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Abbreviation	Definition
PTA	Parent Teachers Association
SSBs	sugar-sweetened beverages
STOP	Science and Technology in childhood Obesity Policy
IHE	Institute for Health and Environment
RCTs	Randomized Controlled Trials
CDC	Center for Disease Control
BMI	body-mass index
IOM	Institute of Medicine



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Promoting Healthy Eating in Children: A Social Marketing Intervention in Slovenian Schools

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1 Abstract

Obesity rates have increased dramatically worldwide over the last three decades, particularly among children and adolescents. One of the causes of childhood obesity is the consumption of unhealthy foods, particularly unhealthy snacks. Thus, the primary objective of the current research was to develop a social marketing intervention to reduce unhealthy food consumption and increase healthy food consumption in Slovenian children, ages 6-10. The design was a pre/post quasi-experiment in which the intervention was implemented in the treatment school but not in the control school, and measures of snack consumption were taken before and after the intervention. The results showed that, compared to the control school, healthy snack consumption (vegetable, fruit snacks) increased, and less healthy snack consumption (sweet snacks) decreased for the treatment school. However, participation was greatly reduced because of pandemic-related issues such that the sample sizes were very small, thus serving as a substantial threat to statistical conclusion validity.

Keywords: obesity, social marketing, intervention, health, behavior change.

2 Introduction

Childhood obesity has emerged as a significant societal problem because of the unprecedented growth in global childhood obesity rates over the last three decades, and the problem is particularly acute in Europe. The dramatic increase in obesity rates is problematic because of its link with severe health problems such as diabetes and cardiovascular disease (Atanasova et al., 2022; Sahoo et al., 2015; World Health Organization, 2016).

Although there are likely many causal factors that have contributed to the increase in childhood obesity, one factor is the changes in social norms and living environments that have contributed to changes in eating habits that have increased unhealthy eating behaviors (e.g., increased portion sizes, unhealthy snacks, etc.). Examples of such social norms and environmental changes include advertising that promotes excessive consumption of unhealthy foods such as sugar-sweetened beverages (SSBs; Watson et al., 2022), larger food and fat intake, and less physical activity



(Atanasova et al., 2022; Sahoo et al., 2015; Sonntag et al., 2015). As part of the Science and Technology in childhood Obesity Policy (STOP) program and its goal to identify factors that contribute to increased childhood obesity in the European Union, the objective of this research was to develop and implement an intervention that would reduce unhealthy eating habits (and thereby increase healthier eating habits) in children ages 6-10 years old.

3 Implementation

3.1 Strategy for Implementation

To implement the intervention, we partnered with the Institute for Health and Environment (IHE) in Ljubljana, Slovenia to conduct an intervention in schools in Slovenia. Like other European countries, childhood obesity is a serious problem in Slovenia (NIJZ, 2016). We chose schools as the site for the intervention because they provide direct access to the children in the proposed age range and allow for the most control over the implementation of the intervention and measurement of its effects.

Negotiations for the implementation of the intervention began in mid-January 2020, with the goal of implementation in September 2020. The timing was unfortunate given the outbreak of the COVID-19 pandemic just a little over a month later. Like most schools in Europe and other countries in which severe outbreaks occurred in March 2020, the Slovenian schools initially closed for in-person instruction. Although the schools re-opened in September 2020, because of new severe outbreaks of COVID-19, the Slovenian schools again closed, and classes went online by November 2020. Given the uncertainty of when schools would re-open, the implementation of the intervention was postponed until September 2021.

4 Research Procedure

4.1 School Selection

Our original goal was to recruit several schools to participate. The first recruitment of elementary schools began in September 2020 and we obtained a list of six schools from the SLOfit program (a national program on sports education in which they systematically monitor the BMI of children and their flexibility, strength, and endurance). Schools were identified that were comparable on demographics and belonged to the top 25% of Slovenian schools with the highest BMI. The initial enthusiasm (early 2020) of the schools to participate was high. However, because of the delay due to the COVID-19 pandemic, the ensuing spike in COVID-19 cases in Summer and Fall 2020, and constantly changing restrictions on in-person interactions, many schools were no longer willing to work with outside organizations. Moreover, because of the increasing number of COVID-19 cases, only children 6-9 years of age were attending classes in person, with older children attending classes online. Thus, we decided to postpone the study until September 2021.

From the initial list of six schools that indicated their willingness to participate, only two were now willing to participate. Thus, we recruited new schools and focused on schools in Ljubljana because the demographics were comparable and the schools were larger in terms of enrollment. In July 2021, three schools agreed to participate, but by September 2021 only two of those schools were willing to participate, which greatly reduced the number of participants. One of the schools served



as the intervention school and the other as the control school (more details are provided in the following sections).

4.2 Intervention Development, Implementation, and Assessment

The first objective was to determine what type of intervention was optimal. Although there are numerous possibilities for intervention to increase healthy eating, they must match the capabilities of the research site (the schools) and must target eating behaviors that are specific to the participants. This required determining the current eating habits of the potential participants to pinpoint specific problematic unhealthy eating behaviors that could be changed. Based on informal surveys with parents and teachers, we expected that snacks and food choices during lunches from the school cafeteria would be good possibilities. The intervention proceeded in three stages: Stage 1) detecting problematic eating behaviors; Stage 2) development of the intervention method; and Stage 3) implementation of the intervention and measurement of effects.

4.2.1 Stage 1: Problem Detection

Stage 1 utilized qualitative research methods to determine the eating habits of the students and potential candidates for effective behavioral change for the intervention. The goal was to elicit information from four stakeholders: children, parents, teachers, and kitchen staff at the control and intervention school. Eliciting information from the children involved photographing the children's lunches, observing their eating patterns, and conducting focus groups. In addition, the children completed snack diaries for one week (more details are provided in a later section). Eliciting information from parents, teachers, and kitchen staff involved semi-structured interviews.

Interviews with parents, teachers, and staff indicated that the food eaten during school (e.g., school lunches) was generally healthy and had reasonable portion sizes, and interviews with students indicated that they were generally happy with the content of their school meals. In addition, given the structure of the school systems for delivering school lunches, there is little flexibility in terms of changing the lunch menus. The interviews further indicated that one potential contributor to unhealthy eating habits was the consumption of unhealthy snacks. Although the students are generally prohibited from bringing snacks to school except for special occasions (e.g., birthdays), analyses of the snack diaries indicated that the children eat unhealthy snacks almost every day (e.g., potato chips, chocolates, pies, cakes, etc.). Fruit snacks are also frequently consumed, which is generally good, but vegetable-based snacks are rarely eaten.

Given these findings, we decided to target the eating of unhealthy snacks for the intervention. The specific goal was to reduce the consumption of unhealthy snacks, and in doing so, increase the consumption of healthier snack foods, in particular, the consumption of healthy vegetable snacks. The logic of this type of objective relies on the "substitution effect" (Watson et al., 2022). Consumers in general, including children, develop deeply ingrained eating habits that are difficult to break, and one of these habits is the amount of food and beverages consumed (Sato et al., 2016), which may explain why campaigns focused on reducing food consumption ("eat less campaigns") are often ineffective (Chambers et al., 2021). Thus, the current intervention did not focus on the reduction of the overall amount of snacks consumed but instead focused on simultaneously decreasing unhealthy snack consumption and increasing healthy snack consumption.



4.2.2 Stage 2: Intervention Development

After identifying the target of the intervention, the next step was to develop the intervention. In keeping with social marketing principles to include all inputs into a behavior in the design of an intervention (e.g., price, promotion, distribution, product; Aceves-Martins, 2016; Watson et al., 2022), our approach to the intervention development was to include all agents connected to the student's diet, which in this case included teachers, parents, and cafeteria kitchen staff. Prior to implementation, the intervention proposal was sent to teachers, parents, and kitchen staff for their input on the sensibility and feasibility of the intervention and its implementation.

4.2.2.1 Children

Children were the primary focus of the intervention and thus most of the intervention time and resources were directed at them. The intervention activities included a workshop, take-home recipe cards, and a one-week competition (the competition was ultimately canceled, as we discuss next).

4.2.2.1.1 Workshop

One objective of the workshop was to encourage children to try new or disliked foods by teaching them how to try new or disliked foods through smell and taste-testing and then combining undesired foods with foods they already know and like. The workshop was called "Children's Masterchef" because the children prepared their own snacks. The snacks were a variation on an American snack called "ants on a log" that was popular in the US in the 1950s and was considered a healthy snack. The original version was a celery stick (the "log") that was stuffed with peanut butter and topped with raisins (the "ants"). The snack was particularly popular with children because of the fun name and simple flavors. We chose this snack because it is relatively unknown to Slovenian children, the snack is highly involving but also fun for the children, and it achieved the objective of trying new or disliked (healthy) foods with liked foods to increase consumption of healthy snacks.

For the workshop, we explained the basic preparation to the children and asked them to prepare the snack using a fruit or vegetable they did not like. The children could choose their own "logs," spread, and "ants," and they worked in pairs, so they prepared the snack for both themselves and their partners. The children were guided through the taste-testing technique (looking, smelling, tasting), which they employed throughout the snack construction to find one that best suited their tastes.

Following the workshop, the children were given take-home recipe cards, which contained 10 easy, quick, but healthy snack recipes. The children were encouraged to make the recipes at home with their parents. The recipes were chosen based on versatility and the ability to swap many ingredients, which they learned in the workshop. The recipes contained both fruits and vegetables.

Originally, a third component of the intervention was a one-week competition among all classes in the number of healthy recipes prepared at home. The winning team's recipe would then be offered at a school lunch. However, very low interest among the teachers prohibited implementing the competition portion of the intervention.

4.2.2.2 Parents

The parental aspect of the intervention included a presentation that provided advice on how to achieve a healthier diet for their children and reduce food "pickiness" in children. The initial plan for the presentation was to have it at a school Parent Teachers Association (PTA) meeting. However,



at the last minute, the school decided to have the presentation separate from the PTA meeting. The presentation occurred the last week of January 2022. Sixty parents were invited but only 20 came to the presentation, which greatly hampered this component of the intervention. The parental intervention also included emails to parents once a week for one month in which they received a recipe and tips for encouraging children’s healthy snacking. At the end of the four weeks, all parents received an electronic file via email that compiled all advice, tips, and healthy snack recipes. Parents also received a manual that provided information on why children often avoid fruits and vegetables, the health problems that can arise when children have unhealthy diets, and advice on what parents can do to encourage their children to eat more fruits and vegetables.

4.2.2.3 Teachers

The teacher intervention plan entailed a group meeting in which the teachers were encouraged to focus on increasing the vegetable intake of their students and provided advice on how to do so. However, interest among the teachers was extremely low, and thus, like the planned competition for children noted earlier, this portion of the intervention plan was not implemented. We return to the issue of low teacher interest and involvement in later sections.

4.2.2.4 Kitchen Staff

The original intervention plan for the kitchen staff was to add vegetable-based snacks into the food lunches. However, the Head of nutrition at the school ultimately decided that this was not possible because of new restrictions and governmental regulations that partly stemmed from the COVID-19 pandemic and partly from a lack of flexibility and ability to implement the plan in a short time frame. Thus, we had to settle for adding salad without vinaigrette to the menu.

4.2.3 Stage 3: Intervention Implementation and Measurement

4.2.3.1 Participants

The total enrollment for first through fourth grades was 190 in the control school and 350 in the treatment school. The breakdown per grade is shown in Table 1.

	1 st Grade	2 nd Grade	3 rd Grade	4 th Grade	Total
CONTROL SCHOOL	44	50	43	53	190
TREATMENT SCHOOL	80	94	77	99	350

Note. Numbers indicate number of students in each grade for each school.

Table 1 - Enrollments by Grade for Control and Intervention Schools

The students in each grade are distributed across individual classes with approximately 25 students per class on average. The initial agreement with the schools was to include all students in all classes. However, because of the burdens and risks associated with the pandemic, the Heads of nutrition for the two schools would now only allow one class per grade to participate, which greatly reduced the sample size. In addition, among eligible students, only the children who provided assent and whose parents provided consent could participate in the study. Because of concerns, fears, and uncertainty about the pandemic, the number of parents providing consent was much lower than expected.

4.2.3.2 Design, Procedure, and Measures

The primary measure was the number and proportion of unhealthy snacks consumed by the children. The design was a pre/post (before/after) design in which we measured the amount and proportion of snack consumption before and after the intervention. To measure the consumption of snacks, all participants filled out a snack food diary in class each day for one week between October and November 2021, which measured the quantity of different types of snacks the children consumed between lunch and dinner. Examples of the food diary can be seen in Figure 1. The diary was organized by day of the week (Monday–Friday, left column, in Slovenian) and for each day there were 33 pictorial representations of different types of snacks. Pictorial representations are recommended over verbal descriptions for young children who may lack the cognitive skills to understand verbal descriptions (Chaplin et al., 2020; Guinard, 2000). Children in the first and second grades circled the food they ate (right column in Figure 1) whereas children in the third and fourth grades could write down what they consumed (left column in Figure 1) along with circling foods. The diary was pretested to ensure that all children understood the task. The 33 pictorial representations of different food snacks were then coded into seven categories (sweets, salty snacks, milk products, meat, fruit, vegetables, and other).

Moj dnevnik prigrizkov

V vsakem okvirčku **napiši, kaj si včeraj pojedel/-a** med obroki kot **prigrizek**. Preveri svoj spomin in bodi čim bolj natančen/-a.

Zapisane prigrizke poskusi najti med sličicami in jih **obkroži**.





Ponedeljek	
Torek	
Sreda	
Četrtek	
Petek	

Figure 1 - Food Diary Example

The intervention was implemented for the treatment school from mid-January through the end of March 2022. Following the intervention, participants completed the same food diaries to provide



the post-intervention measure of snack consumption. The post-intervention food diary measure was collected during April and May of 2022. Note that for both the pre- and post-intervention measures, the timing of the data collection (filling out the food diary for a one-week period) was not fully under our control but depended on when the teachers would allow the measure to be completed, based on their current lesson plans.

5 Results

5.1 Pre-intervention Snack Consumption

5.1.1 Participants

The number of participants for the control and treatment schools represents all of the students who agreed to participate and who received parental consent. The number of participants who completed the pre-intervention food diaries for the control and treatment schools is shown in Table 2. Unfortunately, the overall participation rate was extremely low, as many parents would not give consent for participation. The primary reason given was concerns about COVID-19 transmission and work overload for the students given the additional burden the pandemic bestowed. The participation rate (number of participants divided by total enrollment grades 1 - 4) was 21% for the control school and 10% for the treatment school.

	1 st Grade	2 nd Grade	3 rd Grade	4 th Grade	Total
CONTROL SCHOOL	10	10	10	10	40
TREATMENT SCHOOL	6	12	7	10	35

Note. Numbers indicate number of students in each grade for each school.

Table 2 - Pre-intervention Participation (Completed Food Diaries) by Grade for Control and Treatment Schools

5.1.2 Share of Snack Consumption

We first determined the general share (proportion) of each snack type pre- and post-intervention. The results of this analysis can be seen in Figure 2. As the top portion of Figure 2 shows, pre-intervention, the relative consumption of the different types of snacks showed some similarities between the control and treatment schools but also some notable differences. (Note that because of the lower-than-expected sample sizes, the differences we described are not statistically significant). The two most popular snack categories were sweets and fruit snacks, which represented over half of the snack types for both the treatment and control schools. The relative consumption of sweets was very similar between the treatment and control schools (26% vs. 25%, respectively). However, the share of total snack consumption for fruits was noticeably greater for the control school (34%) compared to the treatment school (26%). In contrast, the consumption of vegetable snacks was a bit higher in the treatment school (7%) than in the control school (5%) and the same was true for salty snacks (10% vs. 8%).



5.2 Post-intervention Snack Consumption

5.2.1 Participants

The number of participants who completed the post-intervention food diaries for the control and treatment schools is shown in Table 3. As noted earlier, the parents were not always cooperative in letting their children participate in the intervention. For example, some parents were not timely in providing consent and thus some children who participated in the intervention and completed post-intervention food diary measures did not complete the initial pre-intervention food diary measure. This was particularly the case for the treatment school, which explains why the number of post-intervention diary measures is greater than the number of pre-intervention diary measures. The teachers were also not always cooperative in terms of administering the food diaries and allowing the children to complete them during class time. This was particularly the case for the control school in which the third- and fourth-grade children were not given the opportunity to complete their post-intervention food diaries, and only a small subset of the first- and second-grade children (40%) were able to complete the post-intervention food diary measures.

	1 st Grade	2 nd Grade	3 rd Grade	4 th Grade	Total
CONTROL SCHOOL	4	4	0	0	8
TREATMENT SCHOOL	13	8	13	13	47

Note. Numbers indicate number of students in each grade for each school.

Table 3 - Post-intervention Participation (Completed Food Diaries) by Grade for Control and Treatment Schools

5.2.2 Share of Snack Consumption

The post-intervention relative share of snack consumption for each snack type can be seen in the bottom portion of Figure 2. To compare the possible effects of the intervention, we first focus on the differences in the pre- and post-intervention relative share of each snack type for the treatment school. The comparisons are shown in Table 4. The objective of the intervention was to increase the consumption of vegetable snacks. The results suggest that the intervention may have had the desired effect. Relative consumption share of vegetable snacks was higher post-intervention (11%) compared to pre-intervention (7%) for the treatment school. Relative consumption of meat snacks was also higher post-intervention (7%) compared to pre-intervention (4%). This increase appears to have come at the expense of sweets, which decreased between pre- and post-intervention (26% vs. 23%), and salty snacks, which decreased between pre- and post-intervention (10% vs. 8%), which is generally good in terms of increasing overall consumption of healthier snacks while decreasing consumption of less healthy snacks, consistent with the substitution effect discussed earlier. However, consumption of fruit snacks also decreased slightly between pre- and post-intervention (26% vs. 24%), as did milk snacks (11% vs. 9%).

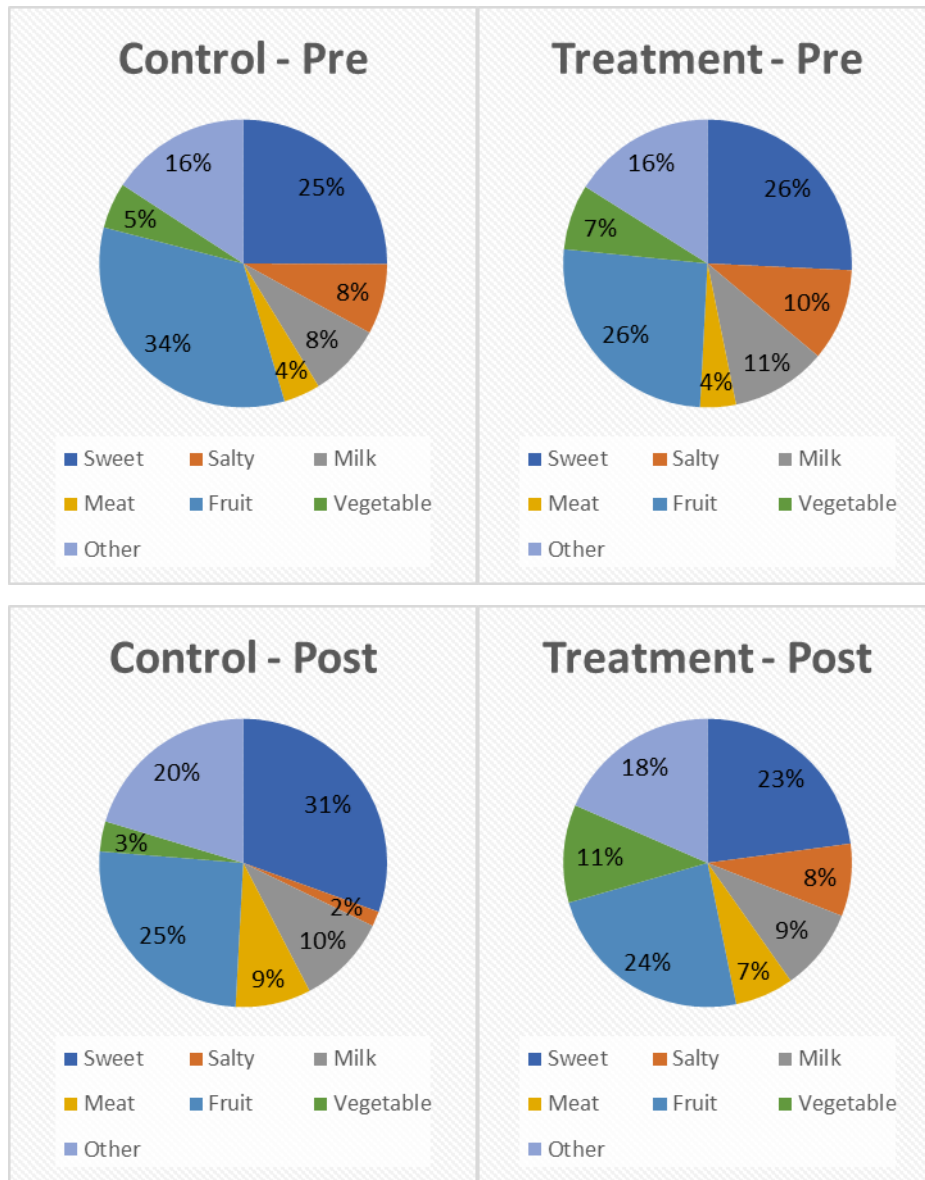


Figure 2 - Pre- and Post-Intervention Snack Consumption by Snack Type

	Treatment	Control	Relative Change (Treatment - Control)
Snack Type	Pre- / Post- Change	Pre- / Post- Change	
Sweet	-3%	+6% (+6%)	-9% (-9%)
Salty	-2%	-6% (-3%)	+4% (+1%)
Milk	-2%	+2% (+1%)	-4% (-3%)
Meat	+3%	+5% (+3%)	-2% (0%)
Fruit	-2%	-9% (-6%)	+7% (+4%)
Vegetable	+4%	-2% (-5%)	+6% (+9%)
Other	+2%	+4% (+5%)	-2% (-3%)

Note. Numbers in parentheses represent comparisons for first- and second-grade children only.



Table 4 - Change in Snack Share Between Pre- and Post-Intervention

Interpreting changes in consumption pre- and post-intervention can be problematic because the changes may have occurred for reasons other than the intervention. The purpose of the control school was to provide some degree of control for changes in consumption over time. However, because of the exceptionally low response rate for the post-intervention snack diary measure, it is impossible to draw clear conclusions based on the relative changes. Nevertheless, for completeness, we note that for the control school, consumption of sweet snacks increased from a pre-intervention share of 25% to a post-intervention share of 31%. In contrast, consumption of fruit snacks (34% vs. 25%), vegetable snacks (5% vs. 3%) and salty snacks (8% vs. 2%) all declined. More important is the relative change, which is computed by subtracting the relative change of the control school from the relative change of the treatment school. This relative change can be seen in the far-right column of Table 4. These results suggest that the intervention was associated with an increase in the relative consumption share of vegetable snacks by six percentage points and an increase in the relative share of fruit snacks by seven percentage points, and also associated with a nine-percentage-point decrease in sweet snack consumption.

Although these results appear to suggest that consumption of vegetable and fruit snacks decreased for the control school, the findings may be misleading because only first- and second-grade children completed the post-intervention diaries for the control school. To address this confound, we calculated the changes between pre- and post-intervention data collection only for first- and second-grade children for the control school. The results are shown in parentheses in Table 4. The results show that the general findings are unchanged, if not stronger. For the control school, consumption of sweet snacks still increased by six percentage points between pre- and post-intervention measures (25% vs. 31%), and consumption of meat snacks increased by three percentage points (6% vs. 9%). In contrast, relative consumption of vegetable snacks declined by five percentage points (8% vs. 3%), fruit snacks declined by six percentage points (31% vs. 25%), and salty snacks decreased by three percentage points (5% vs. 2%). Although based on very small sample sizes, taken together, the results suggest that the intervention was effective in increasing the consumption of vegetable snacks, and also increasing consumption of fruit snacks, while decreasing the consumption of sweet snacks.

6 General Discussion

Obesity rates have increased dramatically worldwide over the last three decades, and this increase has been particularly acute among children and adolescents (Aceves-Martins et al., 2016; Seidell & Halberstadt, 2016). Research suggests that one of the causes of childhood obesity is the consumption of unhealthy foods, particularly unhealthy snacks (Sahoo et al., 2015; Sonntag et al., 2015). Thus, the primary objective of the current research was to develop a social marketing intervention to reduce unhealthy food consumption and increase healthy food consumption in younger children, ages 6-10. Based on qualitative research with children, teachers, parents, and kitchen staff in the early phases of the research, we targeted increasing the consumption of vegetable snacks as the behavior we wanted to change with the intervention. In doing so, we expected any increase in specific snack categories to be offset by decreases in other snack categories (Watson et al., 2022) because food snacking is a particularly stubborn habit in terms of the amount of snacking food consumed (Sato et al., 2016).



The results of the intervention are suggestive of a successful intervention, but with important caveats. First, within the treatment school, the relative share of vegetable snacks was four percentage points higher after the intervention compared to before the intervention, and meat snacks increased three percentage points. This increase in healthy food snacks, particularly vegetable snacks, came at the expense of sweet snacks, salty snacks, and milk snacks, which are generally less healthy. However, the relative share of fruit snacks also decreased two percentage points.

When factoring in the relative consumption of the snack categories in the control school pre- and post-intervention, the differences are even larger. The control school, which did not receive the intervention, serves as a control for changes in snack food consumption that occur for reasons other than the intervention. When comparing the pre- and post-intervention snack consumption for the control and treatment schools, vegetable snack consumption increased six percentage points and fruit snack consumption increased seven percentage points, whereas sweet snack consumption decreased nine percentage points. Based on this pattern of results, the general objective of simultaneously increasing consumption of healthy food snacks and decreasing consumption of less healthy food snacks appears to be successfully achieved.

6.1 Limitations

Although the intervention appears to have increased healthy snacking and decreased unhealthy snacking, certain aspects of the study severely limit the extent to which the findings are likely to be generalizable. The primary limitation is the extremely small final sample size that greatly reduces the statistical power of the study, and consequently, none of the reported findings are statistically significant.

The overarching reason for the very low sample size was the COVID-19 pandemic. Our original goals for the research were to have 300-500 students each for the treatment and control schools and to have full participation across grades 1-4, and this was considered achievable based on our initial inquiries in January 2020, just before the onset of the pandemic, and also based on the experience of the research team in conducting research with children in schools. However, the initial restrictions for social contact forced us to postpone the research until the next year (September, 2021). Moreover, even though schools initially opened back up at the start of the 2021 school year, a new COVID-19 case surge forced many of the classes back online. Finally, even though we were able to resume the implementation of the study later that semester, all of the stakeholders (children, parents, teachers, kitchen staff) were weary of the pandemic ordeal, and cooperation plummeted.

Although the COVID-19 pandemic is an anomaly in terms of frequency of occurrence, the situation nevertheless provides some valuable lessons. In particular, an intervention not only has to be effective in theory, it also requires an enormous amount of cooperation across stakeholders. This cooperation can be difficult to achieve if the stakeholders do not share the belief that the particular behavior change is important and thus do not fully invest in the time and effort needed to implement the intervention. Thus, in many ways, an intervention is only as good as the cooperation and teamwork provided by the stakeholders.



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Social norms paper

1 Introduction

Childhood obesity has emerged as a significant societal problem because of the unprecedented growth in global childhood obesity rates over the last three decades, a growth that many have deemed as epidemic proportions (Boulos et al., 2012; Global Burden of Disease Study, 2015; Kimm & Obarzanek, 2002; Seidell & Halberstadt, 2016; Senthilingam, 2021; The Surgeon General, 2001). Obesity is one of the most prevalent nutritional disorders in U.S. children. For example, according to data from the U.S. Center for Disease Control (CDC), over the last three decades, the number of overweight children (defined as a body-mass index (BMI) above the 95th percentile) ages 6 to 11 has increased 4-fold and the number of overweight children ages 12-19 has increased 3-fold (Kamath et al., 2008) and the increases have been particularly severe for higher-income countries (Ng et al., 2014). Further, the problem of childhood obesity is also particularly acute in Europe, with increases from 10% to 40% in many European countries (Agha & Agha, 2017). The dramatic increase in obesity rates is problematic because of its link with severe health problems such as diabetes, cardiovascular disease, osteoarthritis, chronic kidney disease, cancer, and psychological disorders that occur later in life (Atanasova et al., 2022; Coleman et al., 2022; Daniels, 2009; Kumar & Kelly, 2017; MacMahon et al., 2009; OECD, 2019; Sahoo et al., 2015; Wormser et al., 2011). Childhood obesity is also linked with deaths from noncommunicable diseases, impairs children's educational achievements and general quality of life, and typically persists into adulthood (Agha & Agha, 2017; Sahoo et al., 2015).

Given the severe mental and physical health problems brought on by childhood obesity, it is critical to understand not only the consequences of childhood obesity, but also the causes. The consensus in obesity research is that childhood obesity has multiple determinants (Slyper, 2004). The causes that have received the most research attention are increased caloric intake and decreased physical activity (and thus decreased caloric expenditures; Slyper, 2004). However, although these two factors undoubtedly contribute to increases in obesity (particularly in combination), the more critical question is what are the causal factors that can explain decreases in physical activity and/or increases in caloric intake that are sufficient to lead to the dramatic increases in childhood obesity over the last several decades?

In the following sections, we focus on one particular behavior that has received considerable attention in recent research: frequency of television viewing. As we discuss in more detail presently, television viewing potentially addresses the two causes just noted: decreases in physical activity and increases in caloric intake. Moreover, television viewing and general "screen time" (which includes not only television, but also computers, tablets, smartphones, video games, etc.; Jensen et al., 2022) have increased among children and adolescents over the last several years, and thus serves as at least one explanation for increases in BMI and obesity rates.

2 Television Viewing and Childhood Obesity

One potential cause for the recent increases in childhood obesity rates that has received considerable attention is frequency of television viewing. Numerous studies using diverse methodologies (cross-sectional, longitudinal, experimental) have documented a positive relation



between frequency of television viewing and childhood obesity rates (Jensen et al., 2022; Robinson et al., 2017; Zimmerman and Bell, 2010). For example, a longitudinal cohort study using a representative sample of 10- to 15-year-old US children observed a sizeable dose-response relation between the number of television viewing hours per day and the prevalence of obesity (Gortmaker et al., 1996; Robinson et al., 2017). Similar results were obtained in a longitudinal study of New Zealanders that employed a longer-term cohort, showing that a significant portion of overweight and obesity prevalence at age 26 was attributed to heavy television viewing during childhood and adolescence (Hancox et al., 2004; Robinson et al., 2017).

The possible effect of television viewing on obesity prevalence is generally explained through three non-mutually exclusive mechanisms: 1) decreased physical activity; 2) increased caloric intake while viewing; and 3) exposure to food marketing and advertising during viewing (Jensen et al., 2022; Jordan & Robinson, 2008; Robinson, 2001; Robinson et al., 2017; Zimmerman & Bell, 2010). Television viewing is thought to decrease physical activity by displacing more active leisure activities. The decrease in physical activity in turn results in less energy expenditure and fewer calories burned. Although the hypothesis has intuitive appeal, epidemiologic research findings have been inconsistent (Robinson et al., 2017). Similarly, reviews of experimental interventions for reducing screen time find at best a very small effect on increased physical activity (Ramsey Buchanan et al., 2016). In addition, longitudinal studies have typically found no evidence that reduced physical activity predicts extensive weight gain in children, but have found evidence for the reverse: excessive weight gain predicts later physical inactivity (Salbe et al., 2002; Slyper, 2004).

The second possible pathway by which television viewing contributes to obesity is increased calorie intake while viewing. The reasoning is that the television viewing environment is conducive to food consumption, whether it involves eating a primary meal in front of the screen or consuming snacks while watching television between meals. Indeed, it is common to eat while watching television (Boulos et al., 2012), and a sizeable portion of daily calories are consumed while watching television, particularly for Americans (Matheson, Killen, et al., 2004; Robinson et al., 2017) and minorities (Matheson, Wang, et al., 2004). The hypothesis is that watching television serves as a distraction that can cause viewers to pay less attention to the foods they consume and thus potentially underestimate the total amount of food consumed (Boulos et al., 2012; Moray et al., 2007). There is some evidence for the hypothesis that eating while viewing increases caloric intake. For example, in one experiment, children consumed more food (Temple et al., 2007) and more calorie-dense food (Blass et al., 2006) when watching a new television show than when they were not watching television. Epidemiologic studies have found that television viewing is associated with lower consumption of fruits and vegetables and higher consumption of fast food and energy-dense food and beverages (Ford et al., 2012; Pearson & Biddle, 2011). However, other studies have found no differences in total food consumption as a function of television viewing frequency (Jensen et al., 2022).

The third possible pathway by which television viewing may cause increases in obesity is through exposure to food marketing during viewing. Food marketing includes advertising and product placements within programs. The reasoning is that the advertisements to which children are exposed during viewing act as persuasive communications that increase the desire for the advertised foods and their subsequent purchase. Given that a vast majority of food advertising targeted to children via television programming and other screen times is for snacks and relatively unhealthy foods, greater viewing leads to greater consumption of the less nutritious, advertised foods.



However, although food marketing and advertisements may indeed act as successful persuasive communications that increase desire, purchase, and consumption, as we discuss in much more detail in the next sections, there are other mechanisms by which food advertising can influence food consumption. In particular, we discuss how advertising can also serve a socialization function, just like television viewing (Russell & Shrum, 2021; Shrum, 2009a, 2009b). More specifically, like television, advertisements present narratives that contribute to the development of social norms: what people should and should not do and what is considered normative behavior. In the next sections, we first review the theoretical basis for television programming's socialization function. We then detail how food advertising within the programs also serves the same function and link the narratives that food advertisers establish to the consumption of foods and beverages that can lead to unhealthy diets and potential obesity.

3 Television as a Socialization Agent: How Television Narratives Shape Normative Perceptions and Values

Television viewing serves a variety of functions: it is a source of entertainment (sitcoms, dramas, etc.), a source of information (news, documentaries), and a source of distraction, among others. These functions are what viewers specifically seek from television. However, in addition to these direct functions, research at the intersection of communications and sociology has identified another important function of television: It serves as a sociological agent through which viewers learn what is normative (or at least what they think is normative). Thus, television content is considered to be more than simple entertainment or an information provider: Television tells stories, and these stories have symbolic meaning that reflects shared cultural values (Busselle & Van den Bulck, 2020; Gerbner, Gross, Morgan, Signorielli, & Shanahan, 2002). In turn, television viewers—particularly heavier viewers—come to “cultivate” the worldview that television programs portray.

Television may have particularly strong effects on children and adolescents. Television (and screen time in general) is the primary entertainment source for children, particularly in the U.S., with average daily viewing over three hours per day (Nielsen, 2020), and the level of viewing has remained relatively invariant over the last 10 years (Nielsen, 2020; Watson, 2020b). In addition to standard television viewing on traditional television sets, children and adolescents can view television programming on many platforms (e.g., tablets, laptops, smartphones, etc.; PEW, 2010; Russell et al., 2014). Television programming is considered one of the most influential media sources through which children and adolescents gain important knowledge and learn about social behaviors (Collins et al., 2003; Gerbner, 1995; Russell et al., 2014). Younger individuals may be particularly susceptible to the stories that television tells because the stories often show how adults they want to emulate act (Boehnke et al., 202; Russell et al., 2004), and some have referred to television as children's “super peer” because it serves as a source of normative information about new topics and roles they are just starting to explore (Brown et al., 2005; Russell et al., 2014; Strasburger & Wilson, 2002). In addition, as we detail presently, along with the television program narratives, children and adolescents may be similarly influenced by both overt commercial messages (e.g., advertisements and other commercial messages) and covert ones (product placements, sponsorships; Russell et al., 2014; Shrum, 2013).

In the next section, we briefly review research on cultivation theory, which is the dominant theory of media socialization.



3.1 Cultivation Theory

Cultivation theory is a sociological theory developed by George Gerbner and colleagues (see Gerbner, 1969; Gerbner & Gross, 1976; Gerbner, Gross, Morgan, & Signorielli, 1980; for a review, see Shrum, 2009b). The general premise is that television is the dominant socializing force in American society and thus has a profound influence on the viewers' perceptions of social reality. The theory is premised on two related propositions: 1) that television programs present a consistent but dramatically distorted view of the real world, and 2) that frequent viewing of these consistent and very formulaic representations results in the internalization of these distortions into viewers' worldviews. Put differently, cultivation theory posits that television dominates the symbolic environment of its viewers to such a degree that the distorted images and messages in television programs are "cultivated" by viewers and come to replace worldviews that are developed through daily experience, and this effect occurs in proportion to the frequency of viewing.

The first premise—that television presents systematic distortions of reality—has received substantial support. Numerous content analyses have shown that the world of television is clearly different from the real world. The world of television is remarkably violent, with estimates of five overt acts of crime or violence per hour in an average program, 75% of programs airing in prime time showing some sort of violence, and the rate of crime and violence in programs occurring 10 times more often than real-world violence (Gerbner, Gross, Morgan, & Signorielli, 1986; Lichter, Lichter & Rothman, 1994). Relative to the real world, the television world is also more affluent and materialistic (O'Guinn & Shrum, 1997), doctors, lawyers, and police officers make up a much larger proportion of the workforce (DeFleur, 1964; Smythe, 1954), and television characters tend to be more dishonest and maritally unfaithful (Lichter et al., 1994), relative to the real world. Moreover, these findings have remained relatively stable over time (Signorielli, 1990).

The second premise—that frequent viewing of these distortions biases viewers' beliefs toward these distortions—has also received substantial support. The premise is generally tested by measuring the amount of television people watch and correlating this measure with various measures of attitudes, beliefs, and perceptions. The measures that are chosen correspond directly to the constructs that are prevalent and overrepresented in the television world (e.g., as in the examples just noted, constructs such as crime and violence, affluence, marital discord, occupational prevalence). In support of the premise, studies have shown that the more people watch television, the higher their estimates of real-world violence (Gerbner et al., 1980; Hawkins, Pingree, & Adler, 1987; Shrum, Wyer, & O'Guinn, 1998), personal crime risk (Shrum & Bischak, 2001), perceived danger (Gerbner et al., 1980), and anxiety and fearfulness (Bryant, Carveth, & Brown, 1981). Studies have also shown that frequency of viewing is positively correlated with interpersonal mistrust (Gerbner et al., 1980), greater pessimism about marriage (Shrum, 1999), estimates of the prevalence of doctors, lawyers, and police officers in the workforce (Shrum, 1996, 2001), greater faith in doctors (Volgy & Schwarz, 1980), estimates of societal affluence and ownership of expensive products (Potter, 1991; O'Guinn & Shrum, 1997), and materialism (Shrum, Burroughs, & Rindfleisch, 2005).



3.1.1 Underlying Mechanisms

The most widely accepted psychological mechanism that explains cultivation effects is captured by the accessibility model of cultivation effects (Shrum, 2009a; Shrum & Lee, 2013). The model posits two general propositions. The first is that television viewing serves as a “real-world” prime (Harris et al., 2009) by making the things seen on television (e.g., violence, crime, wealth, marital discord) more accessible in memory. Accessibility refers to the ease of recalling information from memory; the more accessible information is in memory, the easier it is to recall (Wyer & Srull, 1989). The second proposition is that judgments influenced by television are constructed through heuristic processing. When people process heuristically, they do not carefully consider all information in memory before constructing their judgments; instead, they take a cognitive shortcut and consider only a small subset of available information. More specifically, the model assumes that people apply the availability heuristic (Tversky & Kahneman, 1973), and base their judgments on the ease with which relevant information can be recalled, or the simulation heuristic (Kahneman & Tversky, 1982), and base their judgments on the ease with which to imagine a particular thing or event.

3.2 Consumer Cultivation

Both television programs and advertising can also influence beliefs about consumption, referred to as consumer cultivation (Russell & Shrum, 2021; Shrum, 2004; Valkenburg & Piotrowski, 2017). The consumer stories that television tells present systematic distortions of consumption and its importance, and are ones that shine a positive light on consumerism and materialism. Both the ads and the programs portray messages that align closely with Richins and Dawson’s (1992) conceptualization of materialism: Possessions are good, more possessions bring greater happiness, and the quality and quantity of possessions are indicators of success (Buijzen & Valkenburg, 2003). Message system analyses show that the world of television is more affluent than the real world (Hirschman 1988; Lichter et al., 1994; Shrum, 1999), and television representations of consumption are often used as “visual shorthand” to indicate values and social status (O’Guinn & Shrum, 1997, p. 279). Research also confirms the cultivating effect of viewing these distorted messages. Studies have demonstrated a positive relation between overall television viewing frequency and measures of materialism (Shrum et al., 2005; Sirgy et al., 1998; Yang & Oliver, 2010), as well as positive relations between materialism and viewing frequency of particular genres, such as celebrity reality programs and other shows that depict high-income characters and their pursuit of material aspirations (Leyva, 2018). Quasi-experimental (Hyll & Schneider, 2013) and experimental research (Leyva, 2018; Shrum et al., 2011) have produced similar findings.

Similar cultivation effects have been observed in children and adolescents. For example, numerous studies have documented positive relations between children’s television ad viewing and their level of materialism (for a review, see Valkenburg & Piotrowski, 2017). For example, cross-sectional studies have found consistent positive correlations between children’s television advertising viewing and materialism across age groups (Buijzen & Valkenburg, 2003), and the same relations have been noted in longitudinal research (Opree et al., 2014).

The same positive relation between television program viewing and cultivation has been documented for adolescents (Russell & Shrum, 2021). In addition, research has documented television viewing effects for specific products. One example is alcohol consumption. Television programs often portray food and beverage consumption situations. For example, television programs frequently show alcohol consumption and portray youth drinking in a positive light, a



desirable, fun activity that is done frequently and is normative (Russell & Russell, 2009; Russell et al., 2009; Russell et al., 2014). Content analyses of television programming found that all programs contained portrayals of alcohol consumption, including those popular with children (Russell & Russell, 2009) and the frequency of alcohol consumption portrayals is twice the rate of the second most frequently portrayed beverage (Mathios et al., 1998; Russell et al., 2014). Studies show that these portrayals affect children's beliefs and attitudes. For example, frequency of television viewing is related to beliefs about alcohol and its effects (Collins et al., 2007; Collins et al., 2003; Grube & Wallack, 1994). In particular, one study of American teenagers (N = 445) found that television viewing was associated with less negative beliefs about the consequences of alcohol consumption and positively associated with intentions to drink (Russell & Buhrau, 2015).

3.3 Advertising, Social Norms, and Unhealthy Eating Behaviors

As we discussed earlier, advertising does more than simply act as a direct persuasive message; it also provides a socializing function by which viewers absorb a narrative message that implies what is normative (Boulos et al., 2012; Qutteina et al., 2019). For example, a typical narrative for a food advertisement will convey information about when a food is typically consumed, who consumes it, how often it is consumed, how much is consumed, and so forth. Consider the iconic orange juice ad and slogan for the Florida Orange Juice Growers Association in the 1980s: "Orange Juice: It's Not Just for Breakfast Anymore." In this campaign, the Association is trying to change perceptions of a normative behavior: drinking orange juice for breakfast (only). Food advertisements more generally operate through the same mechanism by reinforcing beliefs about which food behaviors are appropriate and normative. Further, based on the accessibility model underlying cultivation effects, the beliefs become increasingly accessible the more one views, which strengthens the attitudes and beliefs (Fazio et al., 1982; Shrum, 1999).

3.3.1 The Television World of Food Advertising

What does the television world of food consumption look like to children? As numerous studies have shown over several decades, the food consumption world of television advertising targeted to children is heavily skewed toward unhealthy eating (Zimmerman and Bell, 2010). First, in terms of frequency, food is the most advertised product in television programming for children in the U.S. (Gamble & Cotugna, 1999; Gantz et al., 2007; Harrison & Marske, 2005). Some studies estimate that children under five years old see more than 4,000 food ads per year (Gantz et al., 2007) and during Saturday morning cartoons, they see a food ad about every five minutes (Cotugna, 1988). The frequency of food consumption portrayals, in both advertising and the programs between the ads, reinforces the normative belief about food. The frequency of portrayals, coupled with frequency of viewing, increases the accessibility of the food-related normative beliefs, which in turn increases the probability that these beliefs will influence judgments and behaviors.

Second, the majority of foods that are advertised are of poor nutritional quality (Batada et al. 2008; Boyland et al., 2011; Institute of Medicine (IOM), 2006; Gantz et al., 2007; Powell et al., 2013). For example, in one study that content analyzed 426 food advertisements in the U.S. and then coded the nutritional value of each product based on the "Nutrition Facts" label, the majority of the foods advertised were for snacks, and for the ads for child audiences, 78% of the advertised foods were for convenience/fast foods and sweets (Harrison & Marske, 2005). Given this vast majority of advertising for snacks, perhaps unsurprisingly, the nutritional content of the advertised foods exceeded the recommended daily requirements for fat and sodium. Similar results were obtained in a content



analysis of 269 advertisements on children's programs in New Zealand, finding that 63% of the ads were for high-fat or high-sugar foods (Wilson et al., 1999).

From a normative effect perspective, the context in which the food is consumed is important, as they serve as consumption cues apart from the advertising message. For example, the behavior of others (e.g., the models in the ads) can influence viewers because people automatically mimic others' behaviors, including eating behaviors such as amount of food and type of food, and they do so without being consciously aware of it (Harris et al., 2009; Johnston, 2002; Tanner et al., 2008). Content analyses show that unhealthy snack food is typically shown being consumed at non-mealtimes, and by attractive models of normal weight, reinforcing an association between eating unhealthy snacks and positive emotions (Folta et al., 2006; Harris et al., 2009; Harrison & Marske, 2005).

3.3.2 Effects of Advertising on BMI and Unhealthy Eating

Numerous studies have documented positive associations between frequency of television and advertising viewing and various measures related to childhood obesity. For example, in a study that combined data from the U.S., Australia, and eight European countries, the number of advertisements viewed per hour was positively associated with the proportion of overweight children (Lobstein & Dobb, 2005). In a longitudinal study, advertising viewing by 1997 for children younger than seven years old was positively correlated with BMI in 2002.

More definitive evidence of a causal effect of ad viewing on unhealthy eating is provided by numerous randomized controlled trials (RCTs) that manipulate ad viewing content. For example, in several experiments reported by Halford and colleagues, advertising viewing was manipulated by having children view 10-minute cartoons in which 8-10 advertisements were embedded, with the treatment condition viewing ads for unhealthy food (e.g., candy, chocolate, popcorn, etc.) and the control condition viewing non-food ads. Across all studies, viewing the ads for unhealthy food increased total food consumption, particularly so for unhealthy foods (Halford et al., 2004, 2007, 2008). Moreover, the effects appear to occur with only a short exposure time. In one study, children who were exposed (vs. not exposed) to a single 30-second advertisement for a food product chose more of the advertised food (Borzekowski & Robinson, 2001). Boyland et al. (2016) concluded, based on a meta-analysis, that acute (experimental) exposure to food advertising increases food consumption in children.

3.3.3 Evidence for a Normative Effect of Advertising on Food Consumption

The results of the studies just discussed generally show that exposure to advertised foods increases consumption of those foods. However, this may occur simply via a direct persuasion route rather than represent an effect of normative beliefs. Evidence of a normative effect would be indicated if exposure to food advertising increased consumption of non-advertised foods. In fact, the studies by Halford et al. (2004, 2007, 2008) show that indeed exposure to food advertising increases children's consumption of all foods, not merely the ones advertised.

Research by Harris et al. (2009) provides even more compelling evidence of a generalized, normative effect of food advertising on food consumption. In one experiment, children watched a cartoon in which food advertising or non-food advertising was embedded, and were given a snack while watching (the snack was not what was advertised). In the second experiment, adults watched a television program in which either an ad promoting snacking and fun product benefits was



embedded, an ad promoting nutritional benefits was embedded, or no food advertising was embedded, and then evaluated a range of healthy and unhealthy snack foods in an ostensibly separate study. The results showed that the children exposed to the food advertising consumed 45% more of the snack food than those not exposed to food advertising. In the experiment with adults, participants exposed to the snack food advertising consumed more of both the unhealthy and the healthy snacks compared to the other two conditions, exposure to food advertising increased consumption of unadvertised products, and these effects were not related to self-reported hunger.

4 Conclusion

Childhood obesity is a worldwide problem that has been steadily increasing over the last several decades, leading to severe health problems such as diabetes, cardiovascular disease, osteoarthritis, chronic kidney disease, cancer, and psychological disorders later in life. Understanding the causes of childhood obesity is essential for developing interventions to reduce childhood obesity. In this research, we have reviewed research on one factor that has been consistently linked to childhood obesity, television viewing. We have in particular focused on the potential role of food advertising, given that the vast majority of food advertising targeted to children is for unhealthy snacks. We have proposed that along with the presumed direct persuasive effects of food advertising on children's consumption of unhealthy foods, advertising also exerts an indirect effect via its function as a socialization agent. Like television program narratives, advertising also provides a narrative through the contexts in which the ads are constructed. These effects contribute to the development of social norms about how unhealthy foods such as snacks and fast food are consumed: who consumes them, how often, what types, how much, and so forth. Understanding the norm-shaping power of children's food advertisements is also essential for developing interventions to reduce children's unhealthy food consumption.

5 References

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