Adolescent television viewing and unhealthy snack food consumption: the mediating role of home availability of unhealthy snack foods

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Abstract

Objective: To examine whether home availability of energy-dense snack foods mediates the association between television viewing (TV) and energy-dense snack consumption among adolescents.

Design: Cross-sectional.

Setting: Secondary schools in Victoria, Australia.

Subjects: Adolescents (n=2984) from Years 7 and 9 of secondary school completed a web-based survey, between September 2004 and July 2005, assessing their energy-dense snack food consumption, school day and weekend day TV viewing and home availability of energy-dense snack foods.

Results: School day and weekend day TV viewing were positively associated with energy-dense snack consumption among adolescent boys ($\beta=0.003$, $p<0.001$) and girls ($\beta=0.03$, $p<0.001$). Furthermore, TV viewing (school and weekend day) were positively associated with home availability of energy-dense snack foods among adolescent boys and girls and home availability of energy-dense snack foods was positively associated with energy-dense snack food consumption among boys ($\beta=0.26$, $p<0.001$) and girls ($\beta=0.28$, $p<0.001$). Home availability partly mediated the association between TV viewing and energy-dense snack consumption.

Conclusions: The results of the present study suggest that TV viewing has a significant role to play in adolescent unhealthy eating behaviours. Future research should assess the efficacy of methods to reduce adolescent energy-dense snack food consumption by targeting parents to reduce home availability of energy-dense foods, and on reducing TV viewing behaviours of adolescents.
Introduction

The prevalence of adolescent obesity has dramatically increased over the past three decades\(^1\), and even though preliminary evidence suggests a slowing in such trends\(^2\), recent data show that approximately one in five adolescents in Western countries are obese\(^3-5\). Obesity during adolescence is of particular concern due to the immediate and long-term negative health and psychological effects, including an increased incidence of cardiovascular risk factors, adult obesity, obesity-related comorbidities, low self-esteem and reduced health-related quality of life\(^6,7\). Central in the development of adolescent obesity is eating behaviour\(^8\). Several studies have shown an association between consumption of energy-dense foods and excessive weight in young people\(^9,10\). Despite such associations, studies have consistently shown that adolescents as a group have unhealthy and sometimes erratic eating habits\(^11,12\), characterised by snacking on energy-dense foods, including those high in fat, sugar and salt\(^13-15\).

Television viewing is the most prevalent leisure-time activity among young people in Western countries\(^16-18\), with many adolescents far exceeding the recommendations of less than 2 hours a day of television viewing. Data from the US suggests that adolescents are spending over 7.5 hours a day engaged in screen media with most of this devoted to TV viewing\(^18\). Adolescents who spend large amounts of time watching television are at particular risk of unhealthy eating behaviours\(^19\). For example, television viewing has been associated with increased meal frequency and food intake\(^20,21\), and more specifically, is positively associated with energy-intake, consumption of energy-dense foods and beverages, and negatively associated with consumption of fruit, vegetables and fibre\(^19,21\). Variations in eating behaviours according to television viewing are of particular concern as they could parallel other negative health consequences of excessive television viewing\(^22\), and they may represent a pathway by which television viewing may lead to poorer health. However, little is known about the potential mechanisms by which television viewing is associated with unhealthy eating behaviours amongst adolescents.

A potential explanation for the association between television viewing and eating behaviours among adolescents stems from the existing literature on the determinants of dietary behaviour. There is evidence that home availability of unhealthy foods (e.g. energy-dense snack foods) is associated with unhealthy eating behaviours, including lower fruit and
vegetable consumption\textsuperscript{23} and higher consumption of energy-dense snack foods and drinks\textsuperscript{24, 25}. Furthermore, it is plausible that television viewing could be associated with home availability of particular foods. For example, while watching television, adolescent are exposed to many advertisements about food\textsuperscript{26, 27} (television is the largest single media source of messages about food\textsuperscript{28}), and these advertised foods are predominantly high in sugar and fat\textsuperscript{29, 30}. Furthermore, several studies have shown that young people’s television viewing is associated with food preferences, requests to purchase foods and drinks advertised, parental willingness to purchase these products, and the availability of these food items in the home\textsuperscript{31-36}. To our knowledge, however, no studies have examined whether home availability of energy-dense snack foods mediates the association between television viewing and consumption of energy-dense snack foods among adolescents. Understanding the mediators of the associations between television viewing and consumption of energy-dense snack food in adolescents is important to inform the development of nutrition promotion interventions.

This study aimed to (i) examine the associations between adolescent television viewing and frequency of consumption of energy-dense snack foods; (ii) examine the association between adolescent television viewing and perceived home availability of energy-dense snack foods; and (iii) to examine whether associations between adolescent television viewing and energy-dense snack food consumption are mediated (explained) by perceived home availability of energy-dense snack foods.

Methods

Study procedure

As part of a cohort study investigating dietary habits among adolescents in Melbourne, Australia, adolescents were administered self-completion questionnaires between September 2004 and July 2005. Study procedures were approved by the Ethics Committee of Deakin University, the Victorian Department of Education and Training, and the Catholic Education Office. Survey participant recruitment and study procedures have been provided in previous publications\textsuperscript{37, 38}. In brief, all co-educational state (government) and Catholic secondary schools (years 7 to 12) with enrolments over 200, located in the southern metropolitan region of Melbourne and the non-metropolitan region of Gippsland, to the east of Melbourne, were
invited to participate in the study. Of the 70 schools (47 metropolitan and 23 non-
metropolitan) that met these criteria, 37 schools (20 metropolitan and 17 non-metropolitan)
agreed to participate.

Participants

All students (n = 9,842) from year 7 (aged 12-13 years) and year 9 (aged 14-15 years) from
participating schools were invited to participate. Teachers distributed parental consent forms
via students. Parental consent was obtained for 4,502 (46%) of all eligible students. Due to
absence from school on the day of testing, teachers administered an online food habits survey
to 3,264 adolescents during class time when they had access to computers. The present
analyses are based on the subset of 2,984 (30%) adolescents who had non-missing data for all
of the variables examined in this study.

Measures

Adolescent consumption of energy-dense snack foods

Consistent with other large-scale studies of dietary intake and eating behaviours of
adolescents \(^{39}\), food intake was assessed using a brief food frequency questionnaire (FFQ).
This FFQ was based on previously validated indices of food intake \(^{40}\) and is described in
detail in previous publications \(^{37,38}\). Respondents indicated how frequently they had
consumed 37 food items during the previous month. Seven response categories ranged from
‘never or not in the last month’ to ‘several times a day’. The present analyses are based on a
subset of three items from the FFQ: confectionery (e.g. chocolates and lollies/sweets), sweet
biscuits/cookies, and potato crisps/salty snacks. The frequency of consumption of the three
items in the past month was converted to a daily equivalent, which is an established method \(^{41}\)
that has been used in other dietary studies \(^{39,42}\). A daily equivalent score for the three items
was calculated as follows: not in the last month (0.00 per day), several times per month (0.11
per day), once a week (0.14 per day), a few times a week (0.36 per day), on most days (0.71
per day), once per day (1.00 per day) and several times per day (2.50 per day). The daily
equivalents of the three items were then summed to create a daily estimate of energy-dense
snack food consumption.
Adolescent television viewing

Adolescents reported how much time (hours/minutes) they usually spend watching television/DVDs/movies on a typical school day (Monday to Friday), which was converted to minutes/day. Adolescents reported how much time (hours/minutes) they usually spent watching television/DVD/movies on a typical Saturday and Sunday. The latter were converted to minutes/day, summed and divided by two to create average viewing on a weekend day.

Home availability

Perceived availability of different foods within the home environment was assessed with items adapted from the Project EAT \(^{39}\). Respondents were asked how frequently (ranging from (1) never/rarely to (4) always) the following items were available within the home: cakes or sweet biscuits; potato crisps or salty snacks; chocolate or lollies. The frequency of home availability of energy-dense snack food items was summed (Cronbach’s \(\alpha = 0.80\)).

Statistical analysis

All analyses were conducted using Stata 11 (Stata Corp, College Station TX, 2003). Descriptive statistics including frequencies, means, and standard deviations were calculated for all study variables according to gender and year level of adolescent participants. Firstly, linear regression analyses were used to examine associations between adolescent television viewing energy-dense snack consumption, between television viewing and perceived home availability of energy-dense snack foods, and between perceived home availability of energy-dense snack foods and adolescent energy-dense snack food consumption. Secondly, as suggested by Cerin et al. \(^{43}\), the mediating effects of home availability on the association between television viewing and adolescent energy-dense snack food consumption were assessed using the Freedman-Schatzkin test of mediation \(^{44}\). The Freedman-Schatzkin test is based on the difference in the unstandardised regression coefficients for the association between an independent (e.g. television viewing) and dependent variable (adolescent energy-dense snack consumption), unadjusted \((\tau)\) and adjusted...
(τ') for the proposed mediator(s). The significance of the mediating effect is computed by dividing this difference (τ-τ') by its standard error and comparing the obtained value to a t-distribution with n-2 degrees of freedom. R² was used to provide an indication of the proportion of variance in energy-dense snack consumption accounted for by each model. All regression models were adjusted for year level of adolescents, and accounted for potential clustering by school (unit of analyses) using the ‘cluster’ command.

Results

Slightly more of the adolescent sample were girls (53%) and in year 7 of secondary school (61%). Table I displays the means and standard deviations for the study variables for the total sample and according to gender and year level. Several small but significant differences were found. Boys reported higher frequency of home availability of energy-dense foods, and reported watching more television on a weekend day compared to girls. Adolescents in year 9 reported higher frequency of home availability of energy-dense foods and reported watching more television on a school day and on a weekend day compared to adolescents in year 7. All further analyses were stratified by gender, adjusted for year level and accounted for potential clustering by school (unit of analyses).

School day and weekend day television viewing were significantly associated with energy-dense snack consumption (τ in Table II). Television viewing accounted for 5% (school day) and 4% (weekend day) of the variance in energy-dense snack consumption among boys and 5% (school day and weekend day) of the variance among girls’ consumption of energy-dense snacks. Linear regression analyses revealed that school day and weekend day television viewing were positively associated with perceived home availability of energy-dense snack foods among adolescent boys and girls (Table III). Further linear regression analyses revealed that perceived home availability of energy-dense snack foods was positively associated with consumption of energy-dense snack foods among adolescent boys (β=0.26, 95% CI 0.22-0.31, p<0.001) and girls (β=0.28, 95% CI 0.24-0.33, p<0.001).

Table II shows the mediating effects of perceived home availability of energy-dense snack foods on the association between school day and weekend day television viewing and
adolescent energy-dense snack consumption among adolescent boys and girls. When perceived home availability was added to each model predicting energy-dense snack consumption by television viewing (i.e. separately for school day and weekend day), the $\beta$ value for the association between television viewing and energy-dense snack consumption was significantly decreased for both boys and girls. However, the association between television viewing and energy-dense snack consumption remained significant ($p<0.001$) in all models. This suggests that perceived home availability partly mediates the association between television viewing and energy-dense snack consumption. The proportion of variance in energy-dense snack consumption explained by television viewing increased when perceived home availability was added to each model (see Table II).

Discussion

Recent reviews have identified as association between television viewing and unhealthy eating among adolescents \(^{19, 21}\); however, little is known about potential mechanisms in the home environment that underpin the association between television viewing and unhealthy eating. The present study is one of the first to examine both the direct and indirect associations between television viewing and energy-dense snack food consumption. The results of the present study show that both school day and weekend day television viewing were positively associated with home availability of energy-dense snack foods and energy-dense snack food consumption. Furthermore associations between television viewing and energy-dense snack food consumption were partially mediated by home availability of energy-dense snack foods. Acknowledging the cross-sectional study design, our findings give weight to the likely importance of addressing television viewing behaviours, as well as home availability of foods, in interventions aimed at promoting healthy eating among adolescents.

Sedentary behaviour has become a significant issue in public health over the past decade, both for adults \(^{45}\) and young people \(^{46}\). Operationally defined as ‘sitting time’ it has often been assessed in respect of screen time, and especially time watching television. However, while research has shown there to be consistent links between TV viewing and unhealthy weight status in young people, associations are often quite small \(^{47}\). This may be due to several factors, including little or no association between TV viewing and moderate-to-vigorous physical activity \(^{47}\), except for some periods of the day, such as immediately after school \(^{48}\), as
well the presence of co-existing behaviours such as diet. TV viewing has been shown to co-
exist with unhealthy eating behaviours\textsuperscript{19}. It may be diet as well as time being sedentary
watching TV that accounts for indicators of poor health, including weight status. Our findings
support the view that TV viewing in young people is associated with energy-dense snack food
consumption. Although only 4-5\% of the variance is explained by this association, this is
likely to be highly meaningful in term of weight status. As argued by Hill\textsuperscript{49}, ‘small changes’
to lifestyle may have significant health effects. This is likely to be true in the context of highly
frequent, repeated behaviours such as TV and snacking.

The present study showed that perceived home availability of energy-dense snacks was
positively associated with adolescent energy-dense snack consumption. Such findings add to
previous research highlighting the important role of food availability within the home\textsuperscript{24,50}. It
has long been known from behaviour modification studies that environmental manipulation,
such as food visibility and availability can have potent effects on behaviour\textsuperscript{51}. Simple
strategies, such as reductions in purchase of energy dense foods, their concealment in the
home, or family rules about frequency and location of their consumption may be helpful. The
present study also showed that television viewing was positively associated with home
availability of energy-dense snacks. Such findings corroborate previous research showing that
while young people are watching television they are exposed to numerous advertisements
about food (usually unhealthy)\textsuperscript{26} and that this translates into young people’s food preferences,
requests to purchase foods and drinks advertised, parental willingness to purchase these
products, and the availability of these food items in the home\textsuperscript{31-35}. In addition, this study
demonstrated that the perceived availability of energy dense snack foods in the home partially
accounts for the association between TV viewing and energy dense snack food consumption.
Such findings suggest that home availability of energy-dense foods could potentially be
influenced by targeting reductions in television viewing, which could also result in reductions
in energy-dense snack food consumption. The involvement of parents and targeting the home
environment is likely to be particularly important in such efforts.

Alternative explanations for several of the present findings are possible. That is, adolescents
watching more TV may have been consuming more of all sorts of snacks, including healthy
snacks. It is also possible that TV viewers consumed more energy-dense snacks because they had less access to fruits and vegetables in the home. To test these possibilities we conducted additional analyses. In the additional analyses, we examined associations of TV viewing with perceived home availability of fruit and vegetables. Results showed negative associations between TV viewing and fruit and vegetable availability, but these were of very small magnitude (B=-0.002 for boys and -0.001 for girls). Further, there were no associations between TV viewing and fruit/vegetable consumption for either boys (B<-0.001) or girls (B<-0.001). Therefore it appears unlikely that TV viewers are consuming more of all sorts of snacks; or that the increased consumption of energy-dense snacks amongst those viewing more TV is strongly attributable to lower availability of fruits and vegetables in the home.

In considering these findings it is important to acknowledge the limitations of the study. The reach of the whole study was modest (46%); however this is comparable to other large scale longitudinal studies. All data were collected by self-report and are subject to socially desirable response bias or other misreporting. The cross-sectional study design does not permit causal inferences to be drawn; potentially a third unmeasured variable could account for the associations observed. Strengths of the study include the large regionally diverse sample of adolescents and parents, and the use of powerful statistical mediation techniques.

**Conclusions**

The results of the present study suggest that television viewing has a significant role to play in adolescent unhealthy eating behaviours. Future research should assess the efficacy of methods to reduce adolescent energy-dense snack food consumption by targeting parents to reduce home availability of energy-dense foods, and on reducing television viewing behaviours of adolescents.

**References**


Table I. Description of outcome, mediating, and predictor variables according to gender and year level of Australian adolescent participants in 2004-2005.

<table>
<thead>
<tr>
<th>School region</th>
<th>Gender</th>
<th>Year level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total sample (n=2984)</td>
<td>Boys (n=1390)</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>67.2</td>
<td>69.2</td>
</tr>
<tr>
<td>Rural</td>
<td>32.8</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Outcome variables

Energy-dense snacks, mean (SD) (range: 0-7.5 per day)

|                       | 1.13 (1.26) | 1.15 (1.34) | 1.19 (1.19)  | 1.14 (1.29)  | 1.10 (1.22)  |

Potential mediating variables

Home availability of energy-dense snacks, mean (SD) (range 3-12)

|                       | 7.53 (1.99) | 7.63 (2.06) | 7.45 (1.92)* | 7.44 (1.95)  | 7.68 (2.04)** |

Predictor variables

School day television viewing (mins/day (SD))

|                       | 134.27 (88.32) | 135.54 (91.19) | 133.16 (85.76) | 131.65 (89.39) | 138.31 (86.52)* |

Weekend day television viewing (mins/day (SD))

|                       | 137.65 (84.26) | 146.01 (86.61) | 130.36 (81.49)** | 134.80 (84.99) | 142.05 (82.97)* |
Chi squared tests (for school region) and independent t-tests (for all continuous variables) examining differences in means by adolescent gender and year level
*p<0.05; **p<0.01; ***p<0.001
Table II. Effects of adjustment for perceived home availability of energy-dense snack foods in the association between television viewing and adolescent energy-dense snack consumption among Australian adolescents in 2004-2005 (n=2984).

<table>
<thead>
<tr>
<th></th>
<th>τ (SE)</th>
<th>τ’ (SE)</th>
<th>τ – τ’ (SE)</th>
<th>t</th>
<th>P-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adolescent boys (n=1390)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School day TV viewing</td>
<td>0.003 (0.0004)***</td>
<td>0.002 (0.0003)***</td>
<td>0.001 (0.0000025)</td>
<td>7.94</td>
<td>&lt;0.0001</td>
<td>0.19</td>
</tr>
<tr>
<td>Weekend day TV viewing</td>
<td>0.003 (0.0005)***</td>
<td>0.001 (0.0004)***</td>
<td>0.002 (0.0000041)</td>
<td>13.58</td>
<td>&lt;0.0001</td>
<td>0.18</td>
</tr>
<tr>
<td><strong>Adolescent girls (n=1594)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School day TV viewing</td>
<td>0.003 (0.0003)***</td>
<td>0.001 (0.0003)***</td>
<td>0.002 (0.0000011)</td>
<td>9.87</td>
<td>&lt;0.0001</td>
<td>0.23</td>
</tr>
<tr>
<td>Weekend day TV viewing</td>
<td>0.003 (0.0005)***</td>
<td>0.001 (0.0003)***</td>
<td>0.002 (0.0000034)</td>
<td>9.06</td>
<td>&lt;0.0001</td>
<td>0.22</td>
</tr>
</tbody>
</table>

τ, unstandardised regression coefficient for association between television viewing and adolescent energy-dense snack food consumption, adjusting for school year and accounting for potential clustering by school (unit of analyses) using the ‘cluster’ command, before adjustment for mediator; τ’, unstandardised regression coefficient for association between television viewing and adolescent energy-dense snack food consumption, adjusting for year level and accounting for potential clustering by school (unit of analyses) using the ‘cluster’ command, and mediator (perceived home availability of energy-dense snack foods); τ – τ’, difference between the two regression coefficients, which when divided by its standard error, can be compared against a t-distribution with n – 2 degrees of freedom; SE, standard error.
Table III. Associations between television viewing and home availability of energy-dense snacks (potential mediator) among Australian adolescent boy and girls in 2004-2005.

<table>
<thead>
<tr>
<th>Home availability of ED snacks</th>
<th>Boys (n=1390)</th>
<th>Girls (n=1594)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School day TV viewing</td>
<td>β=0.005 (0.004-0.006)***</td>
<td>β=0.004 (0.003-0.005)***</td>
</tr>
<tr>
<td>Weekend day TV viewing</td>
<td>β=0.005 (0.004-0.007)***</td>
<td>β=0.006 (0.004-0.007)***</td>
</tr>
</tbody>
</table>

Linear regression analyses, controlling for year level and accounting for potential clustering by school (unit of analyses) using the ‘cluster’ command.