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**Title:** Socio-economic variation in diet and activity-related behaviors of Australian children and adolescents aged 2-16 years.

**Running head:** Childhood diet, activity and SEP

**Authors:** Adrian J Cameron¹, PhD; Kylie Ball¹, PhD; Natalie Pearson², PhD; Sandrine Lioret¹, PhD; David A Crawford¹, PhD; Karen Campbell¹, PhD; Kylie Hesketh¹, PhD; Sarah A McNaughton¹, PhD

¹Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University
²School of Sport, Exercise & Health Sciences, Loughborough University

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**Correspondence and requests for reprints to:**
Dr Adrian Cameron
Deakin University, Centre for Physical Activity and Nutrition Research
221 Burwood Highway, Burwood, Victoria 3125, AUSTRALIA
Telephone: +61 3 9244 6433; Fax: +61 3 9244 6017
Email: Adrian.Cameron@deakin.edu.au
Abstract

Background: Evidence for age-related variation in the relationship between obesity-related behaviors and socioeconomic position may assist in the targeting of dietary and physical activity interventions among children.

Objective: To investigate the relationship between different indicators of socioeconomic position and obesity-related behaviors across childhood and adolescence.

Methods: Data were from 4,487 children aged 2 to 16 years participating in the cross-sectional 2007 Australian National Children’s Nutrition and Physical Activity Survey. Socioeconomic position was defined by the highest education of the primary or secondary carer and parental income. Activity was assessed using recall methods with physical activity also assessed using pedometers. Intake of energy-dense drinks and snack foods, fruits and vegetables was assessed using 2x24-hour dietary recalls.

Results: A socioeconomic gradient was evident for each dietary measure (although in age-specific analyses, not for energy-dense snacks in older children) as well as television viewing, but not physical activity. Whether each behavior was most strongly related to parental income or education of the primary or secondary carer was age and sex-dependent. The socioeconomic gradient was strongest for television viewing time and consumption of fruit and energy-dense drinks.

Conclusions: A strong socioeconomic gradient in eating behaviors and television viewing time was observed. Relationships for particular behaviors differed by age, sex and how socioeconomic position was defined. Socioeconomic indicators define different population groups and represent different components of socioeconomic position. These findings may provide insights into who should be targeted in preventive health efforts at different life stages.

Key words: Socioeconomic, Children, Diet, Physical Activity
Introduction
Socioeconomic position during childhood has been shown to be a powerful predictor of adult health outcomes(1) with some evidence now suggesting that although childhood and adult health are correlated, an independent effect exists of early childhood socioeconomic position on cardiovascular disease risk factors and risk of cardiovascular disease-related morbidity and mortality in adulthood.(2) Consistent support has been shown for a link between the accumulation of negative socioeconomic experiences/conditions across the life course and adult cardiovascular disease risk.(2)

One way that parental level of disadvantage may impact later health outcomes is via the health-related behaviors of children. Among young people in developed countries, a relationship has been demonstrated between level of disadvantage and each of physical activity(3, 4), sedentary behavior(5) and diet(6, 7), although the findings are somewhat equivocal in relation to physical activity.(4)

Two frequently used indicators of socioeconomic position in childhood and adolescence are parental education and parental income.(8) In a recent review, parental education demonstrated a more consistent, though not universal, inverse association with obesity compared with parental income or occupation amongst school-aged children.(8) The presence and the steepness of a relationship between health promoting behaviors and socioeconomic position is likely dependent on the behavior examined(9) as well as the socioeconomic indicator used. It is also possible that the strength of the association between parental education and income with different health behaviors may change throughout childhood. For example, we might expect associations between behaviors of children and parental indicators of disadvantage to be stronger in younger children as they have less autonomy from their parents than older children and adolescents. Conversely, it may be that the accumulated exposure to disadvantage throughout childhood leads to a stronger disadvantage-behavior association in later childhood and adolescence if children continue to be exposed to disadvantage. The influence of parental education may also vary with age and depend on which parent’s education is considered. In early childhood, for instance, it may be that the education of the
parent responsible for a child’s care is more important,(1) while later in childhood, it may be that the education of the parent more responsible for income generation assumes greater importance. The association between parental income and health behaviors may be confounded in early childhood by the reality that parental income at this time is likely to be strongly affected by the timing of a return to paid employment.

Most studies examining the association between socioeconomic position and obesity-related behaviors have not included children across a broad age range and there is therefore little evidence for age-related variation in the relationship between health behaviors and socioeconomic position. Such information may help to determine in each age group which socioeconomic indicators may be best used to identify a population among whom health promotion efforts are required.

With the aim of investigating the relationship between different indicators of socioeconomic position and health behaviors related to obesity across childhood and adolescence, we used data from a cross-sectional national study of Australian children aged from 2 to 16 years. The relationship between parental education level and income with each of physical activity, television viewing, consumption of fruit, consumption of vegetables and consumption of energy-dense snack foods and drinks was assessed.

Methods
The 2007 Australian National Children’s Nutrition and Physical Activity Survey (NCNPAS) was undertaken to assess the food intake, physical activity, height and weight of a national sample of children aged 2-16 years. The cross-sectional survey, described in detail previously,(10) was conducted among 4,487 participants in 54 randomly selected clusters based on Australian postal codes, with equal representation of boys and girls in each of four age groups (2-3 years, 4-8 years, 9-13 years and 14-16 years). Survey data for this study was accessed from the Australian Social Science Data Archive on 25/08/2010.(11)
Selection was based on random digit dialing, with a single child selected per household.(12) Of 16,598 eligible households identified, 10,109 (61%) were recruited to the study. Data were collected during a home visit in a computer-assisted personal interview, and 1-3 weeks later during a computer-assisted telephone interview. Demographic and socioeconomic information, physical measurements and initial 24 hour diet and 48 hour physical activity and use-of-time recalls were collected at the initial home visit. For children aged <9 years, primary caregivers acted as proxy for collection of survey information. Additional diet and physical activity and use-of-time recalls were conducted during the follow-up phone interview. A total of 4,837 completed the in-home interview and 4695 completed the follow-up phone interview respectively (refusals were noted for 502 and 46 children for the in home and phone interviews respectively).(12) The number of recruited households (n=10,109) was far greater than the number completing the in-home and follow-up phone interviews due to quotas for children in each age group being reached. Ethics approval was obtained from the (Australian) National Health and Medical Research Council (NHMRC) registered Ethics Committees of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the University of South Australia. Relevant NHMRC guidelines for working with children were adhered to.

**Socioeconomic Position**

Indicators of socioeconomic position included education level of the primary and secondary carer and parental income. Education level of i) the primary and ii) secondary carer was based on response categories “Year 12 or less”, “Trade certificate or advanced diploma” and “Bachelor degree or higher”. The primary carer was defined as the person living in the household who knew most about the child’s food intake or activity (98% of the time this was a biological parent of the child). The secondary carer was the spouse of the primary carer or another significant care giver in the household. Annual parental income was assessed in 15 categories (1 being highest income, 15 being lowest), with these being collapsed to: AUD$0 to 31,999, $32,000 to $51,999, $52,000 to $103,999.
and ≥$104,000 for analysis by sex and age groups. For all other analyses, income was treated as a continuous variable. Two percent of the sample refused to report their income.

**Dietary intake**

Food intake information was collected using two 24-hour dietary recalls conducted on non-consecutive days as described previously. Nutrient intakes were calculated using a nutrient composition database. Little difference was observed between energy intake using the diet recall method used here and a 24-hour record assisted recall with energy expenditure assessed by doubly labelled water in a pilot study among 92 New Zealand school-aged children. Consumption of foods and beverages in grams adjusted for energy intake using the nutrient density method (intake per 1000kJ of total energy intake) is reported here. This adjustment was made because energy intake varies with age and the pertinent question of whether dietary intake varies by socioeconomic position throughout childhood is most easily answered if the effects of age on intake are removed.

We investigated intakes of four food groupings: i. Fruits - includes fresh, frozen, dried and tinned fruit but not fruit juice, ii. Vegetables - includes all vegetables and dishes where vegetables were the predominant food type, excluding potatoes either fried or cooked with oil or fat, iii. Energy-dense snack foods - includes chocolate, confectionery, crisps and other similar snack foods and energy-dense drinks and iv. Energy-dense drinks - includes non-diet soft, sports and energy drinks, flavored milk, milk shakes, cordial, fruit drinks (≤40% fruit) and chocolate or other high sugar powdered beverage bases. Alcohol was not included in this category as it was not widely consumed.

**Physical activity and television viewing time**

Use of time data was collected using the Multimedia Activity Recall for Children and Adolescents (MARCA) for participants aged 9-16 years. The MARCA is an activity recall of the previous day, segmented according to meal times and/or school bell times. Each child recalled four days of activities. MARCA derived physical activity levels showed moderate to good correlation with those
derived from pedometry (rho=0.54)(16) while a previous comparison with accelerometry resulted in a rho of 0.45.(15) Pedometers (New Lifestyles 1000, New Lifestyles Inc., Missouri, US) were worn for a minimum 6 days by children aged 5-16 years and the number of minutes spent in moderate-to-vigorous physical activity (>3 metabolic equivalents, METs) was calculated. For MARCA and separately for pedometer measures, average time per day spent in moderate to vigorous physical activity was calculated, with average time spent watching television per day (excluding spent at the computer or using videogames) also calculated from the MARCA recall data.

**Body Mass Index**

Height and weight were measured as previously described.(12) Standardized body mass index (z-BMI) was calculated based on the 1990 UK reference data of Cole.(17) BMI categories of normal, overweight and obese were calculated using the age and sex-specific cut-off points of the International Obesity Task Force.(18) Both z-BMI and BMI categories were calculated using the excel add-in LMSgrowth.(19)

**Statistical Methods**

The cross-sectional relationship between age and each of the dietary, physical activity and television viewing behaviors examined was plotted as a line plot using a cubic median spline in Stata (mspline). Plots were constructed for groups defined by sex and education of the primary care giver. Plots based on education of the secondary carer or income were not included due to space considerations. The number of bands for which cross medians were calculated was based on consideration of the effect of greater or lesser numbers of bands on the plot (fewer resulting in graphs with insufficient variation by age and greater resulting in excessive variation by age). Graphs were also constructed using the lowess smoothing command in Stata to confirm that using these two smoothing methods produced comparable patterns (data not shown).

For the purpose of statistical testing (in order to simplify the tables), the cohort was divided into two age groups (2 to 8 and 9 to 16 years), and education of the primary and secondary caregiver was
divided up into two groups (those with a tertiary degree or higher and those without). Univariate models (also including age) were used to assess the association between each outcome measure and each of the three socioeconomic indicators separately. These associations were also tested in multivariable models containing all three socioeconomic indicators (and age). Results in the tables were presented only where confidence intervals did not cross 0. All models were constructed separately for boys and girls and for each age group.

**Results**
The proportion of children whose parents were defined as being in the highest categories of socioeconomic position as defined by either the education of the primary or secondary carer or parental income are shown in Figure 1. Each indicator is revealed as identifying a distinct segment of the sample population with only partial overlap of those identified according to each indicator.

The socioeconomic characteristics of the sample and the mean levels of each of the diet and activity-related behaviors assessed as well as BMI are presented in Table 1 by age group and sex. Table 2 shows the univariate association between each of the diet and activity-related behaviors and the three socioeconomic indicators (education of the primary and secondary carer and parental income). Table 3 displays these relationships in multivariable models that include all three socioeconomic indicators. Figures 2, 3, 4 and 5 graphically represent at each age the cross-sectional relationship between the education of the primary carer and each diet and activity-related behavior as well as zBMI. The behavior-specific results from each of these analyses are detailed below.

**Fruit**
Fruit consumption was lower in older children (p<0.001 for mean difference between oldest age group and each other age group, Table 1). A consistent pattern of greater fruit consumption in children with more highly educated primary carers (female in 90% of cases) was observed in both boys and girls at each age (Figure 2). Each measure of socioeconomic position was positively associated with fruit consumption in age-adjusted analyses (Table 2). In multivariable analyses (Table 3), the education of the primary carer was associated with greater fruit consumption in all
boys and older girls, while in younger girls, the education level of the secondary carer but not the primary carer was associated with consumption. Income was not associated with fruit consumption in analyses adjusted for parental education.

**Vegetables**
Vegetable consumption was steady across age groups (Table 1). The primary carer’s education was consistently associated with greater vegetable consumption in boys (Figure 2), however this was not shown to be statistically significant in either univariate or multivariable analyses (Tables 2 and 3). Income was the only socioeconomic indicator associated with greater vegetable consumption in boys, although this association was not seen in analyses adjusted for parental education. In girls, a socioeconomic gradient only appears in the age group nine to 16 years. In that age group, an association in multivariable analyses between vegetable intake and the education of the primary carer, but not the secondary carer or income was apparent.

**Energy-dense snack foods**
Consumption of energy-dense snacks was higher in older children than in infants (comparison of children aged 2-3 with all other age groups, p<0.001, Table 1), with similar consumption per 1000 kj in children aged 4 to 16 years. In boys, greater consumption was seen among children whose secondary carer had a lower education level (Figure 3, Table 2) with this association remaining after adjustment for the primary carer’s education and parental income (Table 3). In girls, greater snack consumption was associated with lower education of both carers and lower income, with these associations apparent only for those aged two to eight years and in univariate models (Table 2).

**Energy-dense drinks**
Consumption of energy-dense drinks was strongly age-related for boys and girls with the greatest consumption in the oldest children (Figure 3). In age-adjusted analyses, higher socioeconomic position according each indicator was negatively associated with consumption for both boys and girls. In multivariable models, a strong association with the education level of the secondary carer (but not the primary carer) was seen in both younger and older girls, while in boys, as is reflected in
Figure 3, a strong association was seen between consumption and the education of the primary carer (but not the secondary carer). Income was not associated with consumption of energy-dense drinks in boys or girls in multivariable models.

**Moderate and Vigorous Physical Activity**
A negative relationship between age and physical activity levels was present, whether measured using pedometers (measured from five years of age) or the activity recall (measured from nine years of age) (Figure 4). The relationship appeared strongest when physical activity was measured using the recall method. As shown in Figure 4, no gradient in pedometer-measured physical activity was evident according to the education of the primary carer. Table 2 reveals an inconsistent relationship between physical activity and socioeconomic indicators. For older boys, recall-measured moderate and vigorous physical activity (MVPA) was lower among whose secondary carer had a higher education level. In contrast, pedometer-measured MVPA was higher among young girls whose primary carer was more highly educated and recall-measured MVPA was higher among older girls from households with higher income. Inconsistent results were also observed in fully adjusted models (Table 3).

**Television viewing**
In both boys and girls, television viewing time was consistently lower among children from households of higher socioeconomic position (Figure 4). In age-adjusted analyses, this was apparent for each socioeconomic indicator (Table 2). In fully adjusted models, the education level of the secondary carer in boys was associated with television viewing time (Table 3), while in girls strong associations were seen with the education level of the primary carer and with income (Table 3).

**Body Mass Index (BMI)**
Trends in z-BMI across age-groups were similar for boys and girls. The percentage of children classified as overweight or obese rose steadily with age with over one quarter of those aged 14-16 years being placed in these categories (Table 2). The socioeconomic gradient with z-BMI appeared strongest later in childhood, with significant age-adjusted associations between greater education of
the primary carer and lower z-BMI in boys and girls. Education of the secondary carer was associated with lower z-BMI in boys only, while income was associated with z-BMI in girls only (Table 2). Figure 5 shows a consistent but widening socioeconomic gradient in boys and a socioeconomic gradient that only becomes apparent in later childhood in girls. No significant associations between z-BMI and any of the socioeconomic indicators tested were statistically significant in fully adjusted models.

**Discussion**

Using a national, cross-sectional sample of boys and girls aged from two to 16 years, we have explored the associations between diet and activity-related behaviors with socioeconomic position. A socioeconomic gradient was evident for television viewing (only assessed in older children) and each of the dietary measures assessed (in both younger and older children), with one exception being energy-dense snack consumption among older children. No gradient was observed for physical activity while for z-BMI, a socioeconomic gradient was only observed in older children. The socioeconomic indicator most strongly associated with each behavior was sex and age-dependent.

Our findings in relation to the association between dietary behaviors and socioeconomic position are consistent with the results of a recent review, which found parental education to be more strongly related to intake of fruit and vegetables than parental income.(7) Interestingly, that review also noted that of those studies that specifically examined the influence of the father’s education, only one out of six identified a positive association. Conversely, the mother’s education was associated with more frequent intake of fruit and/or vegetables in four of eight studies.(7) Miura et al. have recently shown that displacement of fruit and vegetable intake by higher frequency of “take out” meals may explain the low levels of fruit and vegetable consumption observed among those of lower socioeconomic position.(20)

Our results are also comparable to an analysis of the 1995 Australian National Nutrition survey, in which a strong association was observed between income level and consumption of fruit, but not vegetables in adolescent boys and girls.(6) Although we have shown that parental education was
more strongly associated with consumption than was income, in analyses unadjusted for parental education, we also saw a strong association in older boys and girls between fruit consumption and parental income. Education may be a more stable indicator of socioeconomic position than is parental income, which is more susceptible to change over time, particularly in a household with young children. In relation to physical activity, the inconsistent observations we observed are in line with the findings of a review among adolescents which found that even though a positive association was observed in many studies, this was far from uniform.\(4\) Gordon-Larsen et al. observed in their study of US adolescents that while physical activity was most associated with environmental factors, inactivity was most associated with sociodemographic factors,\(21\) with our results supporting this finding.

A range of factors related to the parents themselves may link parental disadvantage with health-related behaviors of children. Although they remain poorly understood,\(1, 22\) mechanisms responsible for this relationship may include socioeconomic variations in the modeling of behavior and the setting of family norms,\(23\) parental knowledge, skills and self-efficacy,\(24, 25\) provision of opportunities for healthy eating and physical activity, limiting of opportunities for sedentary behaviors such as television viewing,\(24\), and other forms of social support that might support or undermine healthful behaviors. In addition, physical and psychosocial exposures in each of the home, neighborhood and school environments are linked to childhood socioeconomic position and are also therefore likely to be linked to the presence or absence of health promoting behaviors in children.\(1, 22\)

With regard to health outcomes such as cardiovascular disease and premature mortality, specific conceptual models have been developed that hypothesize when and for how long during childhood socioeconomic position-related exposures are important.\(1\) The timing model posits that specific developmental periods during childhood when individuals are most sensitive to socioeconomic exposures may have particularly significant impacts on later health outcomes. The accumulation model in contrast suggests that it is the accrual of the effects of socioeconomic disadvantage that
increases risk of future health outcomes, with risk increasing based on both the intensity and duration of the exposure. Finally, a change model places importance on the direction of the change in socioeconomic position throughout childhood and adolescence.

Elements of the timing model are clearly relevant in relation to health behaviors, with different time periods during childhood likely to be important for different energy-balance related behaviors. A critical window relating to diet behaviors for example, may be very early in childhood when eating patterns are established. (26) Equally, habit formation early in childhood may be particularly significant in an accumulation model where a habit formed at a young age means more time for accumulation of exposure.

Whether the relationship between parental socioeconomic position and health behaviors differs in children who are gaining independence from their parents is an interesting question. From our data, the answer appears to depend on the behavior studied. For greater vegetable consumption in girls, the relationship with socioeconomic position was stronger in older children, while for consumption of energy-dense snacks in boys a relationship was only seen in younger children. The relationship between parental education and z-BMI appeared to be age-related, with the strongest association observed in older children in both sexes. Either the timing or accumulation model may explain this finding, with it being equally possible that the effects of the socioeconomic gradient observed in earlier childhood take some time to manifest as weight changes, or that the socioeconomic gradient in those behaviors most strongly associated with BMI is more evident in older children. It is also worth noting that we found the influence of the secondary carer on children’s behaviors to be most prominent among younger children, with this suggesting that the influence of the secondary carer’s education may not be sustained into adolescence. In contrast, for almost all outcomes with which the education of the primary carer was associated, this was the case in older children, indicating that the influence on behaviors imparted by the primary carer may be important throughout childhood.

In multivariable models, for no behavior were associations seen with multiple indicators of socioeconomic position, possibly reflecting the correlated nature of the variables. Despite this,
associations of different socioeconomic indicators with different behaviors and in different age/sex
groups suggests that these measures are not simply proxies for one another.

**Strengths and limitations**

Some strengths of this work include the use of a national cross-sectional sample covering an age
range from two to 16 years as well as the inclusion of multiple socioeconomic indicators and the use
of well-validated measures. Reverse causality is an unlikely explanation for the observed
relationships as the behaviors analysed (or their determinants) are unlikely to be responsible for a
child’s socioeconomic position. The cross-sectional nature of the study means that changes in either
obesity-related behaviors or socioeconomic position cannot be assessed. The accuracy of self-
reported income in this study is unknown, with the potential existing for measurement error in this
variable, (27) although response bias is unlikely to be a concern in this sample as 98% of
participants reported their income. Furthermore, reporting bias in self-reported diet and activity-
related variables in relation to socioeconomic position, age or the reporting type (proxy for younger
children and self-report for those aged > 9 years) may have affected the findings. Since parents were
generally present at interviews with older children, a reporting type bias is unlikely to explain the
observed findings. A socioeconomically linked reporting bias is also an unlikely explanation for the
findings for two reasons. Firstly, the validity and reliability of the activity and diet measurement tools
has been previously established,(13, 15) Secondly, previous analysis of diet data from the U.S.
NHANES study showed that lower educated individuals under-reported total energy intake,(28) with
this finding suggesting that any misclassification bias in each of the diet outcomes assessed would
have attenuated rather than caused the socioeconomic gradient observed here. **No data was
available on the context of meals eaten, including whether they were provided at school or with
other carers – this information may have provided additional insight into the observed relationships
between socioeconomic position and diet.** Finally, other measures of socioeconomic position (such
as occupational class, housing status, eligibility for benefits, neighborhood measures and composite
measures such as measures of family affluence or wealth\((29, 30)\) may have a different association again with the health behaviors examined.

**Conclusions**
A strong socioeconomic gradient in some eating behaviors and television viewing time, but not physical activity was observed in this study. Relationships differed according to age, sex and whether socioeconomic position was defined according to maternal education, paternal education or parental income. These socioeconomic indicators define different population groups and represent different components of socioeconomic position and are not necessarily proxies for one another. Evidence of the relationships between health-related behaviors and socioeconomic position across a wide age-spectrum may provide insights into who to target in preventive health efforts at different life stages.

**References**


Table 1. Socioeconomic characteristics,* body mass index (BMI) and obesity-related behaviors by sex and age group in the Australian National Children’s Nutrition and Physical Activity Survey.

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
<th>2-3 years</th>
<th>4-8 years</th>
<th>9-13 years</th>
<th>14-16 years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education of main carer (n, %)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 12 or less</td>
<td>694 (28.5)</td>
<td>643 (26.8)</td>
<td>310 (26.0)</td>
<td>324 (25.6)</td>
<td>349 (28.6)</td>
<td>354 (30.5)</td>
</tr>
<tr>
<td>Trade cert or Adv diploma</td>
<td>804 (33.0)</td>
<td>881 (36.7)</td>
<td>390 (32.7)</td>
<td>467 (36.9)</td>
<td>454 (37.2)</td>
<td>374 (32.2)</td>
</tr>
<tr>
<td>Bachelor degree or higher</td>
<td>837 (34.3)</td>
<td>760 (31.7)</td>
<td>450 (37.8)</td>
<td>417 (33.0)</td>
<td>362 (29.7)</td>
<td>368 (31.7)</td>
</tr>
<tr>
<td>Don’t know or other</td>
<td>104 (4.3)</td>
<td>114 (4.8)</td>
<td>41 (3.4)</td>
<td>56 (4.4)</td>
<td>55 (4.5)</td>
<td>66 (5.7)</td>
</tr>
<tr>
<td><strong>Income (AUD), (n, %)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&gt;=104,000</td>
<td>641 (27.7)</td>
<td>605 (26.9)</td>
<td>253 (22.4)</td>
<td>334 (27.8)</td>
<td>323 (28.1)</td>
<td>336 (30.8)</td>
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<tr>
<td>52,000 to 103,999</td>
<td>1028 (44.4)</td>
<td>945 (42.0)</td>
<td>541 (48.0)</td>
<td>544 (45.3)</td>
<td>455 (39.6)</td>
<td>433 (39.7)</td>
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<td>31,200 to 51,999</td>
<td>371 (16)</td>
<td>416 (18.5)</td>
<td>203 (18.0)</td>
<td>197 (16.4)</td>
<td>199 (17.3)</td>
<td>188 (17.2)</td>
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<tr>
<td>0 to 31,999</td>
<td>277 (12)</td>
<td>285 (12.7)</td>
<td>130 (11.5)</td>
<td>125 (10.4)</td>
<td>173 (15)</td>
<td>134 (12.3)</td>
</tr>
<tr>
<td><strong>BMI category† (n, %)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Underweight</td>
<td>142 (5.8)</td>
<td>121 (5.0)</td>
<td>98 (8.2)</td>
<td>57 (4.5)</td>
<td>58 (4.8)</td>
<td>50 (4.3)</td>
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<td>Normal weight</td>
<td>1779 (72.9)</td>
<td>1695 (70.7)</td>
<td>906 (76.1)</td>
<td>950 (75.2)</td>
<td>807 (66.1)</td>
<td>811 (69.8)</td>
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<tr>
<td>Overweight</td>
<td>380 (15.6)</td>
<td>421 (17.6)</td>
<td>152 (12.8)</td>
<td>182 (14.4)</td>
<td>251 (20.6)</td>
<td>216 (18.6)</td>
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<tr>
<td>Obese</td>
<td>138 (5.7)</td>
<td>161 (6.7)</td>
<td>35 (2.9)</td>
<td>75 (5.9)</td>
<td>104 (8.5)</td>
<td>85 (7.3)</td>
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<tr>
<td><strong>Fruit consumption (g/1000kj)</strong></td>
<td>20.8 (19.5)</td>
<td>16.6</td>
<td>23.3 (20.0)</td>
<td>19.9</td>
<td></td>
<td></td>
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<tr>
<td>Vegetable consumption (g/1000kj)</td>
<td>13.1 (11.8)</td>
<td>10.2</td>
<td>15.3 (13.6)</td>
<td>12.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-dense snack foods (g/1000kj)</td>
<td>2.9 (3.5)</td>
<td>1.7</td>
<td>3.0 (3.5)</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-dense drinks (g/1000kj)</td>
<td>23.2 (27.8)</td>
<td>14.9</td>
<td>21.0 (27.1)</td>
<td>12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate to Vigorous PA (pedometer, min/day)</td>
<td>43.2 (20.2)</td>
<td>41.0</td>
<td>35.7 (14.9)</td>
<td>35.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate to Vigorous PA (mins/day)</td>
<td>137.5 (76.4)</td>
<td>128.8</td>
<td>107.7 (69.5)</td>
<td>95.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television viewing (mins/day)</td>
<td>159.4 (86.9)</td>
<td>151.3</td>
<td>149.0 (87.6)</td>
<td>136.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Data are n (%) or mean (std deviation), median
† BMI categories calculated using the age and sex-specific cut-off points of the International Obesity Task Force.(18)
Table 2. Univariate associations between indicators of socioeconomic position and obesity-related behaviors in Australian boys and girls aged 2 to 16 years. The Australian National Children’s Nutrition and Physical Activity Survey.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Age group</th>
<th>Education - primary carer*</th>
<th>Education - secondary carer†</th>
<th>Income‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
</tr>
<tr>
<td>Fruit (g/1000kJ)</td>
<td>2 to 8</td>
<td>5.2 (2.8 to 7.5)</td>
<td>4.2 (1.7 to 6.6)</td>
<td>5.1 (2.6 to 7.7)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>6.1 (4.2 to 7.9)</td>
<td>4.8 (2.5 to 7.1)</td>
<td>4.2 (2 to 6.4)</td>
</tr>
<tr>
<td>Vegetable (g/1000kJ)</td>
<td>2 to 8</td>
<td>2.7 (0.9 to 4.5)</td>
<td>2.7 (0.9 to 4.5)</td>
<td>2.7 (0.9 to 4.5)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>2.7 (0.9 to 4.5)</td>
<td>2.7 (0.9 to 4.5)</td>
<td>2.7 (0.9 to 4.5)</td>
</tr>
<tr>
<td>Energy dense snacks (g/1000kJ)</td>
<td>2 to 8</td>
<td>-0.6 (-1 to -0.3)</td>
<td>-0.7 (-1.1 to -0.3)</td>
<td>-0.5 (-0.9 to -0.1)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>-0.6 (-1 to -0.3)</td>
<td>-0.7 (-1.1 to -0.3)</td>
<td>-0.5 (-0.9 to -0.1)</td>
</tr>
<tr>
<td>Energy dense drinks (g/1000kJ)</td>
<td>2 to 8</td>
<td>-9.5 (-13.3 to -5.7)</td>
<td>-6.3 (-10.2 to -2.4)</td>
<td>-4.6 (-9 to -0.3)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>-9.5 (-13.3 to -5.7)</td>
<td>-6.3 (-10.2 to -2.4)</td>
<td>-4.6 (-9 to -0.3)</td>
</tr>
<tr>
<td>Moderate/vigorous Phys. Act. (diary - MARCA) (min/day)</td>
<td>9 to 16</td>
<td>-15.1 (-25.4 to -4.8)</td>
<td>-15.1 (-25.4 to -4.8)</td>
<td>-15.1 (-25.4 to -4.8)</td>
</tr>
<tr>
<td>Moderate/vigorous Phys. Act. (pedometer) (min/day)</td>
<td>2 to 8</td>
<td>3.0 (0.0 to 5.9)</td>
<td>3.0 (0.0 to 5.9)</td>
<td>3.0 (0.0 to 5.9)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>3.0 (0.0 to 5.9)</td>
<td>3.0 (0.0 to 5.9)</td>
<td>3.0 (0.0 to 5.9)</td>
</tr>
<tr>
<td>Television viewing (min/day)</td>
<td>9 to 16</td>
<td>-21.4 (-32.3 to -10.5)</td>
<td>-24.4 (-35.7 to -13.1)</td>
<td>-27.9 (-40.1 to -15.7)</td>
</tr>
<tr>
<td>z-BMI</td>
<td>2 to 8</td>
<td>-0.2 (-0.3 to -0.1)</td>
<td>-0.2 (-0.3 to -0.1)</td>
<td>-0.2 (-0.4 to -0.1)</td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>-0.2 (-0.3 to -0.1)</td>
<td>-0.2 (-0.3 to -0.1)</td>
<td>-0.2 (-0.4 to -0.1)</td>
</tr>
</tbody>
</table>

*Models also included age. Results are beta co-efficient (95% confidence interval). Only results where confidence intervals did not cross 0 are presented in this table.
†Education of primary and secondary carer was based on a dichotomous variable for those with a bachelor degree or higher vs. those with trade certificate/advanced diploma/high school. Income was categorical but was based on 15 categories (highest=lowest income) and therefore treated as a continuous variable.
Table 3. Multivariable† associations between indicators of socioeconomic position and obesity-related behaviors in Australian boys and girls aged 2 to 16 years. The Australian National Children’s Nutrition and Physical Activity Survey.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Age group</th>
<th>Education - primary carer†</th>
<th>Education - secondary carer‡</th>
<th>Income‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>Fruit (g/1000kJ)</td>
<td>2 to 8</td>
<td>3.2 (0.3 to 6.1)</td>
<td>3.1 (0.1 to 6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>4.2 (1.2 to 7.2)</td>
<td>5.4 (2.9 to 7.9)</td>
<td></td>
</tr>
<tr>
<td>Vegetable (g/1000kJ)</td>
<td>2 to 8</td>
<td>3.3 (1 to 5.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy dense snacks (g/1000kJ)</td>
<td>2 to 8</td>
<td>-3 (-5.9 to -0.2)</td>
<td>-3.5 (-6.3 to -0.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>-10.2 (-15.1 to -5.3)</td>
<td>-5.6 (-10.5 to -0.7)</td>
<td></td>
</tr>
<tr>
<td>Energy dense drinks (g/1000kJ)</td>
<td>2 to 8</td>
<td>-3 (-5.9 to -0.2)</td>
<td>-3.5 (-6.3 to -0.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td>-10.2 (-15.1 to -5.3)</td>
<td>-5.6 (-10.5 to -0.7)</td>
<td></td>
</tr>
<tr>
<td>Moderate/vigorous Phys. Act. (diary - MARCA) (min/day)</td>
<td>9 to 16</td>
<td>-16.2 (-28.2 to -4.1)</td>
<td>-3.3 (-5.2 to -1.3)</td>
<td></td>
</tr>
<tr>
<td>Moderate/vigorous Phys. Act. (pedometer) (min/day)</td>
<td>2 to 8</td>
<td></td>
<td>0.8 (0.0 to 1.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television viewing (min/day)</td>
<td>9 to 16</td>
<td>-21 (-35.2 to -6.9)</td>
<td>-22.9 (-37.3 to -8.6)</td>
<td>3.2 (0.6 to 5.8)</td>
</tr>
<tr>
<td>z-BMI</td>
<td>2 to 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9 to 16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† All models included terms for education of primary and secondary carer and parental income as well as age. Results are beta co-efficient (95% confidence interval). Only results where confidence intervals did not cross 0 are presented in this table.

‡ Education of primary and secondary carer was based on a dichotomous variable for those with a bachelor degree or higher vs. those with trade certificate/advanced diploma/high school. Income was categorical but was based on 15 categories (highest=lowest income) and therefore treated as a continuous variable.
Figure 1. Proportion of children whose parents were defined as being in the highest category of socioeconomic position according to either the education of the primary or secondary carer or parental income in the Australian National Children’s Nutrition and Physical Activity Survey (proportion whose parents were not defined as high socioeconomic position by any indicator also shown).
Figure 2: Consumption of fruit and vegetables (grams per 1000kj energy intake) by age for socioeconomic groups based on education of primary carer in Australian children and adolescents. n=4657
Figure 3: Consumption of energy-dense (ED) snack foods (chocolate, crisps and similar snack food, confectionery) and drinks (grams per 1000kj energy intake) by age for socioeconomic groups based on education of primary carer in Australian children and adolescents. n=4657
Figure 4: Physical activity and television viewing time by age for socioeconomic groups based on education of primary carer in Australian children and adolescents. n=4657

Boys
Girls

Pedometer MVPA (minutes)

MVPA (minutes)

Television viewing (minutes)

Age (years)

Year 12 or Less
Trade Cert or Adv Diploma
Bachelor Degree or Higher
Figure 5: z-BMI by age for socioeconomic groups based on education of primary carer in Australian children and adolescents. n=4787