20.1	15.9
Obese	3.8	6.2	1.7	5.6	7.0	5.4	5.3	5.6
Overweight or Obese	16.7	22.9	15.4	20.5	24.2	19.7	25.4	21.5

**refer to appendix 2, Table A2.4 for cell counts

Figure 4.3 Percentage overweight or obese by highest education level of either parent/carer

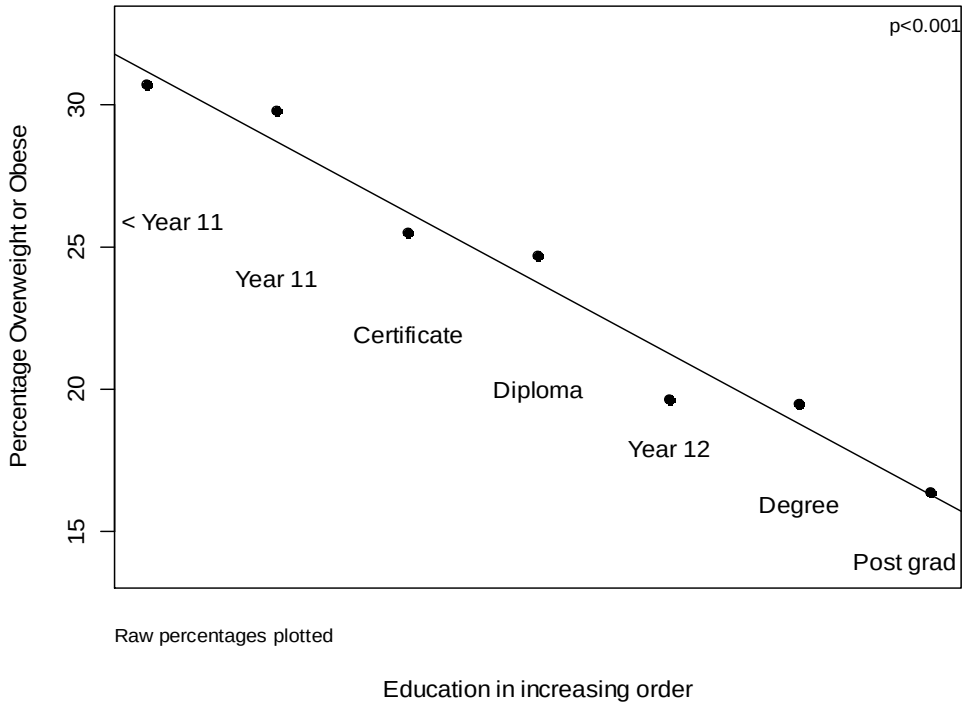
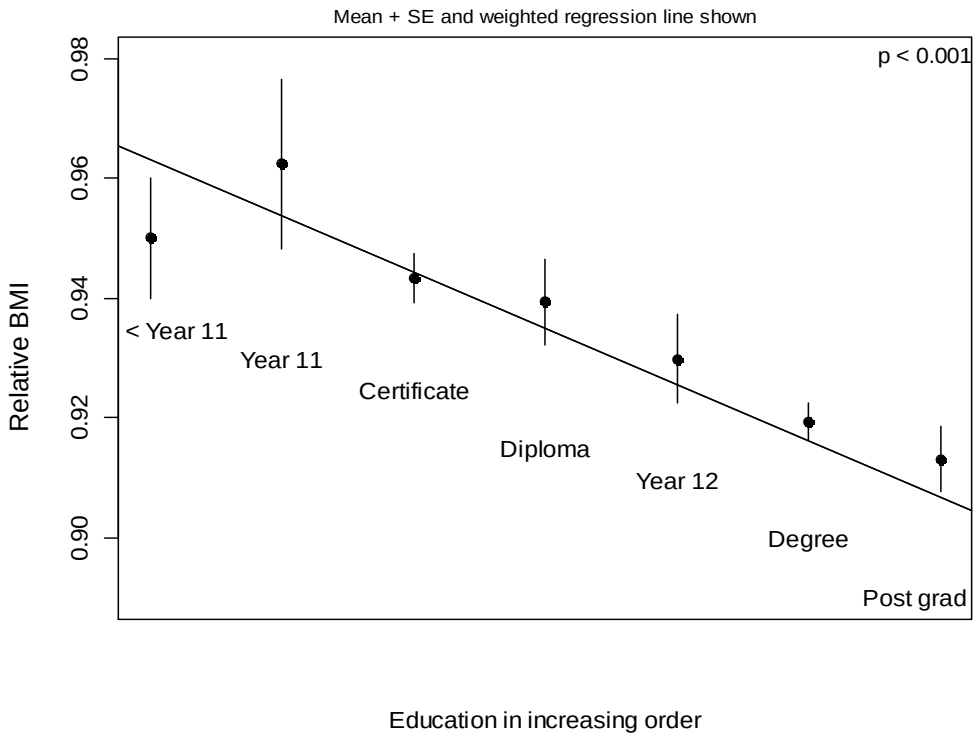


Figure 4.4 Relative BMI by highest education level of either parent/carer



4.2 Nutrient intake and relative BMI

All analyses presented are for children 2–16 years of age.

4.2.1 Relative BMI by dietary energy intake

The weighted regression of relative BMI on dietary energy intake showed energy intake to be negatively associated with relative BMI (Figure 4.6). Similarly there was a significant relationship between percentage overweight or obese and energy consumed (Figure 4.5). This is unsurprising in view of the suspicion of dietary energy under-reporting particularly in the overweight and obese categories.

4.2.2 Relative BMI by the contribution of total and saturated fat intake to energy intake

Relative BMI was not statistically significantly associated with fat as a percentage of energy intake or saturated fat as a percentage of energy intake (Figures 4.7 to 4.10).

4.2.3 Relative BMI by the contribution of dietary sugar intake to energy intake

Dietary sugar as a percentage of energy intake was negatively associated with relative BMI (Figures 4.11 and 4.12). If children in the overweight and obese are under-reporting dietary energy intake (as suspected), it may be that they preferentially under-report intake of sugar containing foods (therefore both their energy intake and the sugar percentage of their energy intake is under-reported). Alternatively, children who are overweight or obese may avoid, or be dissuaded from consuming, sugar containing foods.

4.2.4 Relative BMI by dietary sodium density

Relative BMI showed a positive association with dietary sodium density ($p<0.001$) (Figures 4.13 and 4.14). While it is possible that this is an artefact of under-reporting energy intake by under- reporting intake of sugar containing foods, it is also possible that the association observed is true and that children with a higher relative BMI have higher sodium relative to energy. The measurement of dietary sodium does not take into account the discretionary use of salt in cooking or when the food is served.

4.2.5 Relative BMI by dietary fibre density

There was no statistical evidence of a relationship between relative BMI and dietary fibre density (Figures 4.15 and 4.16).

4.2.6 Relative BMI by dietary calcium density

There was no evidence of a relationship between relative BMI and dietary calcium density in children aged 2–16 years. (Figures 4.17 and 4.18).

Figure 4.5 Percentage overweight or obese by deciles of estimated dietary energy intake (kJ)

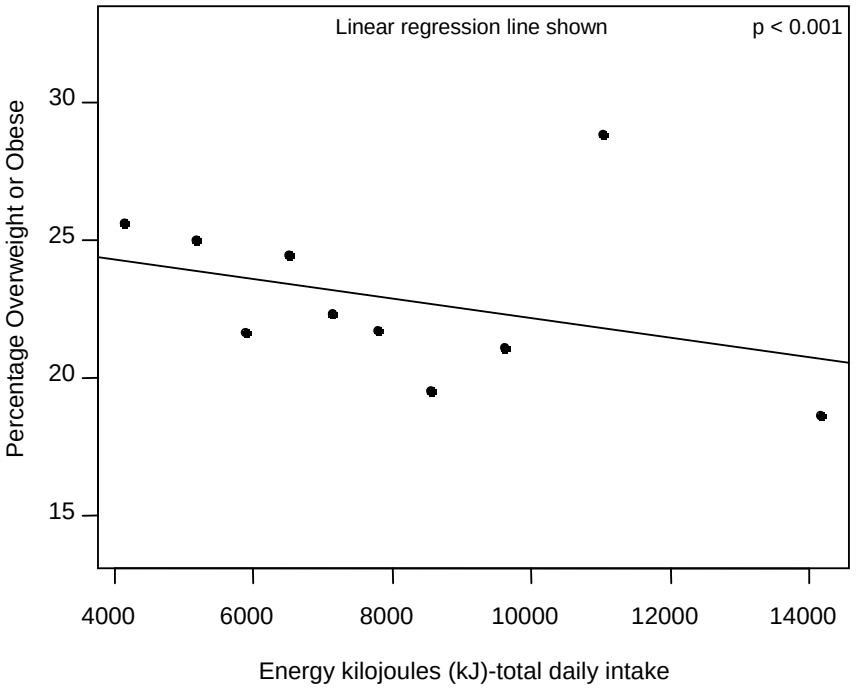


Figure 4.6 Relative BMI by deciles of estimated dietary energy intake (kJ)

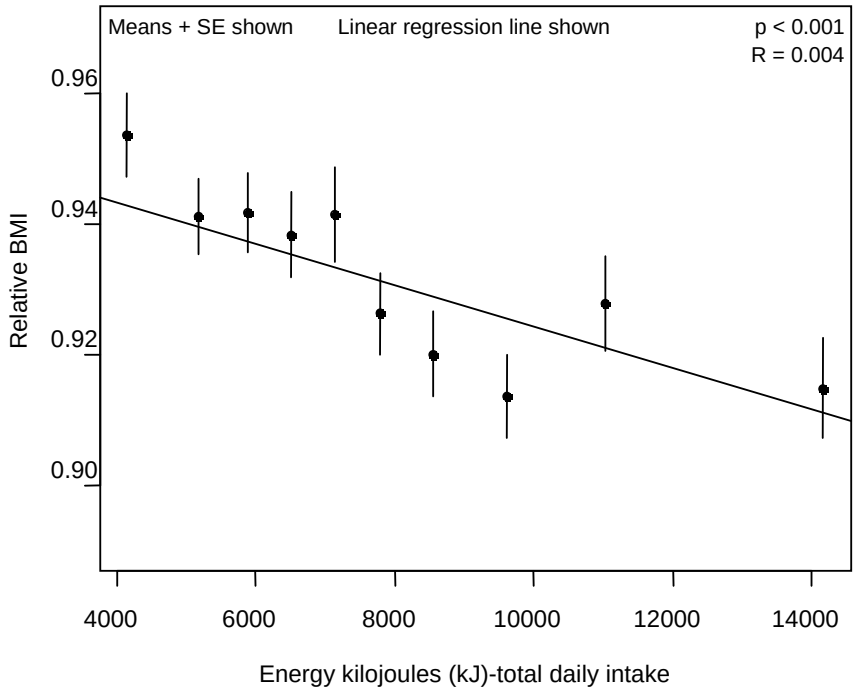


Table 4.5 Percentage in each BMI category by deciles of estimated dietary energy intake (kJ)

Deciles – estimated dietary energy intake (kJ)	831–4757	4757–5531	5531–6190	6190–6802	6802–7463	7463–8200	8200–9022	9022–10213	10213–12222	12222–35061
Underweight %	4.5	8.2	4.3	5.7	4.1	2.6	5.1	4.4	4.6	5.1
Normal	70	66.8	74	70	73.6	75.7	75.5	74.6	66.7	76.4
Overweight	16.8	16.9	15.8	18.9	15.2	16.4	15.4	17.4	22.3	14.7
Obese	8.8	8.2	5.8	5.4	7.1	5.3	4.1	3.7	6.5	3.8
Overweight or Obese	25.6	25	21.6	24.4	22.3	21.7	19.5	21.1	28.8	18.6

Figure 4.7 Percentage overweight or obese by deciles of estimated percentage contribution of total fat intake to dietary energy intake

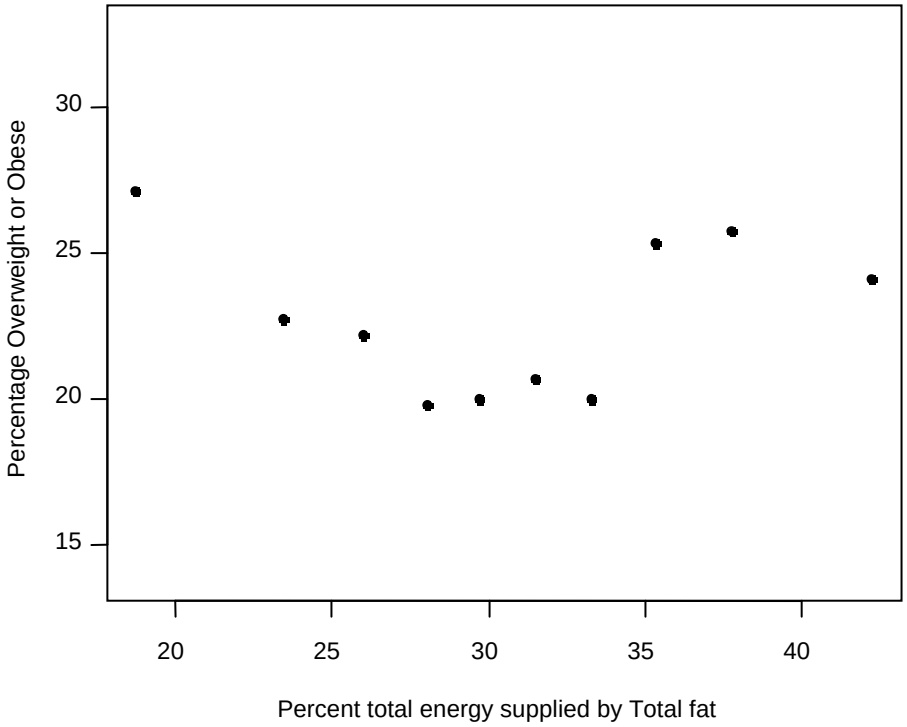


Figure 4.8 Relative BMI by deciles of estimated percentage contribution of total fat intake to dietary energy intake

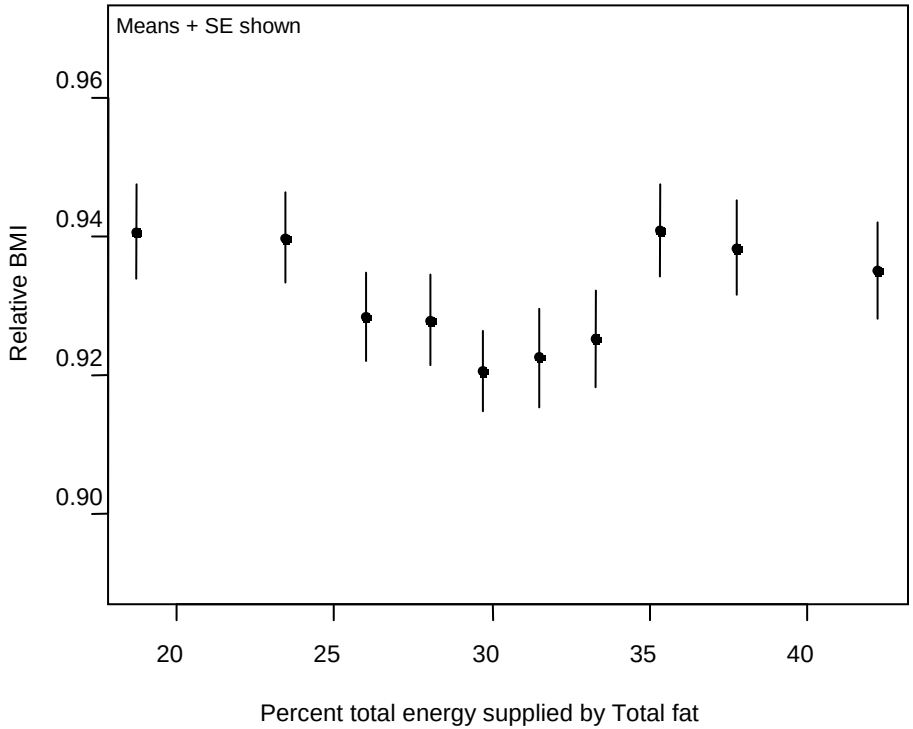


Table 4.6 Percentage in each BMI category by deciles of estimated percentage contribution of total fat intake to dietary energy intake

Deciles – estimated contribution of total fat to energy intake (%)	7–22	22–25	25–27	27–29	29–31	31–32	32–34	34–36	36–40	40–58
Underweight %	3.3	4.5	4.4	4.3	5.9	5.6	8.1	3.7	3.3	4.9
Normal	69.6	72.7	73.3	75.8	74	73.7	71.9	71	71	70.9
Overweight	21.1	16.2	16.5	13.2	15.8	15.9	14.1	20.2	20.3	16.9
Obese	6	6.5	5.7	6.7	4.2	4.8	5.8	5.2	5.4	7.2
Overweight or Obese	27.1	22.7	22.2	19.8	20	20.7	20	25.3	25.7	24.1

Figure 4.9 Percentage overweight or obese by deciles of estimated percentage contribution of saturated fat intake to dietary energy intake

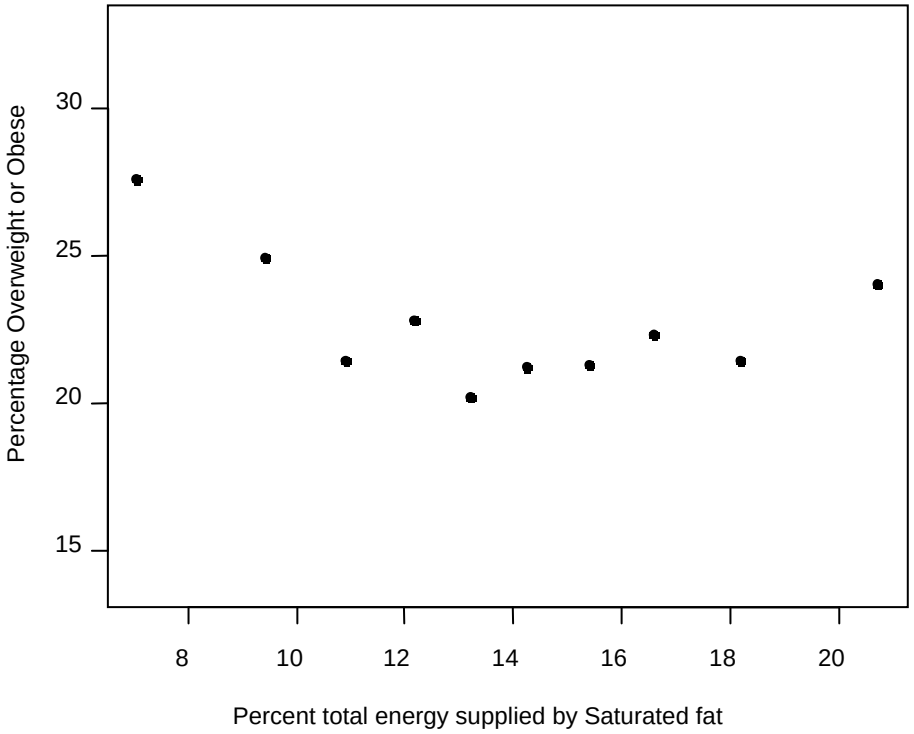


Figure 4.10 Relative BMI by deciles of estimated percentage contribution of saturated fat intake to dietary energy intake

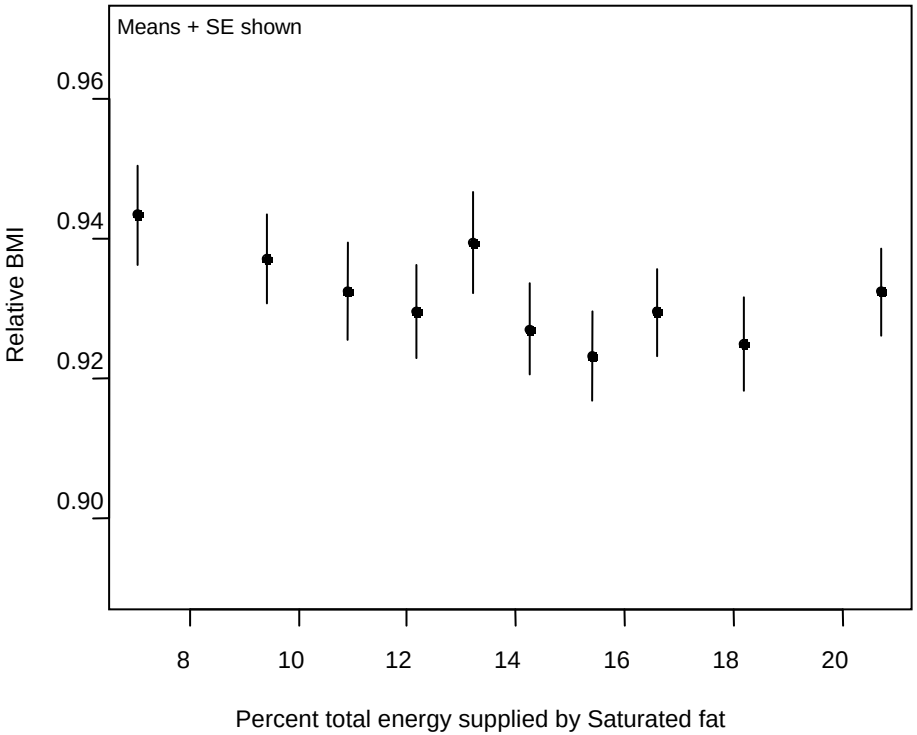


Table 4.7 Percentage in each BMI category by deciles of estimated percentage contribution of saturated fat intake to dietary energy intake

Deciles – estimated contribution of saturated fat to energy intake (%)	1–8	8–10	10–12	12–13	13–14	14–15	15–16	16–17	17–19	19–31
Underweight %	5.1	4.6	3.5	5.1	4.3	5.4	5.7	6	3.5	4.9
Normal	67.3	70.5	75.1	72.1	75.5	73.4	73.1	71.8	75.2	71.2
Overweight	19.4	19.1	15.7	17.9	13.7	14.9	17.2	16.9	15.9	19.1
Obese	8.2	5.8	5.6	4.9	6.6	6.3	4.1	5.4	5.5	4.9
Overweight or Obese	27.6	24.9	21.4	22.8	20.2	21.2	21.3	22.3	21.4	24

Figure 4.11 Percentage overweight or obese by deciles of estimated percentage contribution of total sugars intake to dietary energy intake

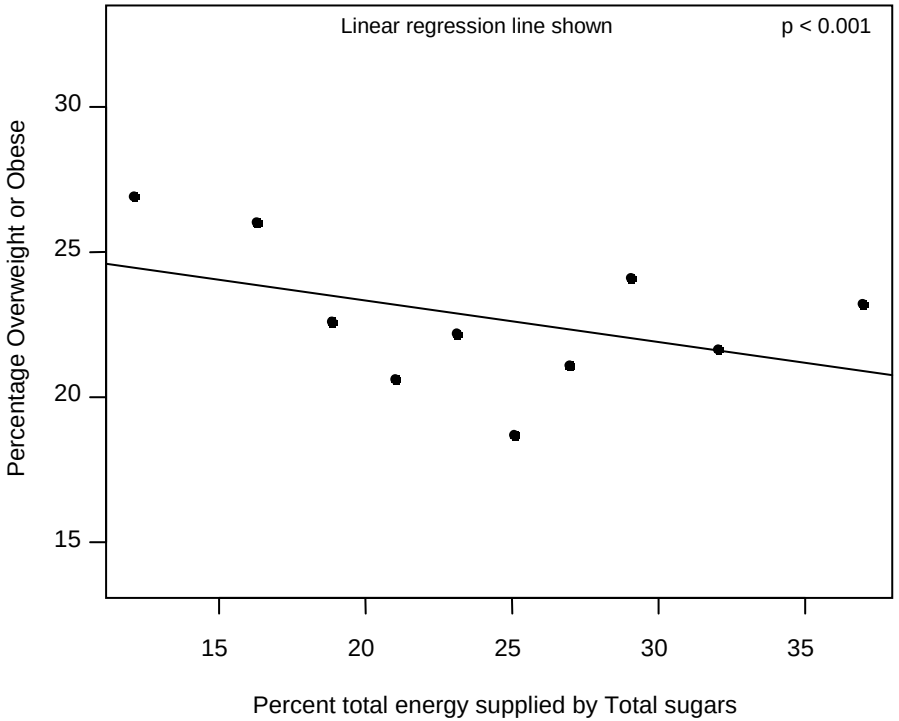


Figure 4.12 Relative BMI by deciles of estimated percentage contribution of total sugars intake to dietary energy intake

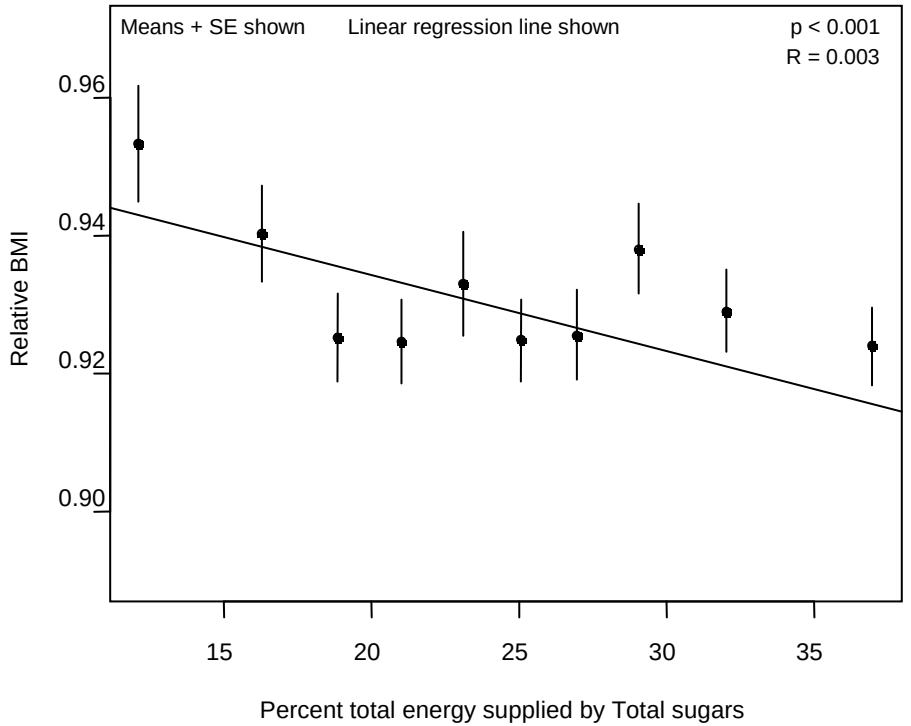


Table 4.8 Percentage in each BMI category by deciles of estimated percentage contribution of total sugars intake to dietary energy intake

Deciles – estimated contribution of total sugars to energy intake (%)	2–15	15–18	18–20	20–22	22–24	24–26	26–28	28–30	30–34	34–60
Underweight %	5.2	3	6.6	3.2	5.3	3.6	5.3	5.4	4.7	5.8
Normal	67.9	71.1	70.8	76.2	72.5	77.7	73.6	70.6	73.6	71
Overweight	17.2	17.7	18.3	17.7	15.5	14.1	14.5	19.3	16.3	19.6
Obese	9.7	8.2	4.4	2.9	6.7	4.6	6.5	4.8	5.3	3.6
Overweight or Obese	26.9	26	22.6	20.6	22.2	18.7	21.1	24.1	21.6	23.2

Figure 4.13 Percentage overweight or obese by deciles of estimated dietary sodium intake per 1000 kJ of dietary energy intake

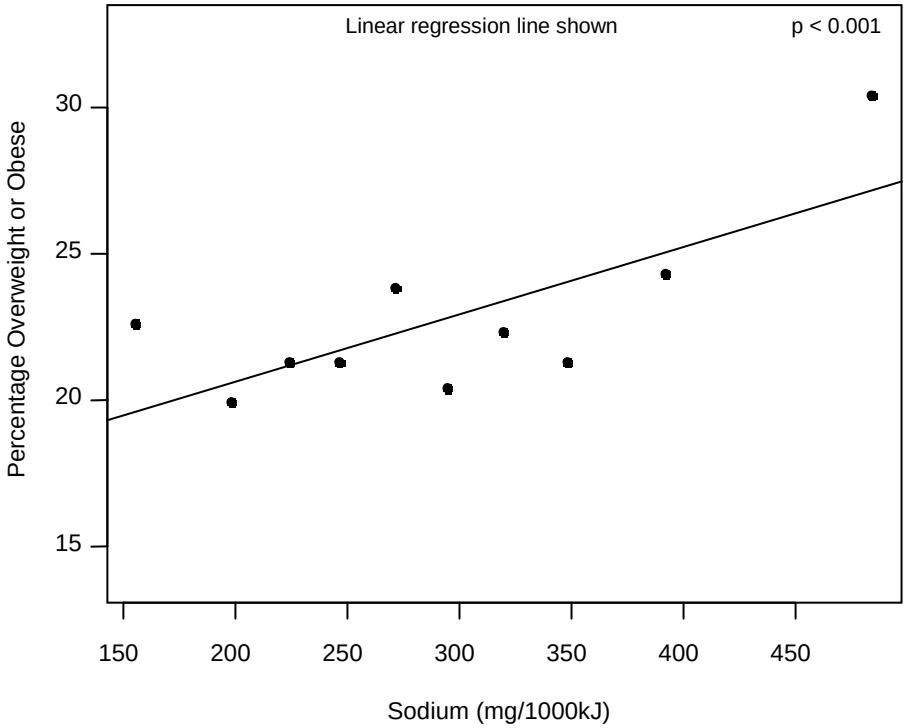


Figure 4.14 Relative BMI by deciles of estimated dietary sodium intake per 1000 kJ of dietary energy intake

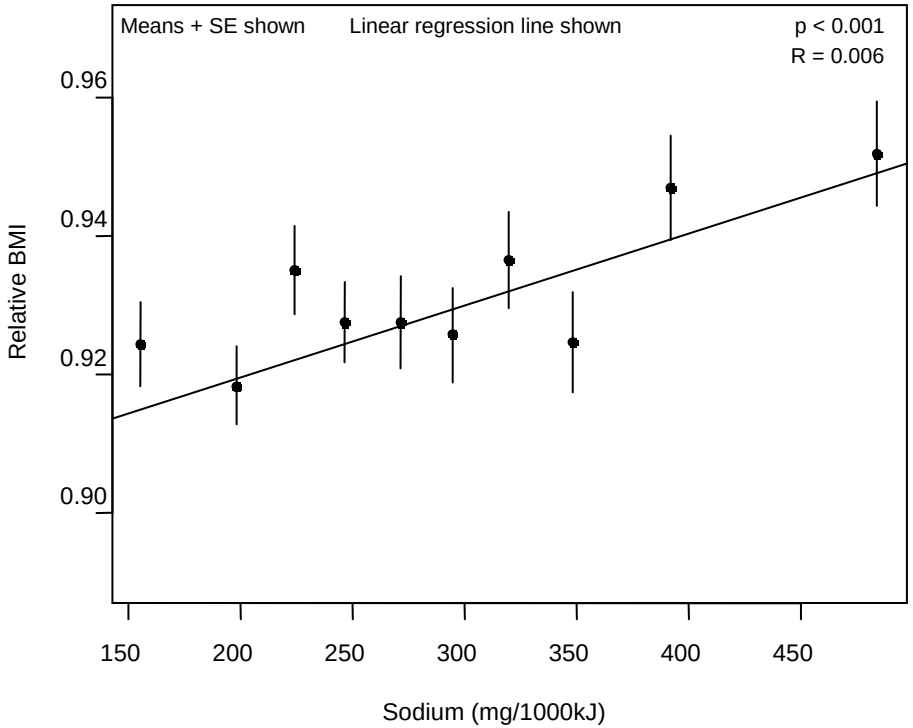


Table 4.9 Percentage in each BMI category by deciles of estimated sodium intake per 1000 kJ of dietary energy intake

Deciles – estimated dietary sodium density (mg/1000 kJ)	53–180	180–212	212–237	237–258	258–283	283–307	307–333	333–369	369–428	428–1594
Underweight %	4.1	5.4	4.4	5.3	6.3	5.2	3.4	6.9	4.1	2.9
Normal	73.3	74.8	74.3	73.4	69.9	74.3	74.3	71.8	71.6	66.8
Overweight	19.1	17.1	16.1	15.7	18.7	14.8	16.4	17.8	16.3	18.5
Obese	3.4	2.9	5.2	5.5	5.1	5.7	5.9	3.5	8.1	11.9
Overweight or Obese	22.6	19.9	21.3	21.3	23.8	20.4	22.3	21.3	24.3	30.4

Figure 4.15 Percentage overweight or obese by deciles of estimated dietary fibre intake per 1000 kJ of dietary energy intake

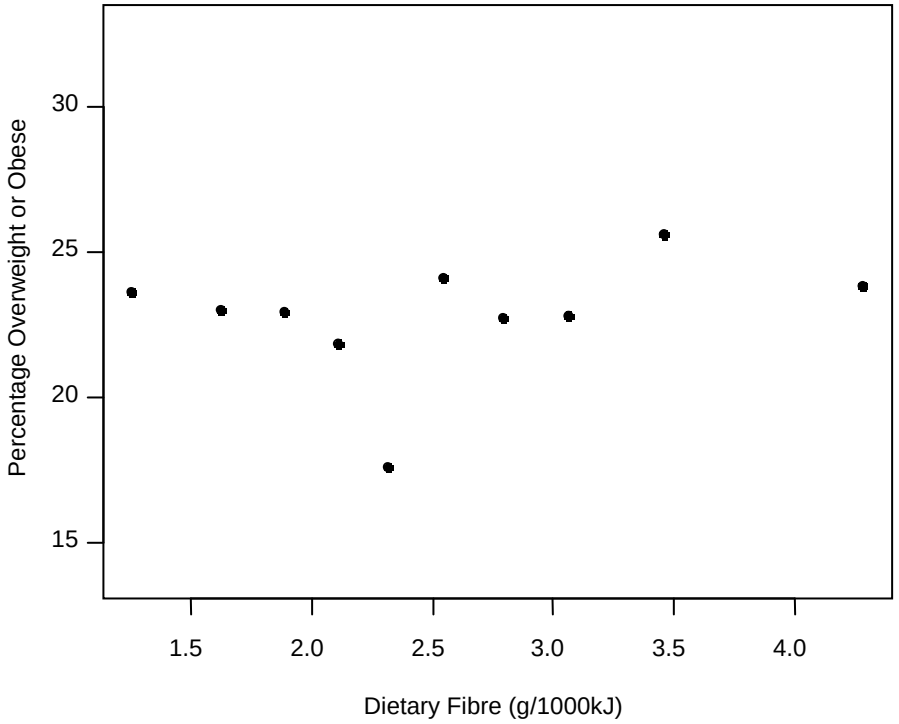


Figure 4.16 Relative BMI by deciles of estimated dietary fibre intake per 1000 kJ of dietary energy intake

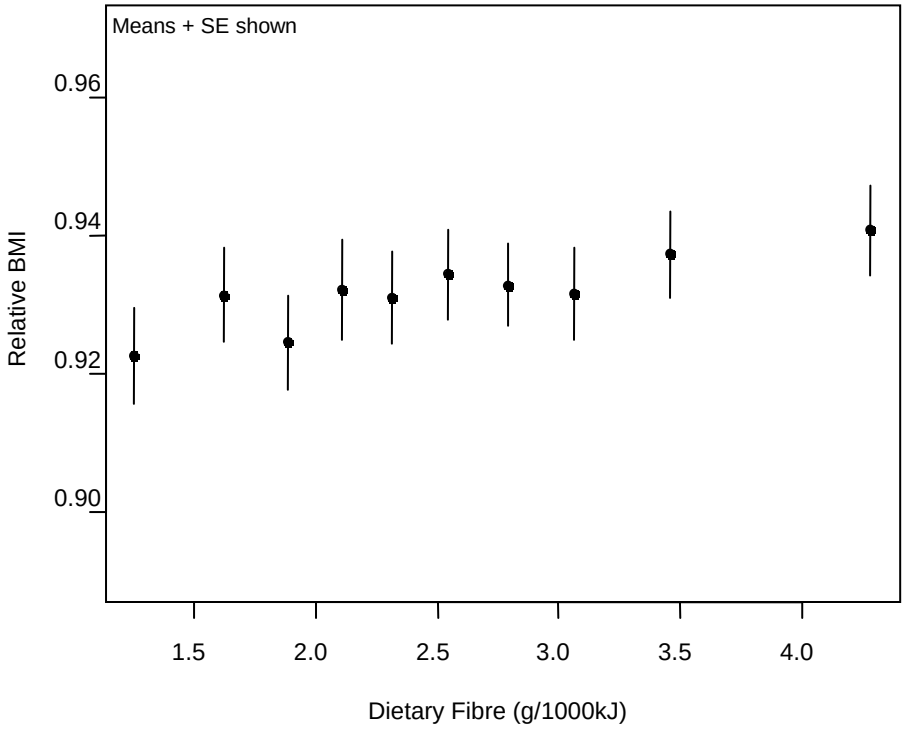


Table 4.10 Percentage in each BMI category by deciles of estimated dietary fibre intake per 1000 kJ of dietary energy intake

Deciles – estimated dietary fibre density (g/1000 kJ)	0–1	1–2	2–2	2–2	2–2	2–3	3–3	3–3	3–4	4–14
Underweight %	5.6	5.6	5.1	4	3.8	4.6	4.4	6.4	4.2	4.3
Normal	70.9	71.4	72	74.2	78.6	71.3	72.9	70.9	70.2	71.9
Overweight	16.8	15.8	18.9	14.7	12.6	18.6	17.8	17	20.5	17.8
Obese	6.9	7.2	4.1	7	5	5.5	5	5.8	5	5.9
Overweight or Obese	23.6	23	22.9	21.8	17.6	24.1	22.7	22.8	25.6	23.8

Figure 4.17 Percentage overweight or obese by deciles of estimated dietary calcium intake per 1000 kJ of dietary energy intake

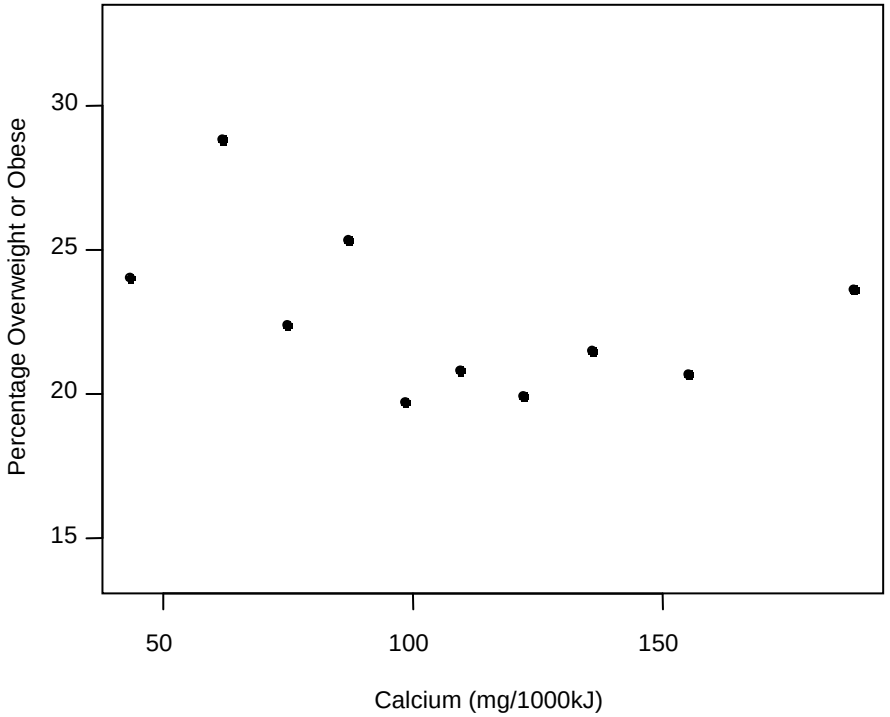


Figure 4.18 Relative BMI by deciles of estimated dietary calcium intake per 1000 kJ of dietary energy intake

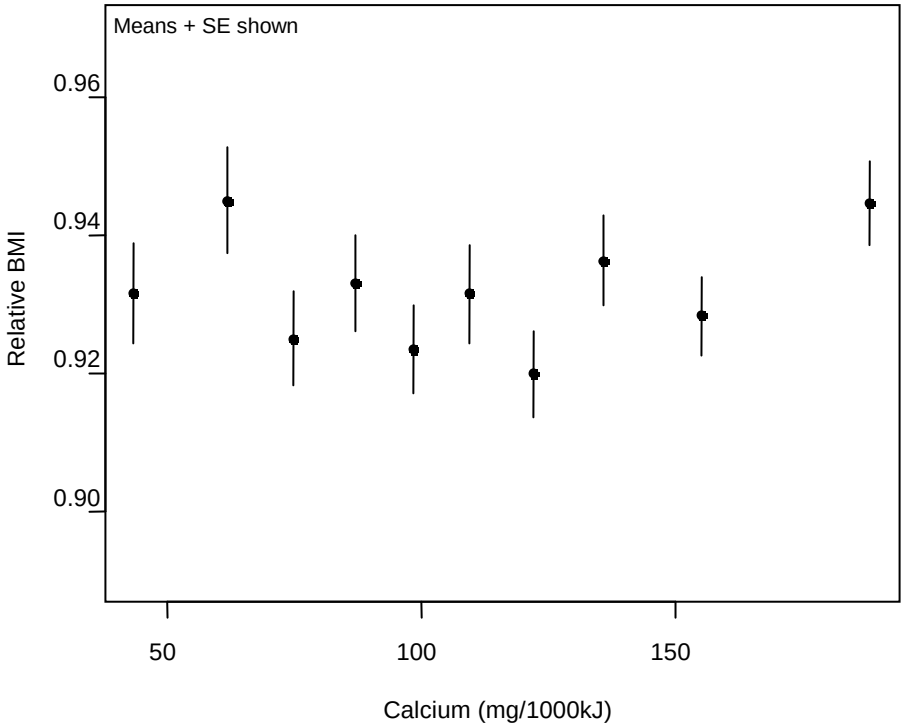


Table 4.11 Percentage in each BMI category by deciles of estimated dietary calcium intake per 1000 kJ of dietary energy intake

Deciles – estimated dietary calcium density (mg/1000 kJ)	11–54	54–69	69–81	81–93	93–104	104–116	116–129	129–145	145–169	169–370
Underweight %	4.6	4.8	5.2	4.4	4.2	9	4.6	3.6	3.8	3.4
Normal	71.3	66.5	72.3	70.4	76.1	70.1	75.5	74.9	75.5	72.8
Overweight	16.8	19.7	17	22	13.8	13.5	16.2	16.7	17.1	17.1
Obese	7.2	9.1	5.4	3.3	6	7.3	3.8	4.8	3.7	6.5
Overweight or Obese	24	28.8	22.4	25.3	19.7	20.8	19.9	21.5	20.7	23.6

4.3 Relative BMI by physical activity

Generally, relative BMI was negatively associated with measures of physical activity, and the percentage of children who were overweight or obese decreased with increasing physical activity as shown by the plotted summaries and tables of pedometer steps ($p=0.001$), pedometer walking distance ($p=0.001$) and physical activity level (PAL) in metabolic equivalents (METs) ($p<0.05$) (Figures 4.19 to 4.26). No significant association was found for minutes spent in vigorous physical activity (Figures 4.23 and 4.24) or minutes spent in moderate-to-vigorous physical activity (MVPA) (Figures 4.27 and 4.28) perhaps because these activities accounted for only a small part of the day for most children (the median for MVPA was less than two hours, compared to more than twelve hours for time spent in sedentary activities).

A positive relationship was observed for relative BMI with time spent in sedentary activities (Figures 4.29 and 4.30).

While the associations found were statistically significant, the amount of variation in relative BMI explained was very small (all correlation coefficients were less than 0.001). This may indicate that the measurement does not measure usual behaviour very well and/or that the behaviour is not an importantly associated with relative BMI.

The relationships between the variables explored are cross-sectional in nature, therefore it is not clear whether the associations indicate that the behaviours are a determinant of relative BMI, or relative BMI is an influence on the behaviours.

Figure 4.19 Percentage overweight or obese by deciles of pedometer steps per day – all days (children 5–16 years old)

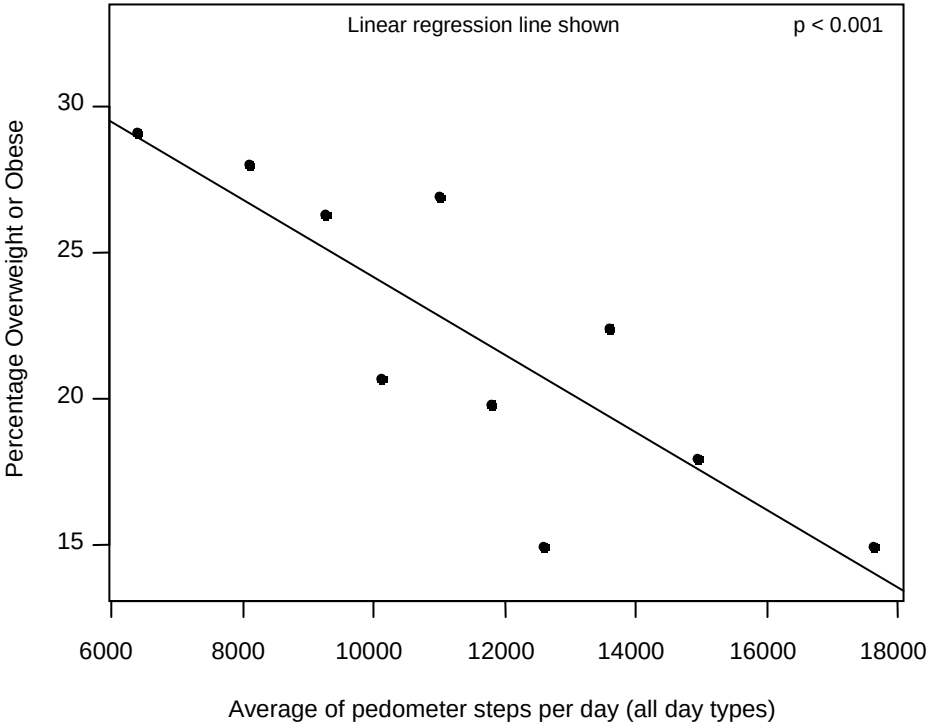


Figure 4.20 Relative BMI by deciles of pedometer steps per day – all days (children 5–16 years old)

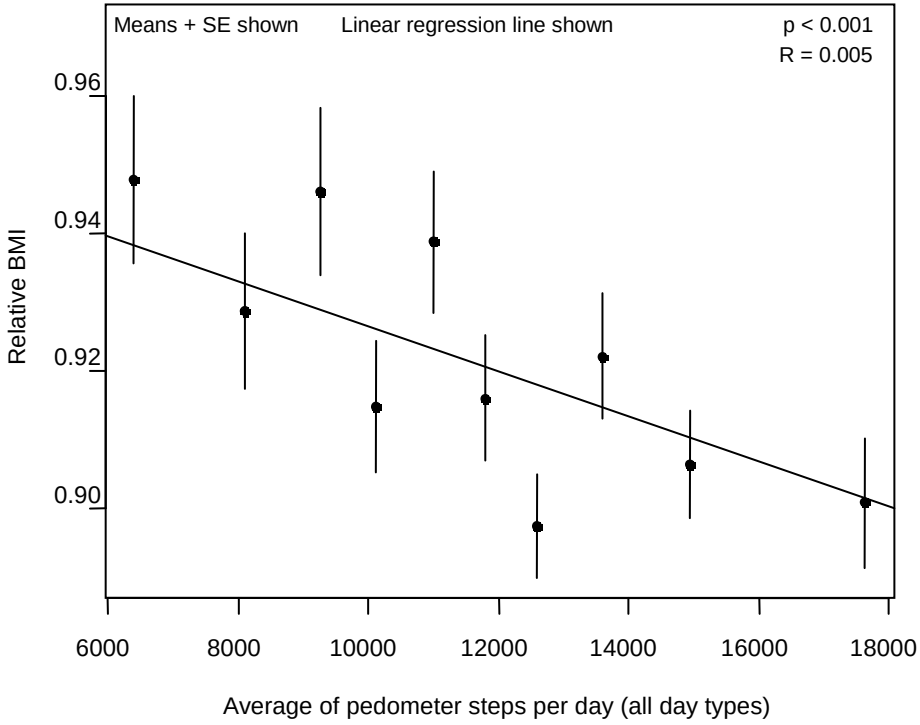


Table 4.12 Percentage in each BMI category by deciles of pedometer steps per day – all days (children 5–16 years old)

Deciles – pedometer steps per day	2309–7400	7400–8687	8687–9659	9659–10600	10600–11372	11372–12243	12243–13116	13116–14281	14281–15962	15962–32930
Underweight	3.9	7.5	5.7	6.5	4.2	4.1	6.7	6.3	3.4	5.1
Normal	66.9	64.4	68.2	72.6	68.8	76.2	78.5	71.2	78.7	80.1
Overweight	18.6	20.6	15.6	15.9	21.6	13.5	12.6	18.8	15.4	11.3
Obese	10.5	7.3	10.7	4.8	5.3	6.3	2.3	3.6	2.5	3.6
Overweight or Obese	29.1	28.0	26.3	20.7	26.9	19.8	14.9	22.4	17.9	14.9

Figure 4.21 Percentage overweight or obese by deciles of pedometer walking distance (km) per day - all days (children 5–16 years old)

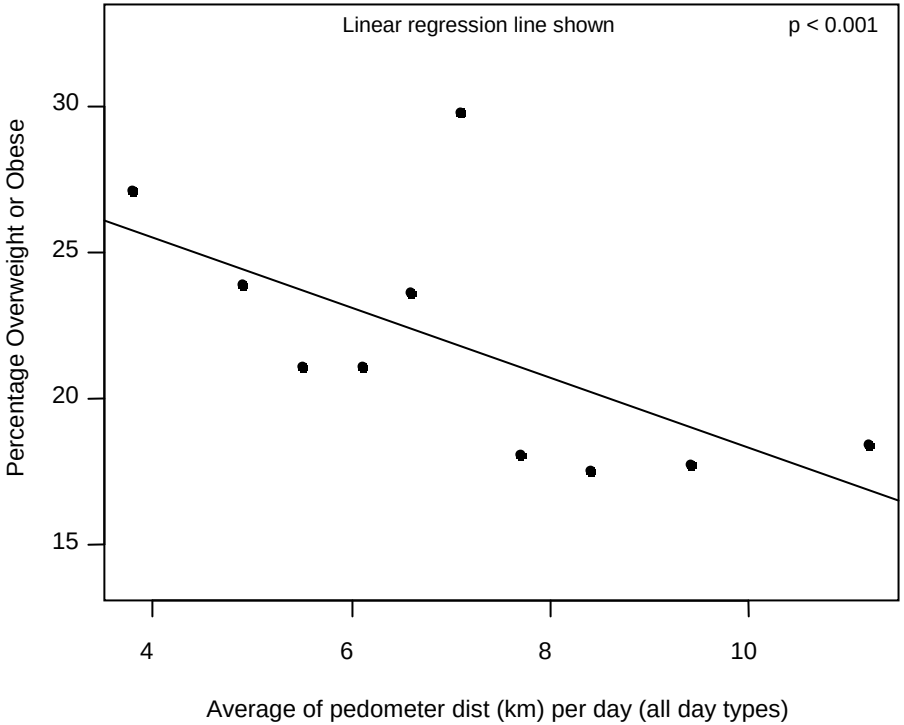


Figure 4.22 Relative BMI by deciles of pedometer walking distance (km) per day - all days (children 5–16 years old)

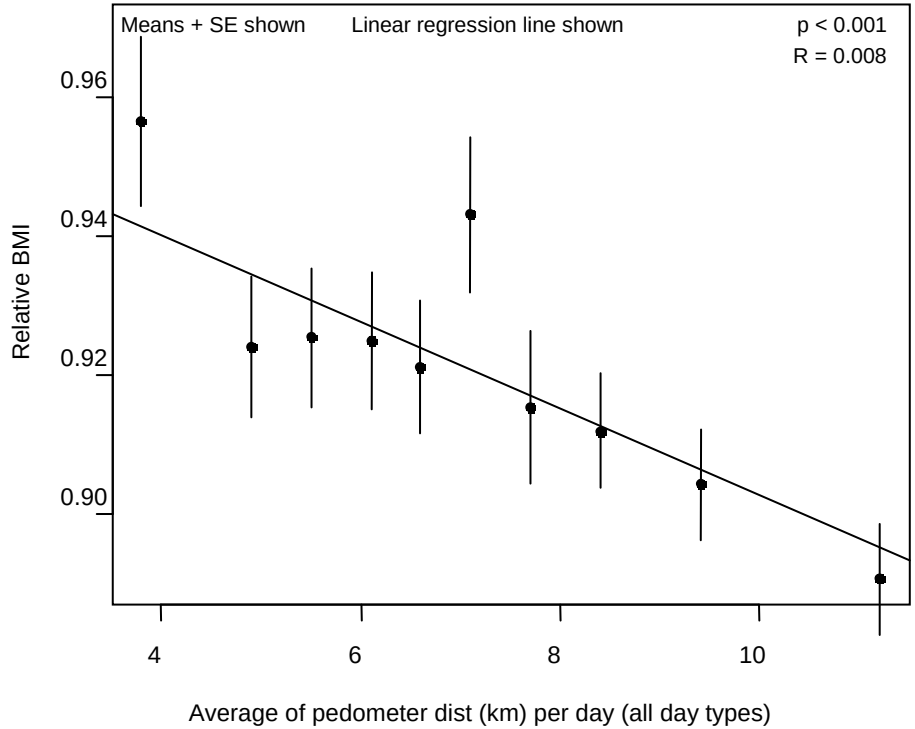


Table 4.13 Percentage in each BMI category by deciles of pedometer walking distance (km) per day – all days (children 5–16 years old)

Deciles – pedometer walking distance (km)per day	0–4	4–5	5–6	6–6	6–7	7–7	7–8	8–9	9–10	10–25
Underweight	6.8	6.1	4.1	4.6	6.0	6.4	6.5	1.5	4.6	6.5
Normal	66.0	70.0	74.8	74.4	70.4	63.7	75.3	81.1	77.7	75.0
Overweight	16.1	17.4	14.3	14.5	16.5	23.1	14.1	14.7	15.3	16.7
Obese	10.9	6.5	6.8	6.6	7.2	6.7	4.0	2.8	2.3	1.8
Overweight or Obese	27.1	23.9	21.1	21.1	23.6	29.8	18.1	17.5	17.7	18.4

Figure 4.23 Percentage overweight or obese by deciles of vigorous physical activity (minutes) per day – all days (children 9–16 years old)

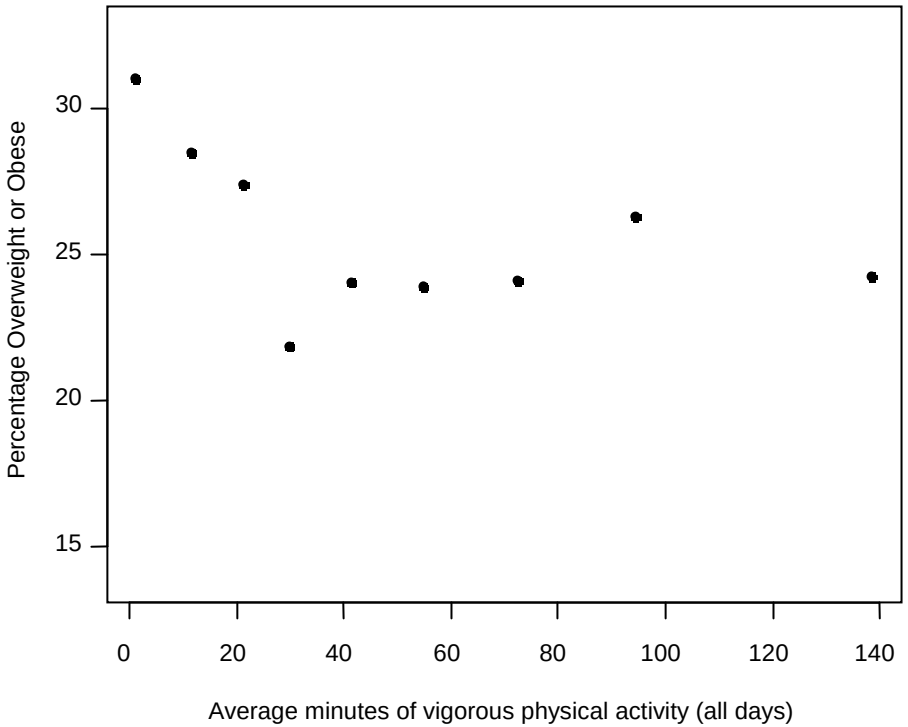


Figure 4.24 Relative BMI by deciles of vigorous physical activity (minutes) per day – all days (children 9–16 years old)

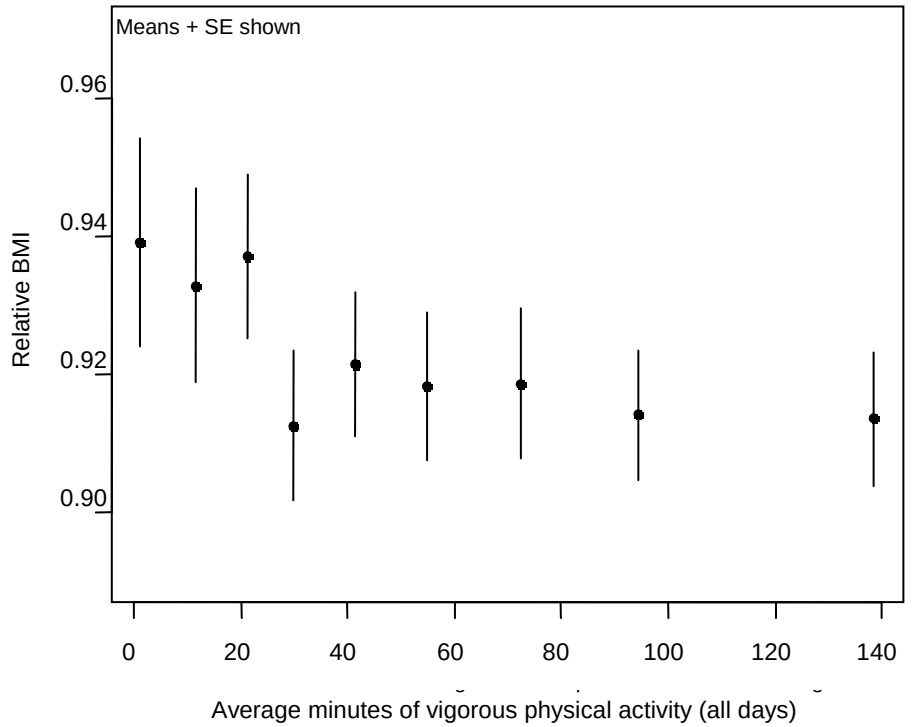


Table 4.14 Percentage in each BMI category by deciles of vigorous physical activity (minutes) per day – all days (children 9–16 years old)

Deciles – vigorous physical activity per day	0–8*	8–16	16–26	26–36	36–48	48–64	64–82	82–113	113–285
Underweight	6.3	8.0	6.9	4.6	5.2	5.8	5.0	3.4	3.8
Normal	62.7	63.6	65.9	73.7	70.7	70.4	70.9	70.3	72.2
Overweight	23.6	16.0	19.0	16.2	20.2	18.5	20.6	22.7	19.9
Obese	7.4	12.6	8.5	5.6	3.8	5.5	3.5	3.5	4.3
Overweight or Obese	31.0	28.5	27.4	21.8	24.0	23.9	24.1	26.3	24.2

*First and second deciles combined because all values in the first decile were zero

Figure 4.25 Percentage overweight or obese by deciles of PAL in METs – all days (children 9–16 years old)

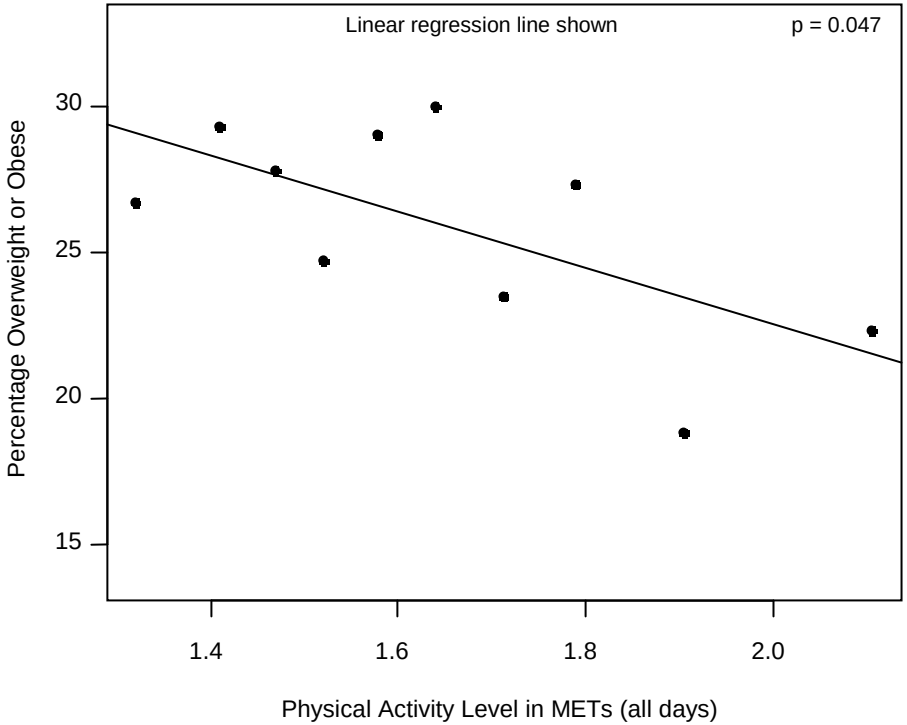


Figure 4.26 Relative BMI by deciles of PAL in METs – all days (children 9–16 years old)

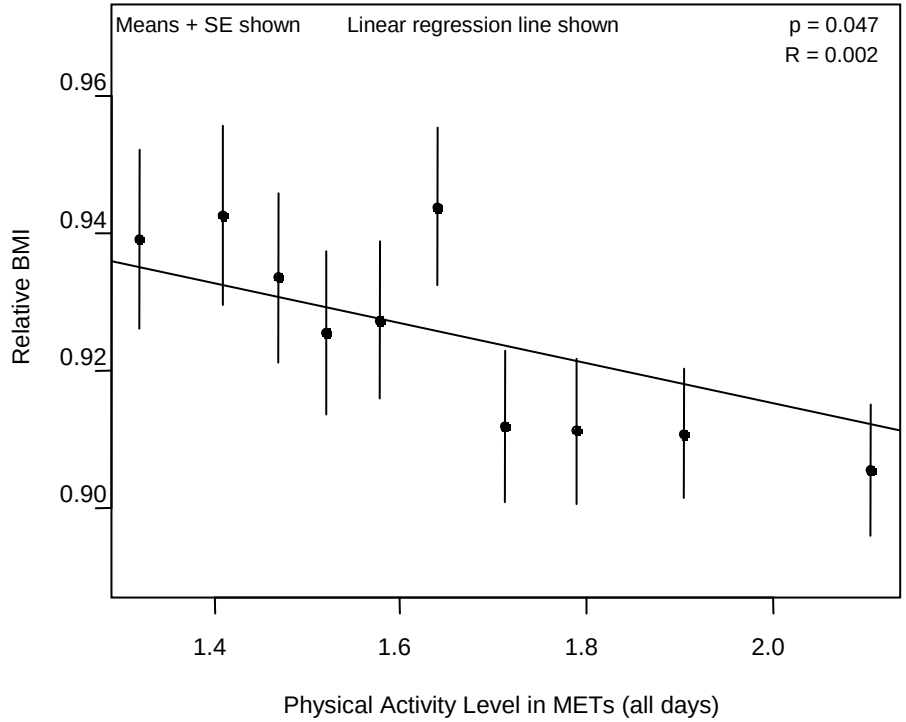


Table 4.15 Percentage in each BMI category by deciles of PAL in METs – all days (children 9–16 years old)

Deciles – physical activity level in METs	1.14–1.37	1.37–1.44	1.44–1.49	1.49–1.55	1.55–1.61	1.61–1.68	1.68–1.75	1.75–1.84	1.84–1.98	1.98–2.91
Underweight	4.6	8.2	7.9	6.8	5.7	1.7	6.0	6.2	3.5	3.0
Normal	68.8	62.4	64.2	68.6	65.2	68.3	70.6	66.6	77.6	74.8
Overweight	17.7	17.3	16.5	17.0	24.4	24.6	18.3	22.2	16.4	18.7
Obese	9.1	12.0	11.3	7.7	4.5	5.5	5.2	5.2	2.4	3.6
Overweight or Obese	26.7	29.3	27.8	24.7	29.0	30.0	23.5	27.3	18.8	22.3

Figure 4.27 Percentage overweight or obese by deciles of MVPA (minutes) per day – all days (children 9–16 years old)

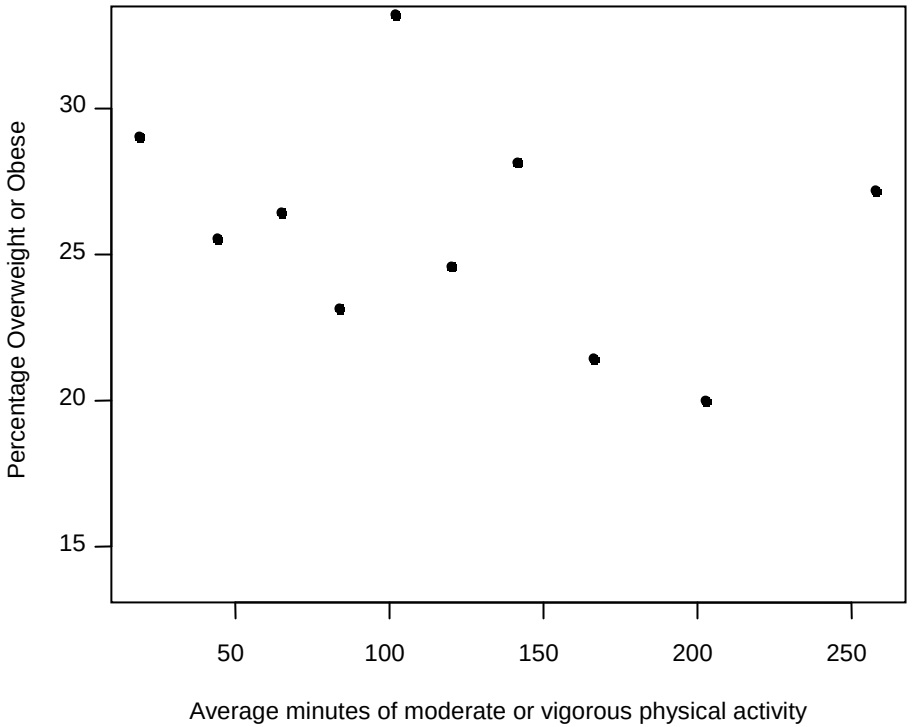


Figure 4.28 Relative BMI by deciles of MVPA (minutes) per day – all days (children 9–16 years old)

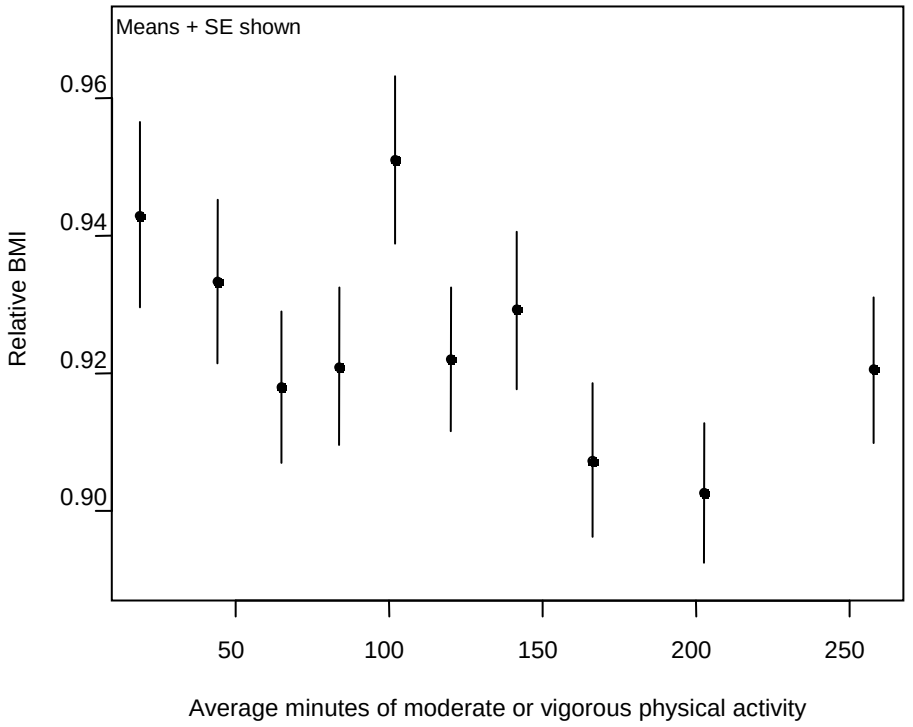


Table 4.16 Percentage in each BMI category by deciles of MVPA (minutes) per day – all days (children 9–16 years old)

Deciles – MVPA	0–32	32–55	55–75	75–93	93–110	110–130	130–152	152–182	182–225	225–491
Underweight	5.4	5.0	5.9	9.2	3.8	3.9	6.0	6.2	5.5	2.7
Normal	65.7	69.5	67.8	67.6	63.1	71.5	65.9	72.5	74.3	69.9
Overweight	19.8	14.6	19.1	18.1	22.9	19.5	23.7	16.8	14.1	23.4
Obese	9.2	10.9	7.3	5.0	10.3	5.1	4.4	4.6	5.8	3.8
Overweight or Obese	29.0	25.5	26.4	23.1	33.2	24.6	28.1	21.4	20.0	27.2

Figure 4.29 Percentage overweight or obese by deciles of sedentary activity (minutes) per day – all days (children 9–16 years old)

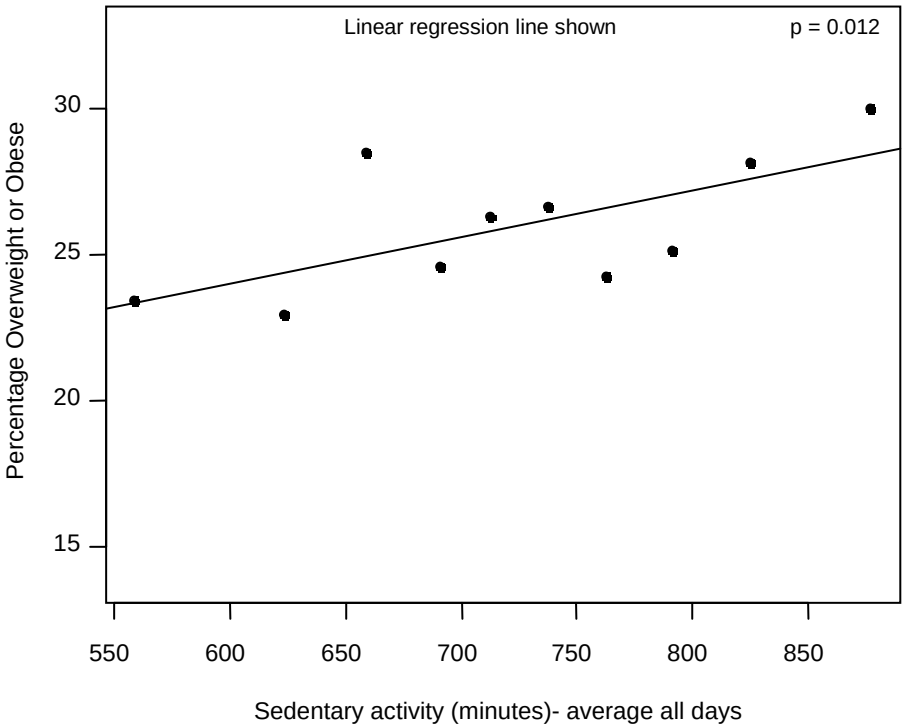


Figure 4.30 Relative BMI by deciles of sedentary activity (minutes) per day – all days (children 9–16 years old)

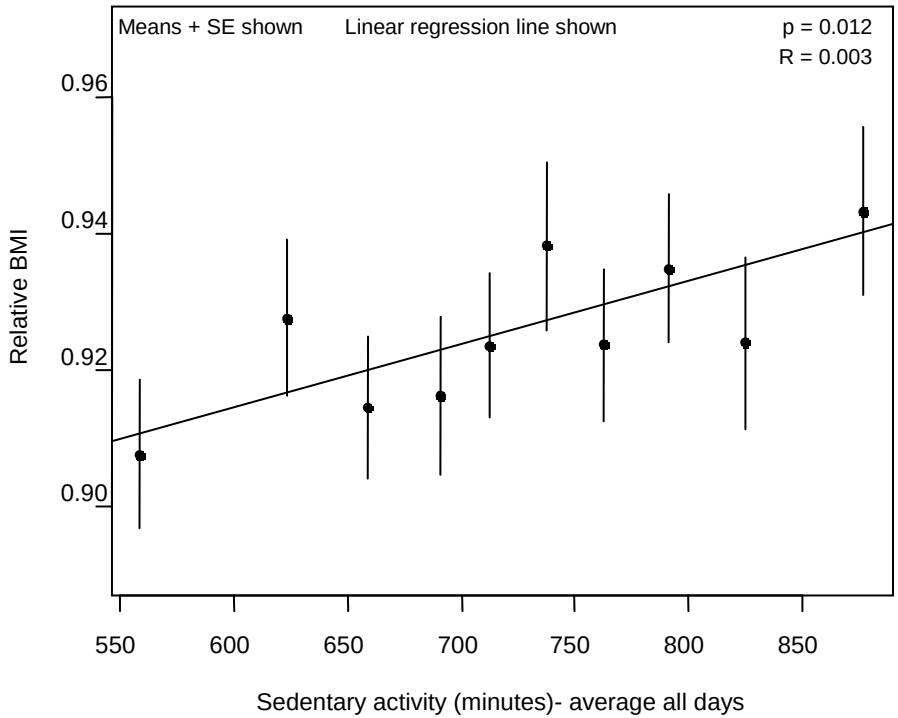


Table 4.17 Percentage in each BMI category by deciles of sedentary activity (minutes) per day – all days (children 9–16 years old)

Deciles – sedentary activity	388–598	598–643	643–674	674–701	701–725	725–749	749–775	775–807	807–845	845–1121
Underweight	5.6	3.6	7.3	6.0	3.6	6.8	4.5	3.6	8.4	3.3
Normal	71.0	73.5	64.0	69.4	70.0	66.6	71.2	71.4	63.5	66.8
Overweight	18.8	17.6	25.5	17.7	19.7	18.3	16.6	17.3	22.5	19.1
Obese	4.6	5.2	3.0	6.9	6.6	8.3	7.6	7.9	5.6	10.9
Overweight or Obese	23.4	22.9	28.5	24.6	26.3	26.6	24.2	25.1	28.1	30.0

Figure 4.31 Percentage overweight or obese by deciles of sleep time (minutes) per day – all days (children 9–16 years old)

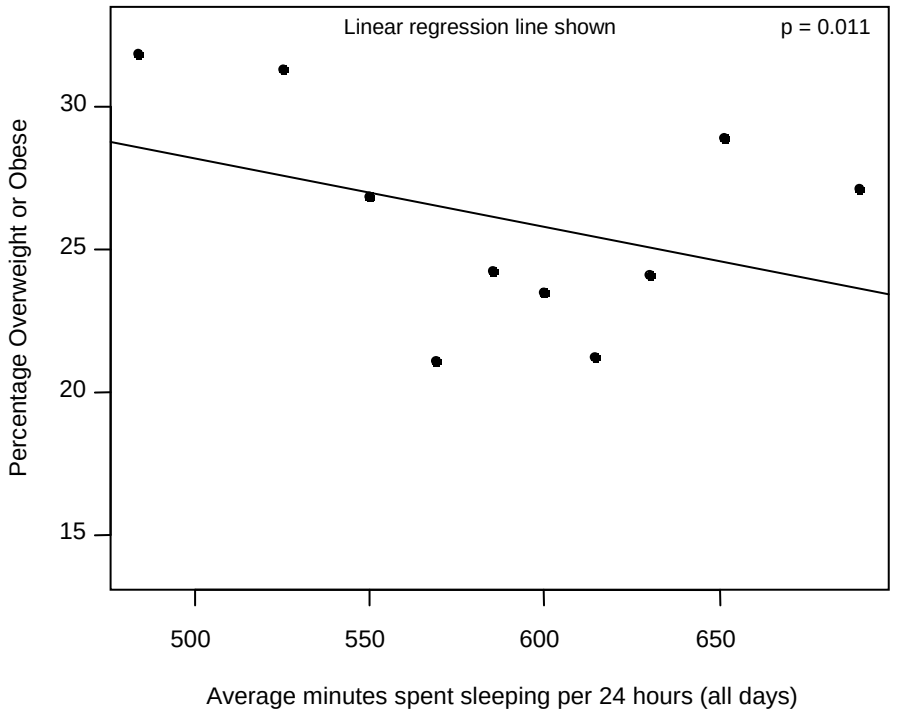


Figure 4.32 Relative BMI by deciles of sleep time (minutes) per day – all days (children 9–16 years old)

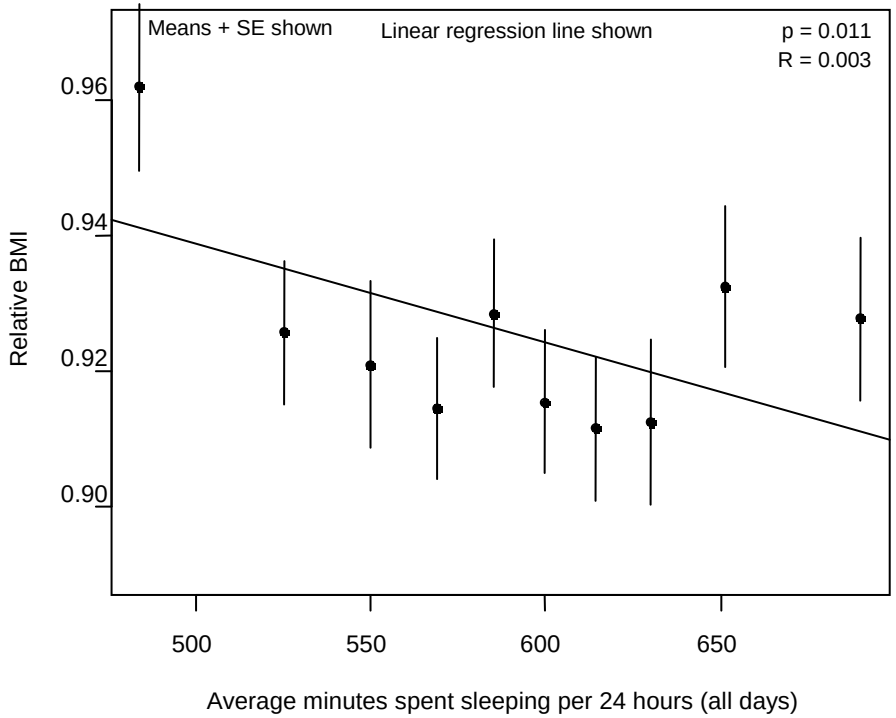


Table 4.18 Percentage in each BMI category by deciles of sleep time (minutes) per day – all days (children 9–16 years old)

Deciles – sleep time	216–509	509–540	540–559	559–578	578–592	592–606	606–622	622–641	641–665	665–926
Underweight	2.5	4.0	7.9	3.8	4.6	4.4	4.9	3.9	6.7	10.2
Normal	65.7	64.9	65.3	75.1	71.3	72.3	74.0	72.1	64.3	62.9
Overweight	20.9	23.2	21.0	15.7	19.9	19.2	13.1	19.7	20.7	21.5
Obese	11.0	8.1	5.8	5.4	4.4	4.3	8.1	4.4	8.2	5.7
Overweight or Obese	31.8	31.3	26.8	21.1	24.2	23.5	21.2	24.1	28.9	27.1

Figure 4.33 Percentage overweight or obese by deciles of sleep time (minutes) difference from average (children 9–16 years old)

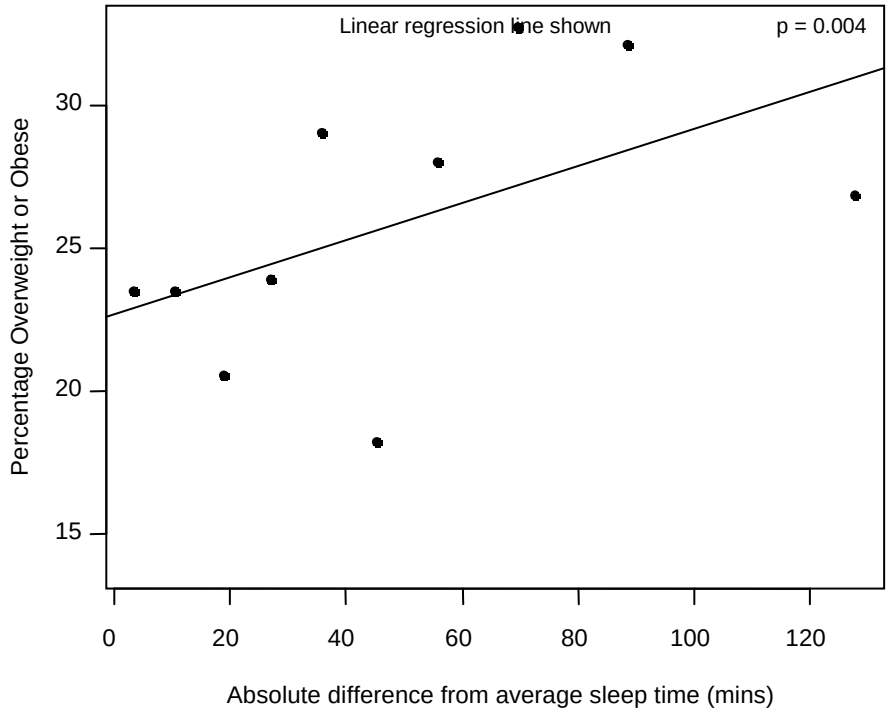


Figure 4.34 Relative BMI by deciles of sleep time (minutes) difference from average sleep time (children 9–16 years old)

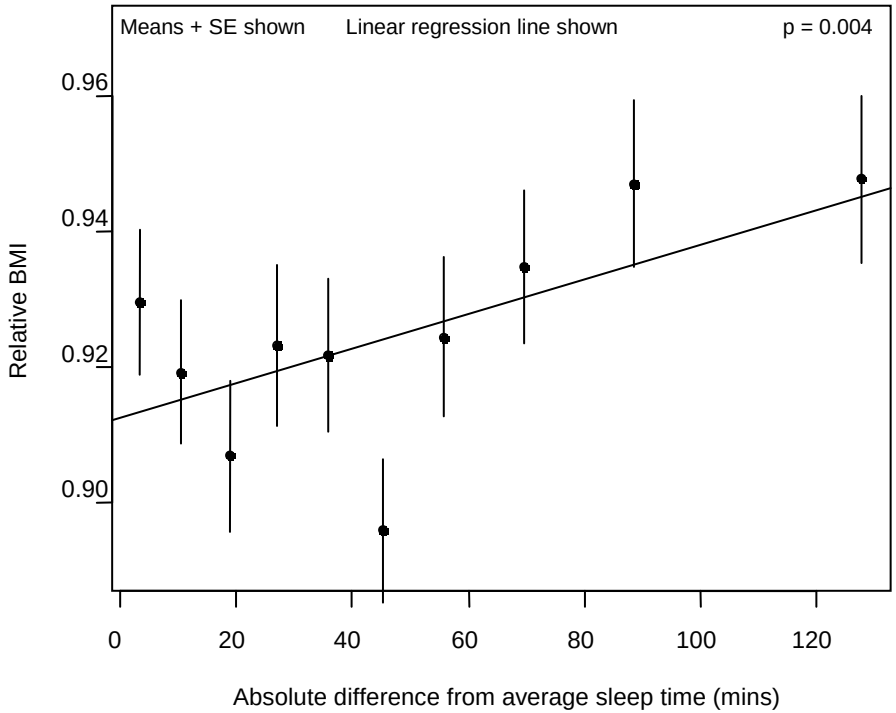


Table 4.19 Percentage in each BMI category by deciles of sleep time (minutes) difference from average (children 9–16 years old)

Deciles – sleep time difference from average	0.41–7.08	7.08–14.6	14.6–22.9	22.9–32.1	32.1–40.4	40.4–50.4	50.4–62.9	62.9–77.9	77.9–104	104–373
Underweight	3.1	5.1	7.1	4.9	6.0	6.2	6.9	5.7	10.2	3.5
Normal	80.2	82.4	79.9	81.0	72.6	86.3	76.3	67.6	60.0	71.5
Overweight	19.9	21.9	17.4	16.9	27.2	15.1	23.6	25.9	25.5	17.7
Obese	5.7	5.0	5.0	10.1	4.9	5.5	8.6	9.7	7.7	9.7
Overweight or Obese	23.5	23.5	20.5	23.9	29.0	18.2	28.0	32.7	32.1	26.8

Figure 4.35 Percentage overweight or obese by deciles of screen time activity (minutes) per day – all days (children 9–16 years old)

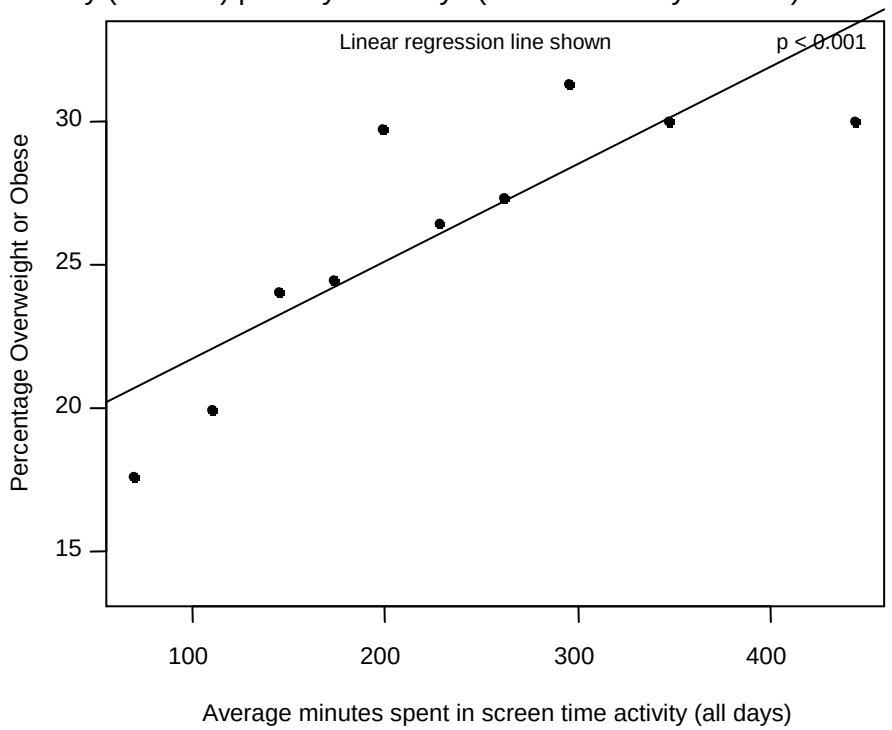


Figure 4.36 Relative BMI by deciles of screen time activity (minutes) per day – all days (children 9–16 years old)

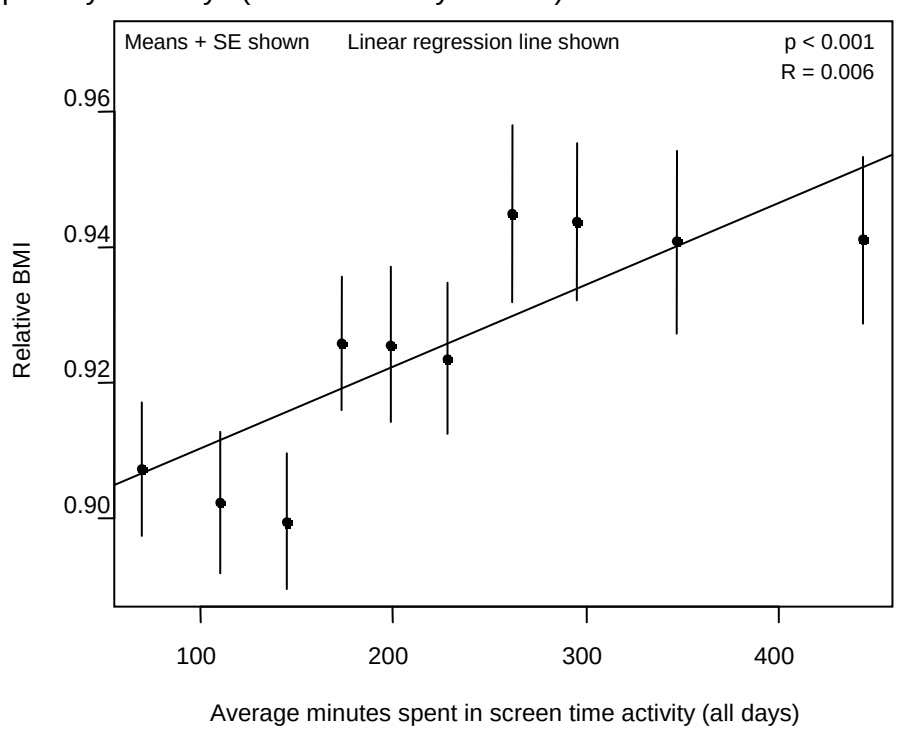


Table 4.20 Percentage in each BMI category by deciles of screen time activity (minutes) per day – all days (children 9–16 years old)

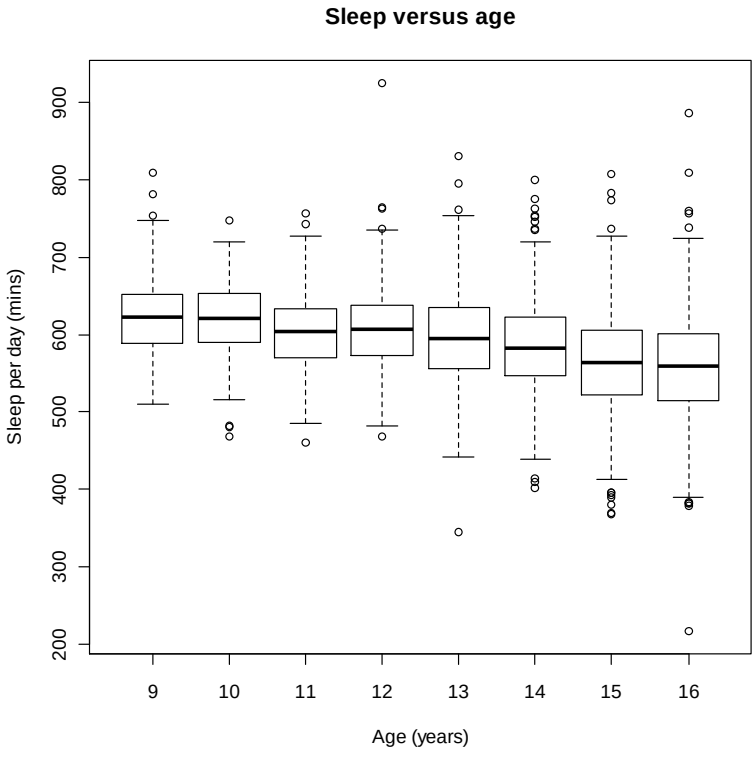
Deciles – screen time activity	0–94	94–128	128–160	160–186	186–212	212–242	242–279	279–319	319–384	384–690
Underweight	5.6	5.4	4.7	5.0	4.6	5.9	6.1	5.7	4.6	4.6
Normal	76.9	74.5	71.4	70.4	65.6	67.6	66.7	62.8	65.5	65.5
Overweight	12.8	16.6	19.6	20.8	22.7	21.7	15.6	24.7	19.0	20.4
Obese	4.8	3.4	4.4	3.6	6.9	4.7	11.7	6.6	11.0	9.6
Overweight or Obese	17.6	19.9	24.0	24.4	29.7	26.4	27.3	31.3	30.0	30.0

4.3.1 Relative BMI by time spent in sleep per day

There was some evidence for a linear relationship between relative BMI and total sleep time, however the plots (Figures 4.31 and 4.32) also suggested the possibility of a U-shaped relationship. An analysis was therefore conducted on sleep time – difference from the population average. In this case, the absolute difference from the average sleep time (over all days in minutes) shows a significant trend with both the percent overweight or obese and with relative BMI ($p = 0.004$) (Figures 4.33 and 4.34). Children who had a sleep time within 30 minutes of the average sleep time had a 22.3% prevalence of being overweight or obese. Those who had a sleep time that was more than one hour from the average sleep time had a prevalence of 31.0% of being overweight or obese.

Note across the ages 9–16 years sleep time was reasonably consistent (Figure 4.37).

Figure 4.37 Sleep time (minutes) per day versus age (years)



4.3.2 Relative BMI by time spent on screen-based activities

A strong positive relationship between screen time and relative BMI was observed ($p<0.001$) (Figures 4.35 and 4.36).

Around 18% of children who spent less than 94 minutes per day in front of a screen (the lowest decile) were overweight or obese, compared to 28.4% of children who spent over 212 minutes/day in front of a screen (the five highest deciles).

4.4 Other noted relationships between variables

4.4.1 Highest education level and household income

Household income and highest education level of either parent/carer was correlated as shown in Table 4.21. Generally children from households with a higher parental education level had a higher household income.

Table 4.21 Highest education level of either parent/carer by household income – number of respondents

Highest education level of either parent/carer	Household Income			
	<$52,000	$52,000–$77,999	$78,000–$103,999	>$104,800
School year 10 or less	149	44	16	6
School year 11 or equivalent	77	28	8	9
Certificate III/IV (including trade certificate)	459	351	248	178
Advanced diploma, diploma	154	140	108	115
School year 12 or equivalent	144	99	49	39
Bachelor degree or Grad Dip	210	276	339	538
A postgraduate diploma, or higher	37	58	86	284

4.4.2 Time spent in screen-based activity and parents highest education level

Children with parents or carers who had a lower level of education spent more time in front of screens ($p<0.001$). Children from households where the highest level of parental education was postgraduate diploma or higher watched screens for 203 minutes on average per day (Table 4.22). Children with parents or carers whose highest level of education was year 11 watched screens for 261 minutes on average (almost one hour more per day).

Table 4.22 Time spent in front of screen (daily average in minutes) by highest education level of either parent/carer

Highest education level of either parent/carer	Mean screen time activity (minutes) per day
School year 10 or less	245.2
School year 11 or equivalent	260.8
Certificate III/IV (including trade cert)	234.4
Advanced diploma, diploma	232.8
School year 12 or equivalent	243.5
Bachelor degree or Grad Dip	218.6
A postgraduate diploma, or higher	202.8

4.4.3 Time spent in screen-based activity and household income

Children from households with a lower household income spent more time in front of screens (p<0.001). Children from households with incomes >$104,000 watched screens for 207 minutes on average. Children from households with incomes <$52,000 watched screens for 245 minutes on average (Table 4.23).

Table 4.23 Time spent in front of screen by household income (daily average in minutes)

	Household Income			
	<$52,000	$52,000–$77,999	$78,000–$103,999	>$104,000
Mean screen time activity (minutes) per day	244.8	232.6	231.2	206.8

4.4.4 Physical activity, parent/carer highest education level and household income

Highest education level of either parent/carer was not found to be linearly related to pedometer distance, number of steps, time spent in vigorous physical activity or time spent in moderate physical activity. Household income was significantly related to activity level for pedometer steps, pedometer walking distance, time spent in vigorous physical activity and physical activity level (all p<0.001), and time spent in moderate physical activity (p=0.01) (Table 4.25). Household income was not significantly related to time spent in sedentary activities.

Table 4.24 Pedometer walking distance by parent's highest education level (daily average in km)

	Highest education level of either parent/carer						
	School year 10 or less	School year 11 or equivalent	School year 12 or equivalent	Certificate III/IV (including trade cert)	Advanced diploma, diploma	Bachelor degree or Grad Dip	A postgraduate diploma, or higher
Pedometer walking distance	6.9	6.8	6.9	7.2	7.1	7.1	7.4

Table 4.25 Physical activity measures by household income

	Household Income			
	<$52,000	$52,000–$77,999	$78,000–$103,999	>$104,800
Pedometer walking distance (km/day)	6.9	6.9	7.2	7.3
Pedometer (steps/day)	11290	11474	11902	11705
Vigorous Physical Activity (min/day)	41.1	46.1	53.0	52.9
Moderate Physical Activity (min /day)	76.3	76.8	70.4	69.2

4.5 Multivariate linear regression models for relative BMI

Stepwise regression was used to determine which variables are jointly statistically significantly related to relative BMI.

4.5.1 Exercise, sleep, screen time and demographic variables

Pedometer steps ($p<0.001$), parents highest education level ($p<0.001$) and household income ($p<0.05$) were found to be statistically significantly related to relative BMI for children aged 9–16 years in a linear weighted model. These variables were chosen by the linear model in preference to screen time, other measures of physical activity, and sleep time.

Only 2% of the variance of relative BMI is explained by this model. The regression model used weighted data to represent the Australian population.

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EXPLANATORY NOTES

Introduction

The 2007 Australian National Children's Nutrition and Physical Activity Survey (ANCNPAS) was commissioned by the Commonwealth Department of Health and Ageing, the Department of Agriculture, Fisheries and Forestry, and the Australian Food and Grocery Council.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the University of South Australia conducted the survey with I-view Pty Ltd undertaking the survey fieldwork. The project team acknowledges the contribution of Flinders University towards analysis of the dietary data.

The survey measured dietary intakes of food and beverages, use of supplements during the previous 24 hours, selected food habits, heights, weights and body mass index (BMI), waist circumference, time spent in physical activity and sedentary activity (screen time), number of daily steps taken and demographic characteristics. These data were gathered on children aged 2–16 years (n=4487) between 22 February 2007 and 30 August 2007. Ethics approval was obtained from the National Health and Medical Research Council registered Ethics Committees of CSIRO and University of South Australia.

The data were collected at a face-to-face home visit (computer-assisted personal interview, CAPI) and a subsequent telephone interview (computer-assisted telephone interview, CATI) conducted 7–21 days after the CAPI.

Food, beverage and supplement intakes were collected for all participants using a standardised, computer-based, three-pass 24-hour recall methodology during the CAPI and the CATI. In collaboration with Food Standards Australia New Zealand (FSANZ), the food and beverage intake data were translated to daily nutrient intake data using the most recent Australian nutrient composition database. Food habit questions were asked of each child and/or parent during the CAPI in relation to usual consumption of fruits, vegetables, type of milk, use of salt and earlier infant feeding practices.

Physical activity was measured in two ways. Time use was measured in children aged 9–16 years using a validated computerised 24-hour recall during the CAPI and the CATI. Children recalled a total of four days. Pedometers were also used to measure the average number of steps taken daily over six days by children aged 5–16 years.

Weight, height and waist circumference were measured for all participants during the CAPI.

Scope and coverage

The survey was conducted using a quota sampling scheme. The primary sampling units were postcodes (stratified by state/territory and capital city/rest of state, giving 13 regions in total). The number of postcodes selected in each region was proportional to the Australian Bureau of Statistics (ABS) population estimates for 2–16 year olds in each region.

There were 576 postcodes excluded from selection. Areas identified in the 2001 ABS Census as having very few eligible children and very remote areas were excluded from the survey sampling frame due to budgetary and time restrictions. Additionally this survey was not designed to obtain information from a sufficient number of Indigenous children to accurately estimate their intake and activity patterns. Using the 2001 ABS population data, postcodes covering areas where more than 50% of the population identified as Indigenous were excluded.

Remaining postcodes had an equal chance of initial selection within each region. The initial national selection of 50 postcode values was expanded to include postcodes in close geographical proximity, thus expanding the number of postcodes to a total of 230. This clustered sampling minimised travel time and costs for interviewers undertaking the face-to-face interviews.

Households (private dwellings) from selected postcodes were then recruited to the survey using random digit dialling (RDD). The telephone number prefix acted as a 'geographic indicator' that corresponded to postcode. Households with children aged 2–16 years were identified and asked if they would participate. One eligible child within the household was selected as the 'study child' for the purposes of the survey. In some cases recruitment of the study child did not proceed because the age and sex quota for that location was filled.

Using RDD resulted in more postcodes in the final sample than were sampled for recruitment because telephone number prefixes do not exactly follow postcode boundaries and some numbers may located be in adjacent suburbs, or some people may have taken advantage of telephone number portability (where they take an existing phone number with them when they move).

Interviewing was conducted on school and non-school days. The proportion of interviews conducted on weekdays, weekends, public holidays and school holidays was selected to reflect the proportions of these days across the fieldwork period.

Coverage rules were designed to ensure that, as far as possible, eligible persons had only one chance of being selected for interview. The child was deemed to be a resident of the household if they usually stayed at the selected household on average for four or more days per week in the case of shared care. Households with more than one fixed line telephone may have had a greater chance of selection; however, this was identified at the screening interview.

Telephone number prefixes cannot be relied upon to indicate geographic location, as an increasing number of people elected to take advantage of phone number portability. For this reason, access to a full listing of numbers with an effective geographic tag, such as an address, postcode or Census Collector District, was limited.

RDD allows for the inclusion of silent, unlisted and recently listed numbers in the sample which would not occur with a sample drawn from listed numbers (i.e. telephone white pages).

There are two situations where RDD cannot reach eligible households in a postcode:

- households where there is no fixed phone line; and
- households where the telephone prefix has been ported in from another area and is not a prefix allocated to the postcode they now reside in, or the survey sampling database.

Survey design

Sample design

The survey sample was randomly selected firstly by postcode (stratified by state/territory and capital city/rest of state), and secondly by households within selected postcodes using RDD of telephone numbers.

Households were contacted and those with children aged 2–16 years (eligible) were identified and asked to participate in the survey. One child within the household was selected as the "study child" for the purpose of the survey.

There was an agreed quota of 1000 children (50% boys and 50% girls) for the following age groups: 2–3 years, 4–8 years, 9–13 years and 14–16 years. The base national sample in South Australia was supplemented by 400 to allow more detailed estimates for that state. A total of 4487 children completed the entire survey. The sampling, selection and recruitment methodology are comprehensively reported in the User Guide (CSIRO et al. 2010) and should be considered when interpreting data.

Survey Response

Of the 16,598 eligible households that were contacted 10,109 agreed to participate in the study, which equalled a response rate of 61%. Of these 10,109 households, 3320 were subsequently not required to participate as the quota for children in their age group had already been filled. Therefore 6789 households were recruited. After initial recruitment, 1546 of the households were not interviewed as the relevant age quota had been met in their postcode cluster. Once recruited, 5.4% of the households withdrew, with the majority stating that they had insufficient time to commit to the survey or had lost interest in completing the survey. A further 2.1% of the sample did not complete all parts of the survey - 4837 completed the CAPI and 4695 participants completed the CATI. The final response rate for completed CAPI and CATI was 40% when calculated as a proportion of eligible households.

Complete data sets

A complete data set was defined as a participant who provided data for all aspects of the survey relevant for their age group (demography, dietary recall ± use of time). There were 4487 complete data sets included in the final database and analysed in this report. Pedometer data are reported from a subset of eligible participants.

Sample weights

Since stratified sampling with non-proportional samples was used, a weight was applied to each participant's record. The weight for each participant was proportional to the number of "similar" children in the Australian population, where "similar" is defined according to factors thought likely to influence nutrition and physical activity (age, sex and state of residence).

Data from the ABS 2006 Census on Postal Area and State by Capital/Rest-of-State for age and sex groups were used to estimate the number of "similar" children in the population. Data from the survey were used to estimate the sample numbers and hence the weights for each individual child. These weights enable the survey data to provide estimates for the whole population of Australian households with children in scope.

Methodology

The stratified quota approach was adopted to provide at least 500 boys and 500 girls from across Australia in each of the age and sex groups covered by the Nutrient Reference Values (NRVs) to allow sufficient numbers to make statistical comparisons of intakes with recommendations. The South Australian Department of Health contributed towards a booster sample (n = 400) for South Australian children.

The data were collected at a face-to-face home visit (CAPI) and a subsequent telephone interview (CATI) conducted 7–21 days after the CAPI. Intakes and activity can vary markedly over different types of days e.g. week days versus week-end days and school versus non-school days. In order to capture intakes and activity patterns that would represent all types of days, the CAPI and the CATI were collected on different day types when feasible. Attempts were made to collect information on school and non-school days (including holidays) in proportion to the number of such days that occurred over the sampling period.

Food and nutrients

Food, beverage and supplement intakes were collected for all participants using a standardised, computer-based, three-pass 24-hour recall methodology during the CAPI and the CATI. Dietary recall software from the Life in New Zealand survey (LINZ24©) was modified for the 2007 ANCNPAS to reflect the Australian food supply. Details of the modifications are included in the User Guide (CSIRO et al. 2010).

All interviewers received training in conducting the 24-hour recall. To assist with estimating the amounts of food and beverages consumed, standard measuring cups and spoons were provided, along with a Food Model Booklet that had life-size diagrams and drawings depicting different serving sizes of foods and different sized food containers to assist participants and interviewers during dietary recalls. The Food model booklet was then left with participants at the CAPI to assist in quantifying food consumed when the CAPI was conducted. Dietitians checked all of the 24-hour recalls for their content and whether or not there appeared to be a reasonable consumption pattern. Any unusual intakes were queried and modified if appropriate.

In collaboration with FSANZ, a food coding system was developed to reflect the current food supply and to maintain comparability with the food groups used in the 1995 National Nutrition Survey (ABS 1998). Additional food groups were added for infant foods and formulae and dietary supplements. In addition, food, beverage and supplement intake data were translated to daily nutrient intake data using the most recent Australian nutrient composition database. The User Guide provides more detailed information on this process (CSIRO et al. 2010).

Nutrient intake data estimated in the 2007 ANCNPAS include: energy, protein, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, alpha-linolenic acid, linoleic acid, long chain omega-3 fatty acids, cholesterol, total carbohydrates, starch, sugars, dietary fibre, alcohol, total vitamin A, pre-formed and provitamin A, thiamin, riboflavin, total niacin equivalents, preformed niacin, vitamin C, D, E, total folate, dietary folate equivalents, potassium, sodium, phosphorus, calcium, magnesium, iron, zinc, iodine and caffeine.

Time and place of consumption of foods and drinks were also recorded. .

Physical activity

Physical Activity Recall

Participants aged 9–16 years used the Multimedia Activity Recall for Children and Adolescents (MARCA®) (Ridley et al. 2006) to self-report 'use of time'. The MARCA is a computerised 24-hour recall which asks participants to recall everything they did on the previous day. The MARCA shows moderate to good validity when compared to accelerometry (Ridley et al. 2006). It uses a segmented-day format, with meal times and/or school bells as anchor points. Within each time-segment, time-sliders indicate the start and completion times for activities in time slices which can be as fine as five minutes. Users choose from about 250 activities listed in a compendium under seven categories (Inactivity, Transport, Sport and Play, School, Self-Care, Chores and Miscellaneous). If the activity required is not available in the activity compendium, the participant can enter the activity as "other" and enter a text description.

Each child recalled a total of four days; two days prior to the CAPI and two days prior to the CATI. During both the CAPI and CATI, the child recalled the two days in either order.

Pedometry

Pedometers were used to collect objective physical activity data for most participants aged 5–16 years. The pedometer used in this survey was the New Lifestyles 1000, which provides the number of steps a day, the distance covered and the number of minutes spent in moderate-to-vigorous physical activity (MVPA, > 3 metabolic equivalents, METs).

The pedometer was worn for seven consecutive days by attaching to a belt or waistband in a position corresponding to mid-thigh on the right side of the body. A security strap and clip was used to secure the pedometer in place and to prevent loss of the pedometer if it slipped from its position.

At the CAPI, the participant or a parent was instructed on how to retrieve data from the pedometer and how to complete the log sheet. The participant was asked to wear the pedometer from when he or she got out of bed in the morning until going to bed at night. Those occasions when the pedometer was removed (e.g. showering, swimming or playing contact sports) were recorded on the log sheet along with the estimated duration of removal. The pedometer and log sheet were posted back to the survey team using a reply paid envelope.

Estimating stride length

Stride length was estimated during the CAPI using the 10 steps method. A linear distance of approximately ten metres was marked out with a metal tape. The participant was asked to line up the toes of both feet with the zero on the tape, walk normally for ten steps and stop by bringing both feet together. Two trials were conducted after an initial familiarisation trial. The average distance covered in centimetres was divided by ten to provide stride length. This distance was programmed into the pedometer so that the daily distance covered was individualised. The default setting in the pedometer of 76 cm is based on adult data and was inappropriate for this survey.

Physical measurements

Height, weight and waist girth were measured on children aged 2–16 years, according to the protocols of the International Society for the Advancement of Kinanthropometry (Marfell-Jones et al. 2006).

Choice of measurement instruments was influenced by the need for interviewers to collect data in participants' homes and therefore conveniently transport equipment.

A minimum of two measurements were taken for each anthropometric variable. A third measure was taken where the second measure was not within 5 mm for height, 0.1 kg for weight, and 10 mm for waist girth. The mean value was used as the final score if two measurements were taken. The median value was used as the final measure if three measurements were taken (See User Guide for further details, CSIRO et al. 2010).

BMI

BMI was calculated as weight in kilograms divided by height in metres squared. Age- (at date of CAPI, rounded to nearest half year) and sex-specific BMI cut offs for normal weight, overweight and obese among children and adolescents were applied to the data (using Table 4 of Cole et al. 2000). For underweight, Grade 3 thinness (corresponding to an adult BMI of 18.5 kg/m^2) was used as a cut off (Cole et al. 2007).

Demographic data

Demographic data items relating to each participant and their household were collected at the CAPI. Responses were provided by the parent or care giver of the participant (see User Guide for detailed information, CSIRO et al. 2010).

Survey methodology issues

Sampling methodology

There are limitations to the use of postcodes as the primary sampling unit as postcodes can cover a wide geographic area (one postcode can include urban, rural and remote areas). However, postcodes do offer a degree of clustering to enable cost-effective face-to-face interviews to be conducted and allow a reasonable geographic distribution of the sample across Australia.

A potential sample design effect is the loss in statistical precision resulting from a clustered sample that does not fully cover the diversity of specific response variables evident in the entire population. The extent of loss in statistical precision largely depends on whether, and how much, the specific response variables have underlying geographic variations.

The potential design effect on the precision of estimates derived from a clustered sample is essentially related to the heterogeneity of the stratum (metropolitan or rural) population for their state. If the members of a cluster (of postcodes) are effectively no more like each other than they are to others within their state (rural or metropolitan area) population, then the intra-cluster correlation is zero and there is no design effect. However, where regional clusters result in cluster members being more like each other and less like other members of their regional population, then even where the intra-cluster correlation is quite small, there will be a design effect, the size of which is then dependent upon the size of the cluster.

Recruitment methodology

The RDD method is a time and cost effective approach to recruitment and has been previously used to generate survey samples for population health studies. However, when this method is combined with a quota system three important methodological issues should be considered.

Firstly, RDD with a quota affects the probability of selection of children. One child per eligible household was randomly selected to take part in this survey. It is desirable to have each child in the total sample frame have an equal chance of selection in the sample drawn. However, with RDD and household sampling, children who are the only child or who have fewer siblings aged 2–16 years have more chance of selection than children living with a larger number of siblings aged 2–16 years. Furthermore, application of the predetermined age quotas (1000 for each age group, i.e. 2–3 years, 4–8 years, 9–13 years and 14–16 years) were disproportionate to the population across each of these age groups. Consequently children aged 2–3 years and 14–16 years had a higher chance of selection, compared to those aged 4–8 years or 9–13 years.

Secondly, it was not possible to gather demographic information on those who refused to participate and those who were excluded because of the quota system. This information is needed to estimate any potential non-response bias. It is not possible to allow for non-response bias in this survey.

Thirdly, to obtain a representative sample of the population, the RDD method relies on accessing current telephone number information and should have as complete coverage as possible. It is estimated that at least 95% of Australian households have a land line (ABS 2003), with some households choosing to replace a land line connection with a mobile phone (ACMA 2008). Portability of telephone numbers as people move across geographic locations can result in recruitment outside the selected postcodes. An advantage of RDD is that silent, unlisted and recently listed numbers can be included by chance.

Cluster Sample Size

The target sample size was achieved for each region. There was no set quota by cluster of postcodes. Some clusters were skewed with either more postcodes or postcodes with higher populations of children 2–16 years. There were some postcodes where no children were selected as all numbers were exhausted with no recruitment (high industrial/commercial areas), and there were other postcodes included that were not part of the initial selection ("phone number transportability") but the family was still recruited.

Seasonality

Data were collected between February and August 2007, resulting in limited information on different intake with changing seasons. The survey collection period should be considered when interpreting the results.

Dietary recall

The 24-hour recall methodology relies on the participant's ability to recall the details of all food, beverages and supplements consumed over a 24-hour period. This method is associated with mis-reporting of foods and beverages consumed, along with inaccuracies in portion size estimation and level of detail to describe the items. Interviewers were trained in various techniques to minimise this source of error, but it remains unavoidable. Despite detailed scrutinizing of the nutrient data by trained staff there may still be some unusual intakes of individual foods.

In recognition of the varying age groups of the participants, the interviews were conducted with the primary care-giver for all children below the age of nine years and with the study child for children aged nine years and over. Primary care-givers were encouraged to be present for all interviews.

One 24-hour recall is considered appropriate to estimate the mean and median for the usual intake of a group. It is not suitable for assessing the usual intake of individuals because of the considerable day-to-day variability in food, beverage and supplement intake within individuals. For this reason, the present survey obtained a second 24-hour recall of intake by CATI for all participants, with 99% of these completed on a non-consecutive day. Provided there are no systematic differences between the CAPI and CATI data, the two days of intake data for each individual can be used to estimate the distribution of usual intake for the population.

Physical activity recall

The 24-hour recall methodology imposes the discipline of fitting all activities into a 24-hour time-frame, and exploits innate chronological narrative data storage and retrieval methods. However, all recalls are subject to the limitations of memory, social desirability effects, and inaccurate estimation of time - all of which vary with age, sex and individual characteristics. Children aged less than nine years are not able to accurately recall what they did the day before and place events into a temporal frame. Therefore, the MARCA was administered only to children aged nine years and over.

Pedometry

The data are based on 'complete' days, defined by at least 1000 steps and the pedometer was removed for no more than 240 minutes. Assuming that the sleep duration for most respondents in this survey is between eight and ten hours, allowing four hours of pedometer removal still gives at least ten to twelve hours in which data were collected. This aligns with recent accelerometer studies that include measurement days on which at least ten hours of data are recorded.

Several studies discard days on which the pedometer was removed for more than 60 minutes. This is an issue, as disregarding days when subjects participated in long periods of swimming or contact sports will lead to spurious estimates of daily physical activity. In the survey, seasonal differences in activity choices will impact on the measurement periods, with aquatic activities more likely in the summer. The vast majority of reasons for pedometer removal during the waking hours, as recorded on the log sheets, related to unavoidable circumstances such as exposure to water and engagement in contact sports. Relatively few were due to forgetting or refusing to wear the pedometer.

As pedometers are most sensitive to activities involving running and walking, and are removed for aquatic activities and contact sports, caution is advised when using pedometer data to assess compliance with physical activity guidelines. It is recommended that engagement in 'sufficient' physical activity also be assessed using criterion-referenced step counts (currently 11,000–12,000 and 13,000–15,000 per day, for girls and boys respectively). Having these cut off points, established in accordance with weight categories (normal vs. overweight/obese), avoids the issue associated with inferring 'daily' MVPA from pedometer data.

It should also be noted that Day Type (weekday versus weekend), in the pedometer data tables, should not be interpreted as 'school day' and 'weekend'. The weekdays in these tables include school holidays, long weekends and pupil-free school days.

Physical Measures

The methodology of performing physical measurements on participants was designed to minimise errors and be consistent. Normally, measurements should not be taken after training or competition, sauna, swimming or showering, since exercise, warm water and heat can produce dehydration and/or increased blood flow. Those circumstances have the potential to affect body mass and girth measurements. To counter this potential issue, physical measurements were taken part way through the interview, when the participant had been sitting for at least 30 minutes.

Measurement of weight was taken with light clothing on, possibly slightly inflating the weight and BMI results. Waist girth was occasionally taken over light clothing, when requested by the subject, and this could also increase the waist girth results. The difference associated with wearing light clothing would be small in each of these measurements.

Comparison with previous dietary surveys

Dietary information recorded in this survey may differ from data obtained using a different method to assess food and nutrient intake (such as a food record or a semi-quantitative food frequency questionnaire), a different food composition database, or if different age groups were assessed.

The methodology used in this survey is broadly comparable to that used in the 1995 National Nutrition Survey (NNS). Differences between the two surveys include the:

- sampling frame;
- age groups used for reporting. The 1995 NNS reported intakes for 2–3 years, 4–7 years, 8–11 years, 12–15 years and 16–18 years;
- use of repeat 24-hour recalls on all survey participants whereas the 1995 NNS collected repeat 24-hour recalls on only 10% of the sample and adjusted for within person variation based on this sub-sample;
- use of CATI for repeat 24-hour recalls, whereas the 1995 NNS repeat 24-hour recall took place in the form of a personal interview;
- food/nutrient composition database – this survey utilised the 2007 AUSNUT database and the 1995 NNS utilised the AUSNUT 1995 database. Both of these food composition databases reflect the composition of foods at the time the survey was completed; and
- the number of major food groups used to report food intake, which was increased to include categories for dairy substitutes and supplements. Some additional sub-groups have also been created to better reflect the current food supply.

Comparison with dietary recommendations

The *Nutrient Reference Values for Australia and New Zealand* (NHMRC 2006) provides Nutrient Reference Values (NRVs) for a range of macro- and micronutrients, including the estimated average requirement, recommended dietary intake (RDI) and/or adequate intake; generally for 2–3 years, 4–8 years, 9–13 years and 14–16 years. For those aged 14 years and above, the acceptable macronutrient distribution range and suggested dietary targets are set for certain nutrients that may help in prevention of chronic disease.

The *Core Food Groups* (NHMRC 1994) recommends quantities of cereals, fruits, vegetables, meat and meat alternatives, and dairy products which were designed to meet 70% of the RDIs for all nutrients except energy (NHMRC 1991). The Core Food Group recommendations were under review at the time of this publication.

The *Dietary Guidelines for Children and Adolescents in Australia* (NHMRC 2003) provides general recommendations for dietary intake without specifying the amounts recommended for consumption. These dietary guidelines were also being reviewed by the National Health and Medical Research Council at the time of this publication.

The *Australian Guide to Healthy Eating* provides consumers with recommendations about the daily amounts and kinds of food that should be eaten for good health and well-being. The Guide aims to encourage the consumption of a variety of foods from each of five food groups every day in proportions that are consistent with the suite of Australian dietary guidelines. The Guide also provides information on the number of serves required from the five food groups and offers practical examples.

Comparison with physical activity recommendations

The *National Physical Activity Guidelines*, issued by the Department of Health and Ageing in 2005, recommends levels of physical activity and sedentary behaviour for children aged 5–18 years. These guidelines recommend that children get at least 60 minutes of moderate-to-vigorous physical activity and accumulate no more than 120 minutes of screen time (television, videogames and computer) each day, especially during daylight hours.

The definition of "compliance" with the guidelines is unclear (Olds et al. 2007). Compliance can be defined as:

- the child satisfies the guidelines on all days of the survey period (the "all days" method);
- the child satisfies the guidelines on most days of the survey period (the "most days" method);
- the child satisfies the guidelines when MVPA and screen time are averaged across the survey period (the "average" method); and
- the level of compliance can be understood as the probability that a randomly chosen child on a randomly chosen day will satisfy the guidelines (the "child x day" method).

ABBREVIATIONS

ANCNPAS	Australian National Children's Nutrition and Physical Activity Survey
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ASSDA	Australian Social Sciences Data Archive
BMI	Body Mass Index
CAPI	Computer Assisted Personal Interview
CATI	Computer Assisted Telephone Interview
cm	centimetre(s)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoHA	Department of Health and Ageing
FSANZ	Food Standards Australia New Zealand
g	gram(s)
hrs	hour(s)
kg	kilogram(s)
kg/m^2	kilograms per metre squared
kJ	kilojoule(s)
km	kilometre(s)
LINZ24©	Life In New Zealand 24-hour diet recall software
MARCA	Multimedia Activity Recall for Children and Adolescents
METRO or metro	Capital city statistical division classification of the child's residential postcode using ABS postal area to statistical local area concordance. Commonly termed as "metropolitan".
METs	Metabolic Equivalents
mg	milligram(s)

mins	minute(s)
ml	millilitre(s)
mm	millimetre(s)
MVPA	Moderate-to-Vigorous Physical Activity
NHMRC	National Health and Medical Research Council
NNS	National Nutrition Survey
NRVs	Nutrient Reference Values
NSW	New South Wales
NT	Northern Territory
PA	Physical Activity
PAL	Physical Activity Level
QLD	Queensland
RDD	Random Digit Dialling
RDI	Recommended Dietary Intake
SA	South Australia
SE	Standard Error
SPSS	Statistical Package for the Social Sciences
TAS	Tasmania
VIC	Victoria
WA	Western Australia

APPENDIX 1: PERCENT OBESE OR OVERWEIGHT BY EXCERISE, SLEEP AND NUTRITION

The following table shows the percentages plotted on the graphs. The results for survey were broken up into 10 groups; Lowest 10%, 10–20% etc.

Table A1.1 Percent Obese or Overweight against Nutrition and Exercise for the 10th percentiles plotted

EXERCISE, SCREEN & SLEEP time										
pedometer steps per day (average all days)	*2300–7400*	*7400–8700*	*8700–9700*	*9700–10600*	*10600–11400*	*11400–12200*	*12200–13100*	*13100–14300*	*14300–16000*	*16000–32900*
% Overweight or Obese	**28%**	**29%**	26%	22%	27%	21%	15%	22%	17%	14%
pedometer dist (km) per day (average all days)	*0.1–4.4*	*4.4–5.2*	*5.2–5.8*	*5.8–6.3*	*6.3–6.8*	*6.8–7.4*	*7.4–8.0*	*8.0–8.8*	*8.8–10.1*	*10.1–25.3*
% Overweight or Obese	**28%**	25%	23%	20%	24%	27%	20%	18%	18%	16%
minutes spent in screen time activity (average all days)	*0–94*	*94–128*	*128–160*	*160–186*	*186–213*	*213–243*	*243–279*	*279–319*	*319–384*	*384–690*
% Overweight or Obese	18%	21%	22%	25%	**28%**	26%	**28%**	**31%**	**28%**	**30%**
Sedentary activity (minutes) (average all days)	*390–600*	*600–640*	*640–670*	*670–700*	*700–730*	*730–750*	*750–780*	*780–810*	*810–850*	*850–1120*
% Overweight or Obese	23%	25%	27%	24%	25%	**28%**	25%	24%	**28%**	**28%**
minutes of moderate or vigorous physical activity	*0–33*	*33–55*	*55–75*	*75–93*	*93–110*	*110–130*	*130–153*	*153–183*	*183–225*	*225–491*
% Overweight or Obese	**28%**	24%	**28%**	25%	**33%**	24%	**28%**	21%	18%	27%
Physical Activity Level in METs (average all days)	*1.14–1.37*	*1.37–1.44*	*1.44–1.49*	*1.49–1.55*	*1.55–1.61*	*1.61–1.68*	*1.68–1.75*	*1.75–1.84*	*1.84–1.98*	*1.98–2.91*
% Overweight or Obese	27%	**29%**	**28%**	25%	27%	**32%**	24%	25%	19%	21%
minutes spent sleeping per 24-hours (average all days)	*220–510*	*510–540*	*540–560*	*560–580*	*580–590*	*590–610*	*610–620*	*620–640*	*640–670*	*670–930*
% Overweight or Obese	**31%**	**30%**	25%	22%	24%	23%	19%	24%	**30%**	**29%**
minutes of vigorous physical activity (average all days)	*	*0–8*	*8–16*	*16–26*	*26–36*	*36–48*	*48–64*	*64–83*	*83–113*	*113–285*
% Overweight or Obese		**30%**	26%	**29%**	23%	25%	23%	22%	25%	22%

Table A1.1 Percent Obese or Overweight against Nutrition and Exercise for the 10th percentiles plotted -*continued*

NUTRITION										
Energy kilojoules (kJ) total daily intake	*830–4330*	*4330–5020*	*5020–5470*	*5470–6010*	*6010–6430*	*6430–6900*	*6900–7480*	*7480–8200*	*8200–9300*	*9300–16670*
% Overweight or Obese	22%	21%	18%	17%	23%	22%	15%	21%	18%	17%
Energy inc Fibre (kJ) total daily intake	*860–4430*	*4430–5130*	*5130–5610*	*5610–6130*	*6130–6570*	*6570–7070*	*7070–7640*	*7640–8330*	*8330–9480*	*9480–17180*
% Overweight or Obese	21%	22%	18%	17%	22%	22%	16%	21%	18%	17%
Total Fat (g) total daily intake	*3–30*	*30–37*	*37–43*	*43–48*	*48–53*	*53–59*	*59–65*	*65–74*	*74–87*	*87–164*
% Overweight or Obese	24%	21%	18%	17%	18%	18%	21%	19%	19%	20%
Sugars (g) total daily intake	*9–58*	*58–70*	*70–82*	*82–92*	*92–102*	*102–112*	*112–122*	*122–138*	*138–162*	*162–326*
% Overweight or Obese	20%	16%	**29%**	16%	17%	22%	21%	17%	18%	18%
Dietary Fibre (g) total daily intake	*2–9*	*9–11*	*11–13*	*13–15*	*15–16*	*16–18*	*18–20*	*20–23*	*23–26*	*26–79*
% Overweight or Obese	19%	18%	18%	22%	25%	17%	18%	18%	19%	21%
Calcium (mg) total daily intake	*50–370*	*370–480*	*480–580*	*580–670*	*670–760*	*760–850*	*850–950*	*950–1090*	*1090–1300*	*1300–3720*
% Overweight or Obese	21%	21%	17%	24%	26%	19%	17%	17%	16%	19%
Saturated Fat (g) total daily intake	*1–13*	*13–16*	*16–19*	*19–22*	*22–24*	*24–27*	*27–31*	*31–35*	*35–42*	*42–92*
% Overweight or Obese	23%	23%	19%	15%	18%	21%	17%	21%	19%	18%
Sodium (mg) total daily intake	*50–1010*	*1010–1250*	*1250–1450*	*1450–1620*	*1620–1790*	*1790–1970*	*1970–2230*	*2230–2530*	*2530–3070*	*3070–9230*
% Overweight or Obese	17%	19%	19%	17%	19%	24%	17%	22%	23%	17%

* Note vigorous activity had many zeros so the first point plotted was the bottom 20% of vigorous exercise observed.

APPENDIX 2: UNWEIGHTED CELL COUNTS

Table A2.1 Cell counts by remoteness indicator

	Remoteness Indicator		
	METRO	*REST OF STATE*	TOTAL
Total children surveyed (N)	2401	2086	4487

Table A2.2 Cell counts by household income grouping

	Income grouping			
	<$52,000	$52,000–$77,999	$78,000–$103,999	>$104,000
Total children surveyed (N)	1232	996	854	1169

Table A2.3 Cell counts by carers level of education

	Highest education level						
	School year 10 or less	School year 11 or equivalent	Certificate III/IV (including trade certificate)	Advanced diploma, diploma	School year 12 or equivalent	Bachelor degree or Grad Dip	A postgraduate diploma, or higher
Total children surveyed (N)	244	131	1306	542	351	1422	488

Table A2.4 Cell counts by state of respondent's residence

	The state of the respondent's residence							
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Total children surveyed (N)	179	1092	96	762	877	184	885	412

Table A2.5 Cell counts for ranges in children's average number of steps (pedometer data)

	Pedometer steps (number of steps)			
	2309–8687	8687–11372	11372–14281	14281–32930
Total children surveyed (N)	488	734	733	489

Table A2.6 Cell counts for ranges in children's average walking distance in kilometres (pedometer data)

	Walking distance (km)			
	0–5	5–7	7–9	9–25
Total children surveyed (N)	515	727	707	487

Table A2.7 Cell counts for ranges in children's level of vigorous physical activity (minutes per day) (MARCA data)

	Time spent in Vigorous Physical Activity (minutes) per day			
	0–7.5	7.5–36	36–82	82–285
Total children surveyed (N)	148	633	659	439

Table A2.8 Cell counts for ranges in children's average physical activity level in METs (MARCA data)

	Physical activity level in METs			
	1.1–1.4	1.4–1.6	1.6–1.8	1.8–2.9
Total children surveyed (N)	442	658	659	440

Table A2.9 Cell counts for ranges in children's level of moderate to vigorous physical activity (minutes per day) (MARCA data)

	Time spent in Moderate or Vigorous Physical Activity (minutes) per day			
	0–55	55–110	110–182	182–491
Total children surveyed (N)	427	655	667	433

Table A2.10 Cell counts for ranges in time spent in sedentary activity (minutes per day) (MARCA data)

	Time Spent in Sedentary activities (minutes) per day			
	388–643	643–725	725–807	807–1121
Total children surveyed (N)	441	665	654	439

Table A2.11 Cell counts for ranges in average sleep time (MARCA data)

	Daily Average Sleep Time			
	3.6–9 hrs (216–540 mins)	9–9.9 hrs (540–592 mins)	9.9–10.7 hrs (592–641 mins)	10.7–15.4 hrs (641–926 mins)
Total children surveyed (N)	445	682	632	440

Table A2.12 Cell counts for ranges in difference from average sleep time (MARCA data)

	Absolute difference from average sleep time (minutes) per day			
	0–30	30–45	45–60	60–373
Total children surveyed (N)	840	355	295	710

Table A2.13 Cell counts for ranges in average screen time (minutes per day) (MARCA data)

	Average Minutes Screen Time			
	0–128	128–212	212–319	319–690
Total children surveyed (N)	440	660	660	438

GLOSSARY

Relative Body Mass Index (Relative BMI) — A calculated ratio of BMI to each a respondent's age and sex specific normal to overweight lower cut off (as defined using Table 4 of Cole et al. 2000) in order to correct BMI for sex and age.

Age in decimal years — (Date of CAPI Interview – Date of Birth)/365.25.

Anthropometry — The science of measuring the size, weight and proportions of the human body. In this study height, weight and waist circumference were measured from which BMI, waist circumference and weight-to-height ratio were calculated.

AUSNUT2007 — A nutrient database developed by FSANZ in collaboration with CSIRO specifically for those foods and supplements consumed during the survey. AUSNUT2007 contains data for 37 nutrients that are expressed per 100 g edible portion (food) or per 100 dosage units (supplements). *One dosage unit = 1 tablet or capsule, or 1 ml or 1 g for those liquid or powder supplements.*

Body Mass Index (BMI) — An indicator of weight status calculated from a child's average weight and height (formula weight/height^2 or kg/m^2). Age- (at date of CAPI, rounded to nearest half year) and sex-specific BMI cut offs for normal weight, overweight and obese among children and adolescents were applied to the data (using Table 4 of Cole et al. 2000). For underweight, Grade 3 thinness (corresponding to an adult BMI of 18.5 kg/m2) was used as a cut off (Cole et al. 2007).

Complete dataset — The sub-set of participants who completed all tasks, specifically:

- children aged 2–8 years - waist circumference, height, weight, 2 days diet recall, and demography,
- children aged 9–16 years - waist circumference, height, weight, 2 days diet recall, demography, and 4 days of physical activity recall.

Computer assisted personal interview (CAPI) — A face-to-face computer assisted interview in the home that gathered household demographic data, 24-hour dietary recall, food habits, weight, height and waist circumference measurements, and physical activity recall over 48-hours (children ≥ 9 years). Pedometers were also fitted for children ≥ 5 years.

Computer assisted telephone interview (CATI) — A telephone computer assisted interview conducted 7–21 days after the CAPI. The purpose of the CATI was to gather a second 24-hour dietary recall and a second 48 hour physical activity recall.

Consumer — Refers to only those children who actually consumed the food/beverage specified (excludes children with zero values).

Country of birth — The country in which the respondent was born.

Distance Is an estimated daily walking distance in kilometres generated by the New Lifestyles-1000 pedometer.

Deciles Quantiles of a distribution that has been divided into tenths where each interval contains one-tenth of the scores.

Food habit questionnaire A questionnaire (15 questions long) relating to food habits such as usual consumption of fruits, vegetables, type of milk, use of salt, food security, and earlier infant feeding practices (administered during the CAPI).

Food model booklet A tool to assist with estimation of portion sizes (adapted from United States Department of Agriculture with permission - modified for Australian foods and adapted for children).

The booklet included:

- Life-size drawings (e.g. mugs, glasses, containers, bowls)
- Amorphous mounds (e.g. mashed potato, rice or peas)
- Life sized photographs (e.g. potato chips)
- Concentric rings, grids and moveable wedge to help determine the dimensional sizes of irregular foods (e.g. pizza, lasagna or watermelon)
- Photographs to assist with correct identification of products (not portion size) e.g. meat cuts, chocolate, milk drinks, carbonated drinks, juices, yoghurt and muesli/snack bars.

Height The perpendicular distance (in centimetres) between the transverse plane of the vertex and the inferior aspects of the feet with the head in the Frankfort plane. Height was measured without shoes or thick socks and no stretch was applied. A minimum of two measurements were taken. A third measure was taken where the second measure was not within 5 mm for height. The mean value was used as the final score if two measurements were taken (median value used if three measurements were taken).

Household income The annual income of both parents/carers combined (where applicable) before income tax is taken out.

Indigenous status Of Aboriginal or Torres Strait Islander origin.

Mean	The mathematical average of a set of values, equal to the sum of the scores divided by the number of scores.
Median	The score located at the centre of a distribution (middle value of numerically ordered data).
Multimedia Activity Recall for Children and Adolescents (MARCA)	A computerised 24-hour recall collecting information on all activities engaged in during the previous day. Time slices can be as fine as 5 minutes with approximately 250 activities to choose from (free text option available for activities not listed).
Metabolic Equivalents (METs)	A unit used to express the energy cost of physical activity (as a multiple of resting metabolic rate) measured by the amount of oxygen used by the body during physical activity compared to the rested state.
Moderate-to-Vigorous Physical Activity (MVPA - MARCA)	Moderate-to-vigorous physical activities requiring ≥ 3 METs as defined by the MARCA software.
Non-sedentary activities	Activities requiring ≥ 3 METs.
Parent/carer education level	The highest year of primary or secondary school completed by parent(s)/carer(s) and the highest qualification ever completed (e.g. A postgraduate diploma, or higher, Bachelor degree or Grad Dip, Advanced diploma, diploma, Certificate III/IV (including trade certificate).
Pedometer	A portable medical-grade accelerometer pedometer (New Lifestyles-1000) that can count steps, estimate walking distance, and record moderate-to-vigorous activity in minutes (seven day automatic memory).
Physical Activity Level (PAL)	A measure of energy expenditure expressed as a multiple of resting metabolic rate and based on reported physical activities.
Population estimates	The descriptive statistics generated (estimated mean, medians, and proportions) after applying population weights to each individual's data to more closely reflect the whole Australian child population (based on age, sex and region). This weighting corrects for the stratified sampling with non-proportionate sampling used in recruitment.
Screen based activities	Activities which involve the use of screens or monitors (i.e. television, computers, videogames, texting).
Sedentary activities	Activities requiring < 3 METs.

Sleep time Average number of minutes of sleep activity.

State/territory of residence The State or Territory in which the respondent currently lives.

24-hour dietary recall An individual's recall of everything eaten and drunk, including water and supplements over a 24-hour period. In this survey it was taken from midnight to midnight.

Waist circumference The measurement of girth of the waist using a metal measuring tape (Lufkin W606PM) against the skin, or over light clothing. The tape was positioned mid-way between the lower costal (10th rib) border and the top of the iliac crest, in the mid-axillary line, perpendicular to the long axis of the trunk. The measurement was taken at the end of a normal expiration (end-tidal) in a relaxed standing position. A minimum of two measurements were taken. A third measure was taken where the second measure was not within 10 mm for waist girth. The mean value was used as the final score if two measurements were taken (median value if three measurements were taken).

Waist-to-height ratio The relative magnitude of waist girth to height, calculated by dividing the average waist measurement in centimetres by the average height measurement in centimetres.

Weight The force the body exerts in a standard gravitational field. Weight was measured in light indoor clothing (shoes, coats and jumpers removed) using Tanita HD332 portable electronic scales. The participant stood still on the centre of the scales without support and with the weight distributed evenly on both feet. A minimum of two measurements were taken. A third measure was taken where the second measure was not within 0.1 kg for weight. The mean value was used as the final score if two measurements were taken (median value if three measurements were taken).

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