Access to excess: how do adolescents deal with unhealthy foods in their environment?

Emely de Vet[1], John B. F. de Wit[2,3], Aleks Luszczynska[4,5], F. Marijn Stok[1], Tania Gaspar[6], Michelle Pratt[7], Jane Wardle[7], Denise T. D. de Ridder[1]

1 Clinical and Health Psychology, Utrecht University, Utrecht, The Netherlands
2 Social and Organizational Psychology, Utrecht University, Utrecht, The Netherlands
3 National Centre in HIV Social Research, University of New South Wales, Kensington, Sydney, Australia
4 Trauma, Health, and Hazards Center, University of Colorado, CO, USA
5 Warsaw School of Social Sciences and Humanities, Warsaw, Poland
6 Instituto de Psicologia e Ciências da Educação (IPCE), Universidade Lusíada de Lisboa
7 Department of Epidemiology and Public Health, Health Behaviour Research Centre, University College London, London, UK

Correspondence: Emely de Vet, Clinical and Health Psychology, Utrecht University, P.O. Box 80140, 3508 TC Utrecht, The Netherlands, tel: +31 (0) 30 253 9250, fax: +31 (0) 30 253 4718, e mail: e.devet@uu.nl

Purpose: Easy access to unhealthy foods is believed to contribute to the current overweight epidemic. It remains unclear, however, how access to unhealthy foods is related to self-regulation of food intake. This study tests the hypothesis that using self-regulation strategies buffers the negative influences of easy access to unhealthy foods. **Methods:** Cross-sectional survey data from 2764 adolescents aged 10–17 years from four European countries (The Netherlands, UK, Poland and Portugal) about use of self-regulation strategies, access to unhealthy foods and intake of unhealthy foods (sweet and salty snacks and sugar-sweetened beverages) were used. **Results:** Both access to unhealthy foods and use of self-regulation strategies were independently, but in opposing directions, related to intake of unhealthy foods. Easy access to unhealthy food products was associated with higher consumption, but this effect could be attenuated by use of self-regulation strategies to facilitate healthy eating even when the food environment tempts one to do otherwise. **Conclusions:** Health promotion policy and programs should not only address the food environment but could also teach young people better strategies to deal with it.

Introduction

The prevalence of overweight and obesity in children and adolescents has increased dramatically in the past decades,[1] with around a third of European youth now overweight or obese.[2] A main contributor to this epidemic is youngsters' diets, which show considerable room for improvement.[3–5] Healthy diets are a challenge in today's food rich environment. Modern societies are characterized by abundant availability and easy accessibility of foods,[6–11] placing a high burden on the individual's capacity to control food intake.

During the past 25 years, changing diets of adolescents have been observed in parallel with changes in the food environment, but evidence for a direct link between food accessibility and adolescents' diets is not widely documented. In a systematic review of reviews, no evidence was found for an association between food accessibility and the dietary behaviours of children and adolescents.[12] Most studies have focused on the availability of healthy products and *healthy eating*,[13,14] with few studies addressing the role that easy access to unhealthy foods plays in *unhealthy eating*.[15] One goal of the present study was, therefore, to examine associations between accessibility of unhealthy foods and unhealthy eating.

Past research focused mainly on the food accessibility itself, but there may also be ways that some individuals are able to resist the temptations associated with easy accessibility of unhealthy foods, so called self regulation. Self regulation reflects the ability to forego immediate reward and pleasure (e.g. having a sweet dessert) in the service of long term goals (e.g. staying healthy).[16,17] For example, self regulation is required when individuals are confronted with a conflict between the urge to indulge in a delicious food and their long term goal of maintaining a healthy weight. In this situation, people may make small changes to their surroundings, such as choosing to keep the tempting foods at a distance[18,19] or activating their dietary goals when confronted with a food temptation.[20,21]

Three categories of dietary self regulation have been reported by adolescents.[22] First, adolescents used strategies directly addressing the food environment, either avoiding temptation (e.g. avoid fast food places) or re arranging their food environment to make it less tempting (e.g. putting crisps out of reach when watching television). Second, they used strategies addressing the meaning of the food environment, such as distraction (e.g. keeping oneself busy if one gets hungry before dinner) or suppression (e.g. ignoring the smell of tasty foods when passing a bakery). Third, they used strategies that directly addressed the goal to eat healthily such as setting goals and rules (e.g. how many candies a day one can have) or deliberating goals (e.g. when feeling like eating something unhealthy, taking a moment to consider whether you really want it) (De Vet E et al. submitted for publication). These self regulation strategies are hypothesized to correlate with lower intake of unhealthy foods.

Although easy access to unhealthy foods may be detrimental to a healthy diet, using the appropriate strategies may be beneficial to it. Furthermore, these opposing forces may operate jointly rather than in isolation, and we expect food accessibility and the use of self regulation strategies to interact. More specifically, easy access to unhealthy foods is only problematic if adolescents lack the appropriate strategies to handle the access to excess. Similarly, self regulation strategies might be particularly useful when the goal to eat healthily is challenged by an unsupportive environment. This study tests the hypothesis that using self regulation strategies buffers the negative influences of easy access to unhealthy foods and reduces the likelihood that an adverse food environment 'gets under the skin'.[23,24]

The present study was a large scale survey of adolescents from four European countries testing the following hypotheses: (i) self reported accessibility of unhealthy foods is associated with higher intake of those foods; (ii) using self regulatory dietary strategies is associated with lower intake of unhealthy foods; and (iii) the negative influence of easy access to unhealthy foods can be attenuated by using the appropriate self regulation strategies.

Methods

Participants, design and procedure

Data were collected in schools in four European countries (The Netherlands, UK, Poland and Portugal), selected to represent a range of overweight prevalence and socio economic background. Poland and the Netherlands are countries with lower overweight prevalence than the UK and Portugal.[25] The UK and the Netherlands are socio economically more privileged than Poland and Portugal. Schools were selected to represent variety in rural and urban regions as well as higher and lower socioeconomic status areas.

The data collection protocol complied with the ethical guidelines in each country (i.e. when medical ethical approval was required, approval was established). Passive (i.e. participation unless objection is made by signing the opting out form) or active (i.e. participation only on signing the opting in form) consent from adolescents and their parents was obtained, depending on the guidelines from each country's ethical review board. Adolescents aged 10 17 years were asked to complete the questionnaire in one session at school in the classroom setting. Completing the questionnaire took ∼30 min. It assessed background characteristics, self regulation strategies for eating, access to unhealthy foods and snack and soft drink consumption. A total of 24 schools participated, with 50.9% of these schools located in rural areas and 68.6% of these schools being situated in areas with a high socio economic status. The questionnaire was completed by 2764 adolescents.

Measures

The questionnaire was similar for all four countries. A 'mother version' was created in English, and each country translated and back translated it to the country's native language.

Unhealthy eating was assessed by asking about the average daily intake of two single items, sugar sweetened beverages and snacks.[cf.26] Specifically, adolescents were required to indicate their consumption on a 0 (<1/none) to 5 (>4) scale by the following items: (i) How many glasses of soft drinks, lemonade or energy drinks do you drink on an average day, and (ii) How many snacks do you eat on an average day? (followed by examples of country specific snacks).

Scores for snacking and soft drinks were summed to obtain an index for unhealthy eating.

Accessibility of unhealthy foods was assessed by asking about two items, the ease with which snacks and soft drinks can be obtained during school breaks and leisure time; for example, 'Whenever I feel like having a snack or soft drink during school breaks, I can easily get it (like from a vending machine, canteen or shop)'. Response options ranged from totally disagree [1] to totally agree [5]. Cronbach's α was 0.71, and a mean score of the two items was computed.

Self regulation strategies for eating were assessed with the Tempest Self Regulation Questionnaire for Eating (TESQ E). This is a 24 item validated instrument to assess dietary self regulation strategies among adolescents (De Vet et al., submitted for publication). Individuals are asked to rate on a five point Likert scale ranging from 1 (never) to 5 (always) how often they use specific self regulation strategies from the three categories outlined in the introduction. Each category includes two strategies, which are assessed with four items each, and a mean score was calculated for each category. The first category reflects strategies for *addressing the food environment* directly and includes items describing temptation control and avoidance (Cronbach's $\alpha = 0.83$). The second reflects strategies for *changing the meaning of the food environment*, and includes items describing distraction and suppression (Cronbach's

$\alpha = 0.86$). The third reflects strategies for *addressing the goal to eat healthily* and includes items describing goal and rule setting and goal deliberation (Cronbach's $\alpha = 0.86$). Scores on the three categories were significantly correlated (range: $r = 0.66$ to 0.73, P's < 0.001).

Weight and height were self reported, from which body mass index (BMI) was calculated. Because BMI is strongly influenced by age and gender in adolescence, it was dichotomized (1 = overweight or obese, 0 = not overweight or obese) using age and gender specific cut off points also used by the International Obesity Task Force.[27]

The <u>Family Affluence Scale</u> (FAS) was used as an indicator of family socioeconomic status.[28] The four items are as follows: (i) 'Does your family own a car, van or truck (no; yes, one; yes, two or more'; (ii) 'Do you have your own bedroom for you alone (no, yes)'; (iii) 'During the past 12 months, how many times did you travel away on holiday with your family' (not at all; once; twice; more than twice), and (iv) 'How many computers does your family own' (none; one; two; more than two). Following the procedure adopted in the World Health Organization's Health Behavior in School aged Children Study,[28] the two highest response categories were combined in items three and four. Three categories were then created based on the summed FAS score, indicating low affluence (FAS between 0 and 3), medium affluence (FAS score 4 or 5) and high affluence (FAS score 6 or 7).

<u>Immigrant status</u> was assessed by asking respondents what language they usually spoke with their parents.[29] A dichotomous variable was computed (speaking the country's national language or another language).

Data analyses

First, we aimed to examine whether access to unhealthy foods (hypothesis 1) and self regulation strategies (hypothesis 2) were associated with unhealthy eating. In hierarchical linear regression analyses, background characteristics (age, gender, family affluence, immigrant status and overweight status) were entered in the first step. In step 2a to step 2d, access to unhealthy foods and the three categories of self regulation strategies (addressing the food environ ment, changing the meaning of the food environment, addressing the goal to eat healthily) were entered separately to the analyses. In step 3, access to unhealthy foods and the three categories of self regulation strategies were entered simultaneously to the analysis. Unhealthy eating was the dependent variable.

The hypothesis that the negative influence of easy access to unhealthy foods can be attenuated by using the appropriate self regulation strategies was tested through three multiple linear regression analyses, for each of the categories of self regulation strategies, separately. In the first analysis, background characteristics, access to unhealthy foods, the use of self regulation strategies addressing the food environment directly and the interaction term between access to unhealthy foods and strategies addressing the food environment were entered simultaneously. In the second and third analyses, use of self regulation strategies addressing the food envir onment was replaced by use of strategies changing the meaning of the food environment and use of strategies addressing the goal to eat healthily, respectively (including in the interaction terms). All variables were mean centered. If an interaction term was significantly associated with unhealthy eating (P value < 0.05), additional simple slope analyses were conducted as specified by Aiken and West[30] to decompose the interaction. Simple slopes were computed at two levels of the moderator, examining the relationship between access to unhealthy foods and unhealthy eating for low users of self regulation strategies [mean (M) 1 standard deviation (SD)] and high users of self regulation strategies (M + 1 SD).

To correct for a potential clustering effect at the country level, all analyses were re run using complex sample analysis with the four countries as strata. The design effect was very small (the square root of the design effects deviated maximally 0.002 from 1.00), which indicates that the standard errors changed by ~0.2% when the country level was taken into account. Because the findings were not different for both types of analyses, regular linear regression analyses are reported here for ease of interpretation.

Results

Description of participants

Participants' mean age was 13.17 years (SD = 1.92), 50.9% were boys and 94.2% spoke the country's national language. Of the partici pants, 11.7%, 35.8% and 52.5% were from low, middle and high affluent families, respectively. Of the participants, 24.7% were overweight and 3.2% were obese based on the age and gender specific cut off points for adolescents.

Are access to unhealthy foods and self-regulation strategies related to unhealthy eating?

Hierarchical regression analysis indicated that background variables were either unrelated (family affluence and overweight status) or weakly related (age, gender, immigrant status) to unhealthy eating. Older adolescents, boys and adolescents who mainly speak a foreign language at home appear to eat somewhat less healthily than those who were younger, female or speak the country's native language at home (table 1).

Adding access to unhealthy foods and the three self regulation scores individually to the model showed that after adjustment for background characteristics, all four variables were associated with unhealthy eating. Adolescents consume fewer unhealthy foods if they either have low access to unhealthy foods or use each self regulatory strategy more frequently (table 1). Entering access to unhealthy foods and self regulation strategies simultaneously to the regression model gave similar results, except that the association between changing the meaning of the food environment and unhealthy eating became non significant (table 1).

In sum, these results illustrate that access to unhealthy foods and self regulation strategies are independent significant contributors to unhealthy eating, also when background characteristics are taken into account. The next step is to disentangle how access to unhealthy foods and self regulation strategies are interacting.

Do self-regulation strategies protect against an adverse food environment?

There was a significant interaction between access and self regulatory strategy use for all three strategies (see figure 1).

The interaction between access to unhealthy foods and addressing the food environment was significant ($\beta = 0.07$, $P = 0.001$, adjusted $R^2 = 17.2\%$). Decomposing the interaction revealed that access to unhealthy foods was less strongly associated with unhealthy eating for individuals who frequently apply strategies to address the food environment (B = 0.67, $P < 0.001$) than for those who do not use this kind of self regulatory strategy often (B = 0.96, $P < 0.001$).
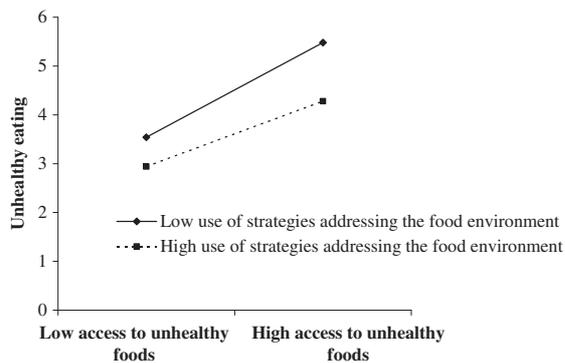
The interaction between access to unhealthy foods and changing the psychological meaning of the food environment was also signifi cant ($\beta = 0.05$, $P = 0.02$, adjusted $R^2 = 16.3\%$). Decomposing the interaction pointed to a similar pattern, with unhealthy eating being less strongly influenced by access to unhealthy foods for indi viduals who frequently apply the strategies related to changing the meaning of the food environment (B = 0.76, $P < 0.001$) than for those who do not use this strategy often (B = 0.96, $P < 0.001$).

The interaction between access to unhealthy foods and addressing the goal to eat healthily ($\beta = 0.05$, $P = 0.02$, adjusted $R^2 = 17.3\%$) was also significant. The association between access to unhealthy foods and unhealthy eating was weaker for individuals who often use strategies to address the goal to eat healthily (B = 0.76, $P < 0.001$) than those who do not use this strategy often (B = 0.96, $P < 0.001$). Figure 1 shows a graphical presentation of the interaction between

Table 1 Regression analyses of unhealthy eating on access to unhealthy foods and use of self regulation strategies

Entered variables	B (SE B)	β	P
Step1			
Age	0.07 (0.03)	0.06	0.01
Gender (0 = boys, 1 = girls)	0.51 (0.10)	0.11	<0.001
Medium (=1) versus low (=0) family affluence	0.18 (0.17)	0.04	0.29
High (=1) versus low (=0) family affluence	0.09 (0.16)	0.02	0.60
Immigrant status (0 = native, 1 = foreign)	0.52 (0.22)	0.05	0.02
Overweight status (0 = no overweight, 1 = overweight or obese)	0.05 (0.12)	0.01	0.66
Step 2a			
Access to unhealthy foods	0.48 (0.05)	0.23	<0.001
Step 2b			
Addressing the food environment	0.74 (0.06)	0.27	<0.001
Step 2c			
Changing the meaning of the food environment	0.55 (0.06)	0.21	<0.001
Step 2d			
Addressing the goal to eat healthily	0.59 (0.05)	0.24	<0.001
Step 3			
Access to unhealthy foods	0.40 (0.05)	0.19	<0.001
Addressing the food environment	0.41 (0.08)	0.15	<0.001
Changing the meaning of the food environment	0.04 (0.09)	0.02	0.64
Addressing the goal to eat healthily	0.30 (0.08)	0.12	<0.001

Step 1: $F_{(2155, 6)} = 6.83$, $P < 0.001$; $R^2 = 0.02$; Step 2a: $F_{(2130, 7)} = 21.17$, $P < 0.001$; $R^2 = 0.06$; Step 2b: $F_{(2139, 7)} = 27.11$, $P < 0.001$; $R^2 = 0.08$; Step 2c: $F_{(2122, 7)} = 18.63$, $P < 0.001$; $R^2 = 0.06$; Step 2d: $F_{(2139, 7)} = 23.15$, $P < 0.001$; $R^2 = 0.07$; Step 3: $F_{(2096, 10)} = 28.86$, $P < 0.001$; $R^2 = 0.12$.

Figure 1 Interaction between access to unhealthy foods and self regulatory strategy use (n = 2116)

access to unhealthy foods and the use of strategies addressing the food environment. The pattern is similar for the interaction between access to unhealthy foods and the other two categories of self regulation strategies. In sum, these analyses show that access to unhealthy foods is consistently associated with a higher intake of these products, but that using self regulation strategies can reduce the negative influence of access to unhealthy foods.

Discussion

This is one of the first studies to explore the unique and combined influence of environmental and psychological factors on eating behaviour in adolescents. Studying environment person interactions is important because it provides valuable insights into the conditions under which environmental features exert an influence on health behaviours. Despite many studies on environmental correlates of weight related behaviours, it still remains unclear exactly how and why environmental factors exert their influence on behaviour[12,15,23,24] and why they do not exert the same effect on everyone.

Our results reveal two important findings. First, both access to unhealthy foods and use of self regulation strategies contributed uniquely, but in opposing directions, to unhealthy food intake. Second, using self regulation strategies to support healthy eating attenuates, but does not eliminate, the impact of an adverse food environment. Although the negative impact of access to unhealthy foods is not diminished, the reduction is of relevant magnitude. When access to unhealthy foods is easy, high users of self regulation strategies consume about one daily serving of snacks or sodas less than low users of self regulation strategies. It has been calculated that weight gain can be prevented in 90% of the population, if the energy balance is affected with about 100 kcal per day,[31] which is comparable with one daily serving of snacks or sodas.

In the present article, we focused on physical aspects of the food environment and how these interact with self regulation. Yet, also social, cultural, political and economical aspects of the food environment may exert an influence on adolescents eating behaviour and interact with self regulation.[32,33] It would be inter esting to investigate whether self regulation interacts similarly with other types of environmental influences.

The present study's strengths and weaknesses need to be acknowledged. An important strength of the present study is the large and diverse sample with adolescents from four different countries. A first limitation is the use of self reported weight and height to calculate BMI, which may be subject to misreporting in this age group.[34] Future studies should aim to include more objective body composition measures. Another major limitation of the present study is the cross sectional design. Although this is one of the first studies exploring the interaction between food environ ments and strategies to deal with this environment, no conclusions about causality can be drawn. Our findings have some implications for interventions. Currently, much attention goes to understanding or changing environmental contributors to unhealthy lifestyles. Altering food environments (for example, changing the line of products in school canteens or banning vending machines from schools) is important, but is also a complex, costly and time consuming process, commonly involving many parties and decision makers. Although it remains important that food environ ments are designed in such a way that the healthy choice is the easiest choice, the present study suggests that additionally there may be ways that people can protect themselves from the tempta tions of the food environment. The finding that self regulation strategies were associated with a lesser impact of an adverse food environment, would, if it were shown to be a causal effect, suggest another avenue for health promotion, namely to train young people

in the use of self regulation strategies. An additional advantage is that, where environmental adaptations are often restricted to single types of environments and settings, possessing self regulation strategies to eat healthily may be helpful to deal with temptations irrespective of the setting the influence originates from. To exemplify, although (local) health professionals and school boards may cooperate in removing unhealthy foods from the school environments, unhealthy foods may remain just as easily accessible in the supermarket, convenience store or kiosk just outside the school. Self regulation strategies, in contrast, reflect general principles that can be applied to eat healthily irrespective of the setting one is in.

To conclude, the present study confirmed that easy access to unhealthy food products was associated with higher consumption, but this effect could be moderated by use of self regulation strategies to facilitate healthy eating even when the food environment tempts one to do otherwise. This might imply that health promotion actions should not only address the food environment but could also teach young people better strategies to deal with it.

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Key points

- Easy access to unhealthy foods is associated with more unhealthy eating.
- Using self regulation strategies is associated with lower intake of unhealthy foods.
- Self regulation and access to unhealthy foods interact
- Self regulation strategies reduce negative influences of access to unhealthy foods.

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