


Techniques for Advertising Healthy Food in School Settings to Increase Fruit and Vegetable Consumption

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Abstract

Background: Childhood obesity rates in Western developed countries are rapidly increasing. While research shows that eating more fruits and vegetables (FV) is a preventive measure, children do not eat adequate amounts of FV. Marketing of high salt, fat, and sugar foods influences children's eating behaviors, decreases FV consumption, and is prevalent in children's surroundings. Garnering the power of ads on children, a potential solution for increasing FV consumption is FV marketing/advertising. Schools can serve as a viable option for testing this advertising because a significant amount of children's time is spent in school settings. However, research surrounding the use of FV advertising in schools is lacking in a consensus on the most effective methodologies.

Objective: This paper reviewed existing research on FV advertising in schools and proposed directions for future research surrounding methodology and experimental design.

Study Design, Setting, Participants: PubMed and PsycINFO databases were searched with variations of the terms “vegetable,” “marketing,” “advertisements,” “consumption,” and “schools” (eg, “vegetable consumption AND advertisements AND schools”). Study inclusion criteria were: conducted in school settings, used FV marketing as primary intervention, and measured change in FV consumption or preference.

Measurable Outcome/Analysis: This review qualitatively compared the studies' participant demographics, methodologies, and measures of success, and evaluated the studies' strengths and weaknesses.

Results: Of the 38 articles reviewed, 8 met the inclusion criteria. Five studies examined elementary school populations; 4 were conducted in cafeterias. Major forms of advertising/interventions were print media, video media, and classroom education interventions, of which print media was the most widely used. Three articles utilized change in consumption of FV as a measure of success, while others measured change in preference. All studies reported increased consumption/preference in at least 1 intervention during or immediately after the intervention. However, only 4 studies conducted follow-up testing.

Conclusion: FV advertisements in schools appear to be effective in increasing FV consumption among children. To develop implementable advertising, future studies should maintain cohesive methodologies by controlling for novelty effects, conducting follow-up testing, and measuring actual FV consumption rather than preference.

Keywords

school nutrition, advertisements, fruits, vegetables, children

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What do we already know about this topic?

As advertising fruits and vegetables in schools has been shown to be effective in increasing fruit and vegetable preference among children, schools are uniquely positioned to utilize advertising to change attitudes about these foods and contribute to healthier food environments.

How does your research contribute to the field?

We confirm that healthy food advertising is effective in changing children's food habits, and further identify 3 shortcomings in the current literature that prevent these advertising strategies from being used ubiquitously and effectively in schools.

What are your research's implications towards theory, practice, or policy?

Using the shortcomings in current research that we identified to create a more standardized methodology for increasing effective fruit and vegetable advertising in schools could be a practical and inexpensive way of improving children's eating habits.

Introduction

Over the past 2 decades, childhood obesity rates around the world have been rapidly increasing, with the US having 1 of the highest rates among the developed countries.¹ Research on treating obesity through diets, weight loss programs and pharmaceutical drugs has also informed various preventative measures, specifically diet and exercise. Studies have consistently shown the benefits of fruit and vegetable (FV) consumption as a preventative measure for obesity.² Not only do FVs contain vital micronutrients, but their high fiber and water content promote satiety, preventing excess calorie consumption.² Most FV are nutrient dense foods, since they contain many nutrients and a high water content. Nutrient dense foods have a high nutrient (fiber, vitamins, and minerals) to calorie or weight ratio, as opposed to energy dense foods which have a high calorie to nutrient ratio.³ Unfortunately, children in the US consume inadequate quantities of FV. While 40% of children meet their recommended servings for fruit, only 7% meet the recommendation for vegetables.⁴ This low intake is alarming because research shows that childhood habits, such as FV consumption, continue into adulthood.⁵ Given the role of FVs in obesity prevention and treatment, the importance of increasing FV consumption in children specifically is evident.

A potential solution to inadequate FV consumption is the development of marketing strategies and materials to promote FV consumption. Television, web, and print marketing that children experience affects their behavior and decision-making. In fact, studies have confirmed that viewing unhealthy food commercials increases the likelihood that the specific food or a similar food will be consumed.⁶ Further studies have shown that children who are exposed to unhealthy food commercials eat fewer FVs than those that are not.⁶ Given the apparent effectiveness of marketing in increasing high salt, fat, sugar (HSFS) food consumption, marketing that promotes FVs could potentially be a part of the solution to increase FV consumption.

Current research that measures the effects of FV marketing involves a wide range of strategies, settings, audiences, and outcome measures. However, its viability has not been

decisively measured because of the many differences between the research methodologies. Furthermore, other studies employ methodologies that could result in spillover effects, such as using social media campaigns, aired TV commercials, or billboards. This review aims to determine if FV marketing strategies have the potential to influence children's FV consumption in school settings. It also outlines methodological flaws in current school-based FV marketing literature that are barriers to testing the effectiveness of FV marketing on students.

Background

Advertising has been shown to influence behavior and product preference in children.⁷ Children express their consumer behavior through requests made to their parents, which research has shown to be influential in product preferences of parents. Thus, the presence of marketing and advertisements dictates much of how Western countries view products, especially food products. An average American child is exposed to around 40 000 commercials for food/beverages per year, 70% of which are for fast food, cereal, or candy, all HSFS foods.⁸ The overwhelming amount of HSFS exposure is alarming because of the proven persuasive effects that ads have on the dietary decisions of children.⁹ For example, increasing exposure to advertising in children was associated with a significantly greater intake in the number of calories consumed and an increased likelihood that the food consumed will mirror the type of food marketed.⁶ In other words, children exposed to marketing have been shown to select advertised food and beverages, which are often energy-dense and nutrient poor.¹⁰ Furthermore, minority and economically disadvantaged populations are at a greater risk for being affected by these HSFS commercials because of targeted advertising.^{11,12}

Marketing HSFS foods is not limited to television and computer screens, it is also prevalent in schools, depending on school contracts with food and beverage retailers.¹³ The presence of this marketing in schools can form an association between the food brand and the school in a child's mind, normalizing the consumption of that brand. Interactions and

relationships a child forms in school are extremely important, as children spend the majority of their weekday waking hours in school. According to Bronfenbrenner's Ecological Model,¹⁴ schools are on the same level of influence as parents or immediate family. As a result, HSFS marketing in schools is particularly harmful because its presence alludes to the school's support for a certain brand or type of food.¹³ Introducing FV marketing in schools could help shift perceptions and eating habits of FV in school-age children.

The persuasive effects of food marketing coupled with its prevalence among the most vulnerable populations (ie children, disadvantaged and minority populations) makes marketing a powerful tool that could be utilized in swaying consumers' choices surrounding food. Increasing the marketing of healthy food options, especially FVs that otherwise have little representation in advertising, could be an innovative method of increasing FV consumption. While the causes of insufficient FV consumption span well beyond advertising, increasing the visibility of FV marketing to children could help increase consumption. This study reviews the literature surrounding advertising FV in schools and whether it has an effect on FV consumption, focusing especially on intervention studies.

Methods

The format of data collection, presentation, and analysis follows a narrative review format as outlined in Green et al.¹⁵ This paper underlines the importance of narrative reviews, specifically a narrative overview, or unsystematic narrative review, as an avenue to summarize research with broad perspectives, such as the multidisciplinary research involved in examining FV consumption or preference in response to advertisements and marketing. This research spans the fields of psychology, nutrition, and communications, and as such contains critiques from many angles. The methodology adopted in this paper follows that suggested by Green et al¹⁵: each article to be reviewed should be summarized briefly, and each article also can be critiqued and analyzed individually, as well as against one another. For this review, each article was summarized, then critiqued and compared with other articles.

Databases searched were PubMed and PsychINFO. The search was conducted for articles published between January 2000 and November 2019. The following terms and databases, and total number of articles that appeared for each search are shown in [Table 1](#).

Title review. Key words were found in the title, such as "school", "intervention", "adolescents", or "children" to determine if the study outlined an intervention that utilized advertising/marketing and measured or explored the effect on FV consumption/preference. If the title had the words "campaign", "social media", "adults", or "physical activity", the article was not considered. Social media and web marketing campaigns, or any other form of advertising that could

not be contained in the school setting, were excluded from this review since exposure and access to these could have been affected by factors outside the scope of this study. Interventions where adults were in the sample were only included if the adults were sampled because of their relationship with the school-aged children, ie if they were parents or teachers. Any type of intervention that included a physical activity component was also excluded because promotion of physical activity could confound the results of FV preference or consumption.

Abstract review. 38 abstracts were read to determine if the intervention indeed measured FV consumption or preference in schools with children, utilizing some form of marketing or visuals. Some abstracts revealed that they had a social media or physical activity component that led to differences in consumption or preference. 14 unique abstracts passed the review.

Full paper review. From the 14 studies that passed the abstract review, some had a social media or campaign component, which excluded them from the review. Others did not directly use FV advertising to measure consumption or preference, but rather used more indirect routes of "marketing" such as picture books or video games. Eight studies passed the full paper review.

As a result of the search, 38 abstracts were reviewed, and from those, 14 were selected for full paper review. Of the full paper review articles, 8 fit the inclusion and exclusion criteria (see [Table 1](#)). All 8 studies were reviewed for quality and all were found to be acceptable for this review.

Results

Summary of Studies' Methods and Results

Complete details of each study are found in [Table 2](#).

Participants and settings. The population of 5 of the 8 articles was 5-11 year old students¹⁶⁻²⁰; the other 3 articles sampled 13-15-year-old eighth graders (n=2), or preschoolers²¹⁻²³ (ie, 3-6-year-olds). Most articles (n=5) included a sample of mostly racial/ethnic minorities, for example, African American, Hispanic/Latino, and other ethnic minorities.¹⁹⁻²³ In 4 articles, more than 50% of the students qualified for free/reduced lunch or were of a low socioeconomic status.^{18-20,23} Main study settings were either the cafeteria or classroom.

Marketing techniques. The 3 major types of media that all 8 articles used were print (posters and banners), video (TV segments and commercials), and classroom education (lectures about manipulative techniques of food advertisements and health benefits of FV). Three studies tested the impact of only 1 type of media. Of the others (n=5) that utilized a mixed media approach, 3 studies utilized classroom education as

Table 1. Results of database search: This table lists the databases used, search terms used in each database, articles found per search term, the 3 step filtering process, and the inclusion and exclusion criteria.

Database	Search Term	Total	Passed Title Review	Passed Abstract Review	Passed Full Paper Review
PsychInfo	Vegetables AND marketing	194	11	5	3
	Vegetables AND advertising	78	7	6	3
	Food marketing in schools AND adolescents	138	5	2	2
	Increasing vegetable consumption AND intervention	269	4	3	1
PubMed	Vegetable consumption and marketing in schools	38	6	2	2
	Vegetable commercials and consumption	7	1	1	1
	Food marketing AND intervention AND adolescents	518	4	1	1
Totals		38	14**	8**	
***Total number does not double count articles found in multiple searches					
Inclusion Criteria					
<ul style="list-style-type: none"> • Intervention studies • Use print media, motion media, or other forms of advertising/marketing FV • Conducted in school settings with children in preschool through 8th grade as the primary subjects • Measured consumption of, preferences for and attitudes toward FV as a result of the advertising intervention 					
Exclusion criteria					
<ul style="list-style-type: none"> • Experimental design that uses social media or public campaigns • Experiments where there are other interventions such as physical activity • Interventions that were focused on adults instead of school-aged children 					

Table 2. Summary of results of 8 articles that met inclusion criteria.

Study	Population (Age/Grade)	Population Demographics	Study Location	Setting of Intervention	Intervention Design	Advertising Medium	Measure of Success	Results of Outcomes of Interest
Bezbaruah (2013)	4th grade	85% white 29% reduced lunch n= 329	City in the midwest, USA	Cafeteria	<ul style="list-style-type: none"> ▲ Time 1 (control): measured amount of green beans consumed by students ▲ Time 2 (intervention): Spoke character poster advertising green beans was placed in cafeterias. Amount of green beans consumed was measured ▲ Duration: 1 day 	Print	<ul style="list-style-type: none"> ▲ # of girls and boys that chose green beans ▲ Increase in # of students that consumed green beans (29% vs 39% of students) ▲ Increase in total oz. Of consumption (125 oz vs 145 oz) 	
Bryan (2016)	8th grade 13-15 years old	n= 536	Rural/Suburban area Texas, USA	Classroom	<ul style="list-style-type: none"> ▲ IG: Marketing education sessions held for students to learn about deceptive, manipulative, marketing and how it impedes on free choice of youth ▲ CG: Nutrition and behavior education sessions given for students to learn about healthy/unhealthy foods and how they affect the body ▲ Duration: 1 year ▲ Two separate cohorts for a total of 2 years 	Print + classroom education	<ul style="list-style-type: none"> ▲ oz. Of green beans consumed (total and on average) ▲ 1 day post intervention choices of snack foods ▲ Autonomy and social justice questionnaires <p>Mean Control= 2.30,SD=.79</p> <p>Mean Exposé= 2.13,SD=.85, P=.02</p>	
Bryan (2019)	8th grade 13-15 years old	51% Latino 46% White 40% reduced lunch n= 362	Rural/Suburban area Texas, USA	Classroom	<ul style="list-style-type: none"> ▲ IG: Marketing education sessions held for students to learn about deceptive, manipulative, marketing and how it impedes on free choice of youth ▲ CG: Nutrition and behavior education sessions given for students to learn about healthy/unhealthy foods and how they affect the body ▲ Duration: 1 year ▲ Two separate cohorts for a total of 2 years 	Print + classroom education	<ul style="list-style-type: none"> ▲ Social status appeal of healthy eating questionnaire ▲ 1 week post intervention choices of snack foods ▲ Cafeteria purchase data for food coded as healthy/unhealthy ▲ Autonomy and social justice questionnaires ▲ Social status appeal of healthy eating questionnaire <p>Decrease in unhealthy food choices in cafeteria purchases b (time x condition) = -.012; s.e. = .005; $t = 2.21$; $P = .027$; OR = .92; 95% CI: .85 to .99)</p>	
Grassi (2016)	5th grade 10 years old	n= 60	Treviso, Italy	Classroom	<ul style="list-style-type: none"> ▲ Two separate cohorts for a total of 2 years ▲ IG: 12 2-hour sessions of health promotion activities, media education, and creation of health communication campaign ▲ CG: no intervention ▲ Duration: 10 weeks 	Print + video + classroom education	<ul style="list-style-type: none"> ▲ Self-administered surveys measuring FV consumption, motivation, self-efficacy, perceived parental support relating to FV consumption ▲ Focus group questions on students' health and media beliefs and knowledge, critical thinking, obstacles in regards to FV consumption <p>t-tests demonstrated</p> <p>▲ Increase in students' FV consumption at post intervention ($P < .0001$ for fresh fruit, salad, raw vegetables, cooked vegetables, 100% fruit juice) and at follow-up ($P = .001$ for fresh fruit, 100% fruit juice, and $P = .002$ for raw vegetables)</p>	

(continued)

Table 2. (continued)

Study	Population (Age/Grade)	Population Demographics	Study Location	Setting of Intervention	Intervention Design	Advertising Medium	Measure of Success	Results of Outcomes of Interest
Gustafson (2017)	Elementary school-aged; 5-11 years old	77% White 54% low SES n= 1614	Kearney, Nebraska, USA	Cafeteria	<ul style="list-style-type: none"> ▲ IG Participation-only: created healthy food posters ▲ IG Marketing-only: had healthy food posters hung up in their schools ▲ IG participation and marketing: Created healthy food posters and had them hung up in their schools ▲ CG: no intervention 	Print	<ul style="list-style-type: none"> ▲ Students' vegetable consumption calculated via food photography at 2 points 1) After food selection 2) Before throwing away plate 	<ul style="list-style-type: none"> ▲ Multivariate linear regression demonstrated increased vegetable consumption in participation and marketing group during promotion period (3/4 of a serving, P<.001) ▲ Increased FV consumption in participation and marketing group during follow up (1/3 of a serving, P=.04) ▲ Increased FV consumption in marketing-only group during follow-up (P<.01) ▲ Random effects regression model demonstrated ▲ Highest increase in FV consumption in print and video group; 239.2% increase (P<.001)
Hanks (2016)	Elementary school-aged; 5-11 years old	83.5% Hispanic 82% low SES n= 22 206	Urban northeastern USA	Cafeteria	<ul style="list-style-type: none"> ▲ IG print media: Poster hung on top of salad bar ▲ IG video media: TV with marketing video clip on top of salad bar ▲ IG print and video: Poster and TV present on top of salad bar ▲ CG: no intervention 	Print + video	<ul style="list-style-type: none"> ▲ # of students that walked to the salad bar ▲ # of students that chose an a la carte FV option 	<ul style="list-style-type: none"> ▲ Second highest increase in FV consumption in print-only group; 90.5% increase (P=.04) ▲ No significant increase in FV consumption in video-only group ▲ Four-way mixed ANOVA and post hoc t-tests demonstrated ▲ Increase in lunchtime FV consumption in IG at post-intervention test and follow up (P<.001)
Home (2004)	5-11 years old	82.5% ethnic minorities 56.5% reduced lunch n= 749	Inner-city London, UK	Cafeteria + classroom	<ul style="list-style-type: none"> ▲ IG: Food Dudes videos shown and letters from upperclassmen role models read in class; rewards given for FV consumption after lunch and snack time 	Video	<ul style="list-style-type: none"> ▲ Visual calculation of FV consumption at lunch (0, 25, 50, 75, or 100%) ▲ Weight of FV eaten by 5-7 year old students ▲ Parental reporting of FV consumption at home (via phone) 	
Nicklas (2011)	Preschool 3-6 years old	All african american and Hispanic most qualified for reduced lunch n= 183	Houston, Texas, USA	Classroom	<ul style="list-style-type: none"> ▲ IG: Judy fruity and Reggie veggie video commercials (created through focus groups of parents) shown to toddlers ▲ Duration: 4 exposures of 2 30-second commercials during normal TV program 	Video	<ul style="list-style-type: none"> ▲ Pre- and post-intervention FV preference questionnaires with "yummy/yucky" face options 	<ul style="list-style-type: none"> ▲ Proc GLM procedure demonstrated ▲ Higher vegetable preference in IG in target vegetables post-intervention (P=.02) <p>Control FV preference score: 1.01 (.73) Intervention FV preference score: 1.26 (.67)</p>

their major intervention in combination with print media (student created posters).^{17,21,22} One of the classroom education studies also utilized student-created video media as part of their intervention.¹⁷ The 2 remaining mixed media studies employed both print and video media.^{19,20}

Most studies (n=5) had a control group that did not have an intervention. However, Bryan et al (2016) and Bryan et al (2019) employed the use of a control group that received nutrition education in lieu of the advertisement education received by the intervention group.^{21,22} While Grassi et al also used nutrition education as part of their intervention,¹⁷ their control group still received no intervention. The intervention by Bezbaruah et al¹⁶ used a pre-intervention measure of the same group as a comparison instead of having a different control group.

Measurement of outcome. Three out of the 8 studies measured actual consumption of FVs from a previously set amount of FV after students had completed their meals. Of these, 1 weighed the amount of FVs remaining on the plate after students had eaten lunch,¹⁶ and 2 used visual methods to calculate remaining FV portions.^{18,20} Of the studies that used visual methods, Horne et al,²⁰ weighed the amount of FVs consumed only for a subset of the sample. The remaining 5 studies measured change in preference of FV instead of consumption. Nicklas et al measured preference for FVs through a Likert-style questionnaire²³ and Hanks et al¹⁹ measured how many students chose a plate that contained FVs or walked to the salad bar. The 3 classroom education studies measured attitude changes towards junk food and healthy food.^{17,21,22} Bryan et al (2016) also measured consequent choices for a one-time “snack pack”, while Bryan et al (2019) measured purchases made by students at the school cafeteria over a period of 3 months.^{21,22}

All 8 studies included at least 1 vegetable as part of their outcome measure. Bezbaruah et al measured only the consumption of green beans. Three of the 8 studies used fruit and vegetables that were already present in the school’s cafeteria (n=3). Three other studies (n=3) introduced specific FV that they measured preference towards or consumption of: Bryan et al (2016) used snack packs containing carrots, fruit cup, or trail mix; Horne et al used 4 different fruits (apples, pears, bananas, and satsumas) and 4 different cooked vegetables (peas, carrots, sweetcorn, and broccoli); and Nicklas et al.’s preference measure targeted broccoli, carrots, apples, and bananas. Finally, Grassi et al used a questionnaire that asked about consumption of various food groups (including FV) instead of measuring consumption of specific FV.

Association of fruits and vegetables marketing and consumption. All 8 studies produced significantly positive results in at least 1 of their intervention groups. In studies with 1 main intervention group (n=5), the intervention group had

either significantly higher consumption of or significantly greater preference for FVs.^{16,20-23}

However, in the 3 studies that examined multiple interventions and media, there was not a significant change in all the outcomes.¹⁷⁻¹⁹ In the experiment conducted by Grassi et al¹⁷ that measured children’s and parents’ outcomes, only the children’s attitudes towards FV and unhealthy food were impacted. Availability of FVs at home and change in parents’ outlook towards FV did not change significantly as a result of the experiment. In the study conducted by Gustafson et al,¹⁸ only the group of students that was involved in the combined participation and marketing treatment had significant changes in FV consumption immediately following the intervention. The 2 other treatment groups did not have significant changes to their FV consumption. Lastly, in the experiment conducted by Hanks et al,¹⁹ the intervention that utilized a TV segment and vinyl banner, as well as the intervention that utilized only the vinyl banner resulted in increased FV consumption, whereas the TV segment-only intervention did not produce significant changes in consumption.

Four studies collected follow-up data to measure how long lasting the effects of the intervention were.^{17,18,20,22} As shown in Figure 1, all studies collected measurements 2-4 months post-intervention. In Horne et al,²⁰ by 4 months post intervention fruit consumption had dropped below baseline levels and vegetable consumption also had decreased. By contrast, in Gustafson et al,¹⁸ the marketing only condition and the participation and marketing conditions both continued to have elevated levels of consumption by the end of the 2-month follow up period. In Bryan et al, follow-up preference data from cafeteria purchases by the intervention group still showed significantly higher healthy choices and lower unhealthy choices than the control group. There was no social or motivation data, showing change in social perception of healthy food and motivation to eat healthy food, collected at follow-up. Similarly, in Grassi et al,¹⁷ the intervention group had elevated self-reported consumption of fresh fruit, raw vegetables, and fruit juice 3 months post-intervention. They also had higher levels of motivation and self-efficacy than the pre-test. The other 4 studies did not conduct any follow-up measurements.

Limitations of Studies

From the 8 studies that were reviewed, 3 major limitations in study design and methods stood out: novelty effects, lack of follow-up, and inconsistencies in the type of data collected. Figure 2 summarizes the presence or absence of these limitations in each study. Some studies acknowledged that they contained some of these limitations. The novelty effect was addressed by Hanks et al and Nicklas et al^{19,23} Grassi et al¹⁷ addressed that their follow-up period might have been too brief to draw any long-term conclusions. Horne et al²⁰ also briefly discussed the 2 different types of data collected: preference and consumption, noting that an increase in

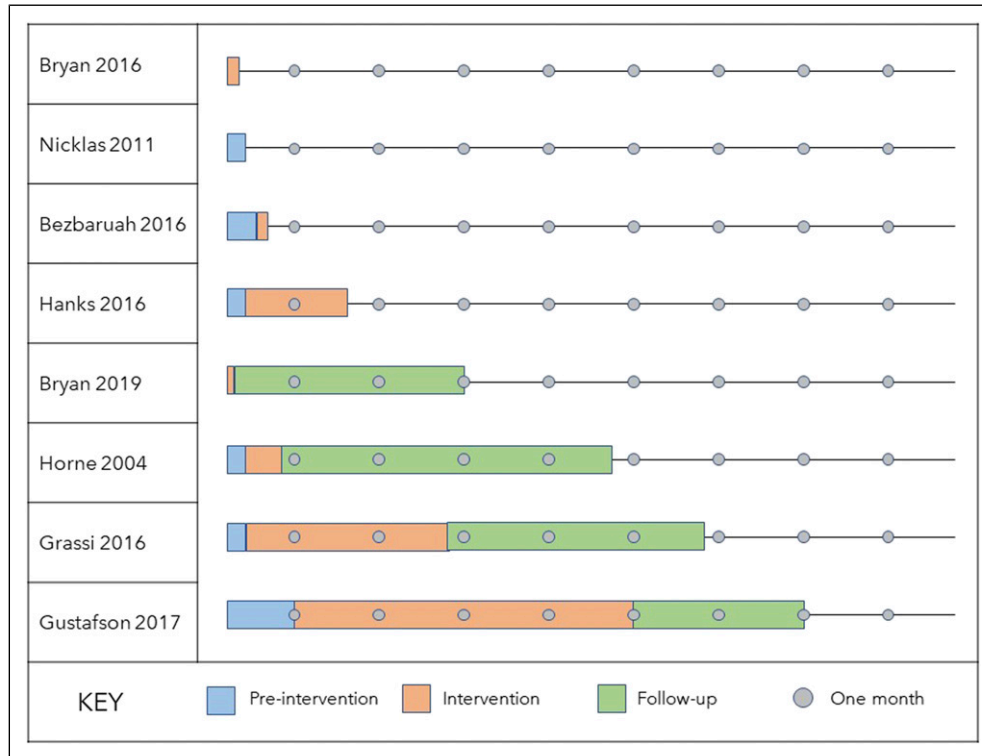


Figure 1. This figure describes the study design for all 8 reviewed studies from shortest to longest duration of intervention and follow-up periods.

preference does not imply an increase in consumption. While there were other individual limitations to each study, the following were common themes throughout the reviewed literature and must be addressed in conducting future research.

Novelty Effects and Follow up

Bryan et al²¹ (2016) collected only 1 type of FV preference data, the snack pack choices made by students from a list of predetermined healthy and unhealthy snacks. The snack packs had an added novelty effect since they only would have been given out to students once, and they had never been given these before. Any statement made about the effectiveness of the intervention through data from the snack pack choices is potentially biased (upwards or downwards) because of this novelty effect. On one hand, since it is a one-time snack pack, and therefore viewed as a “treat”, students could have been more inclined to make unhealthier choices than they would in a more routine setting. On the other hand, since the snack pack is an extra intake of calories than they would have otherwise had, conscious students could have been more inclined to make healthier snack pack choices than in their normal routine meals. Therefore, this extra new snack could have added a variable not previously accounted for by the researchers. Bryan et al²² (2019) corrected for this novelty

effect by measuring students’ FV preference over a period of 3 months through their cafeteria purchases. This model more closely followed the preference measurements in the other studies.

Another example of the novelty effect was in Horne et al²⁰ when the intervention introduced fruit at snack time to children for the intervention specifically. This dramatically inflated the consumption measures for fruit at baseline measurements, leading to a decline in consumption measures at follow-up. The other studies did not introduce a stimulus that would have produced the novelty effect. Most chose to test consumption or preference with a preexisting food environment, such as food in the cafeteria at lunch time that has not been newly introduced, or food at home. This allows the evaluation of current/future habits that are built on current practices.

Follow-up measurements are vital in examining how long it takes for the novelty effect of the intervention to wear off, how long the effects of the intervention last, and therefore how successful the intervention could be for implementing on a larger scale. Four of the 8 studies conducted follow-up measurements (Bryan et al, Grassi et al, Gustafson et al, Horne et al),^{17,18,20,22} and of these 4, only Horne et al reported decreased FV consumption levels at follow-up. The studies that seemed to have a high success rate of maintaining students’ preference (and self-reported consumption) of FV

above pre-intervention levels throughout the follow-up period were all classroom intervention studies that motivated healthy eating through cognitive means, suggesting that engaging students in critical thinking could lead to longer lasting behavioral outcomes.

Type of Outcome Data Collected

Of the 8 studies, only 3 measured actual FV consumption (Bezbaruah et al, Gustafson et al, Horne et al),^{16,18,20} and of those 3, only Bezbaruah et al measured consumption by weight of FVs consumed. Gustafson et al and Horne et al measured consumption visually by looking at plates when students first picked them up and when students were finished with them.^{18,20} The other 4 studies did not measure consumption, but rather preference and attitudes towards FVs. Bryan et al (2016), Bryan et al (2019), and Grassi et al employed the classroom education method, so their outcome measurements centered around motivation to eat FVs.^{17,21,22} However, while Hanks et al and Nicklas et al did not aim to change attitudes around FVs, their outcome measures were centered on measuring preference towards FVs instead of actual consumption.^{19,23} For example, the study conducted by Nicklas et al²³ measured attitudes towards FVs by preschool children via a “yummy/yucky” scale questionnaire, but whether these children would actually eat the FVs

they marked as “yummy” was not addressed. Similarly, in Hanks et al,¹⁹ the measured outcomes were the number of students walking to the salad bar or choosing trays that had a portion of FVs, but it failed to address whether students actually took salad from the salad bar or consumed the FV portion on their tray. Not including the amount of FVs consumed could inflate the effectiveness of the intervention for increasing FV consumption, because showing preference for FVs does not equate to eating FVs.^{Figure 2}

Discussion

In total, 8 articles were included in this narrative overview. Each article was an intervention that examined the effect of FV advertising or food marketing on FV consumption or preference in school settings of children aged 3-13 years old in Western developed countries. All studies found a positive correlation between marketing interventions and FV consumption or preference. Three major types of media used for these studies were print, video, and classroom education, with print being the most common. Limitations of the 8 studies overall were that some did not correct for novelty effects, lacked follow-up, and collected data on preference instead of consumption. These methods pose limitations because they hinder the ability to understand the implementation of these

	Food Novelty Effect	Follow-Up Data	Consumption Data
Bezbaruah 2016	✓	✗	✓ Oz. of green beans
Bryan 2016	✗ New snack item	✗	✗
Bryan 2019	✓	✓ Cafeteria purchase data for 3 months	✗
Grassi 2016	✓	✓ Self-administered FV consumption data at 3 months	✗
Gustafson 2017	✓	✓ Plate photography at 2 months	✓ Before and after eating plate photo
Hanks 2016	✓	✗	✗
Horne 2004	✗ New fruit	✓ % consumption at 4 months	✓ % consumed visual calculation
Nicklas 2011	✓	✗	✗

Figure 2. Summary of key findings details the methodological strengths and limitations of reviewed studies.

experiments scaled up to a real-world setting and make it difficult to compare effectiveness of methodology against 1 another. Addressing these limitations will allow for future studies to reach a consensus on best practices in advertising methods that will increase children's consumption of FVs.

Print Media Was Most Commonly Used and has Cost and Versatility Benefits

More interventions used print approaches than video or classroom education approaches. One reason for this could be the high accessibility of print materials. There is a low monetary and labor cost of creating print materials as opposed to video or classroom education materials and execution. The implications of the low costs are that once the most effective types of print media are determined, the media can be used repeatedly. Because the print media method eliminates recurring costs, it would be an overall less costly intervention than other media. This allows for standardizing FV advertising across schools, ensuring that students of all backgrounds have equal exposure to beneficial FV advertising, given that the advertising is suitable for a given population. Print materials are also more versatile in their placement potential. Schools do not need access to TVs, computers, or other electronic devices to administer this intervention, further increasing its accessibility.

Student Engagement Could Play a Role in Fruits and Vegetables Consumption

When the age range was held constant (5-11 years), using videos that were not created by the students themselves was unsuccessful.¹⁹ These videos featured cartoon fruit and vegetable characters that the students had no prior exposure to. The videos that did significantly impact this age group (5-11 years) were either created by students themselves, or featured actors of similar ages,^{17,20} suggesting that increasing the amount of engagement and relatability between students and the videos could increase the impact of the intervention. The results from Gustafson et al¹⁸ directly test the interaction between students' engagement in the marketing intervention and its impact on FV consumption. Students that were in the participation-only group in this study (those that created marketing materials) had significantly higher FV consumption than those that were just exposed to marketing materials created by someone else. These studies demonstrate how increased student engagement with the creation of video and print materials in an elementary-school age group could be correlated with increased FV consumption.

Age and Gender Could Play a Role in Interactions With Media

Both Nicklas et al and Hanks et al utilized videos featuring FV-based characters as part of the intervention.^{19,23} The

population targeted by the first study was preschool students, while the second study targeted 5-11-year-olds. The intervention involving TV segments was successful for Nicklas et al, while it was not for Hanks et al. While Hanks et al and Nicklas et al did not use the same video segments and had different experiment designs, it is worth noting that videos containing cartoon FV characters could be more appealing to preschoolers than to an older audience. This could be further pursued by looking at the breakdown by age of the data gathered by Hanks et al.

Furthermore, Grassi et al, Bryan et al (2016) and Bryan et al (2019) utilized the classroom education intervention, but studied different age populations.^{17,21,22} Grassi et al studied fourth graders, while Bryan et al (2016) and Bryan et al (2019) studied eighth graders. Of note, while they both tested for psychological measures, such as motivation to eat healthier food and social views towards healthy food, Grassi et al utilized nutrition education in addition to marketing and communications education, whereas nutrition education served as the control group for Bryan et al (2016) and Bryan et al (2019). Consequently, the differential effects of age/grade on marketing and communications education cannot be identified. Eighth graders' receptiveness to nutrition education could be much different than that of fourth graders because of the very same adolescent values that the Bryan et al (2016) and Bryan et al (2019) studies utilized. These studies utilized adolescents' tendencies to seek autonomy from adult control in demonstrating how HSFS advertising manipulates children into making unhealthy decisions.^{21,22} Adolescents might be less receptive to behavior change from nutrition education because of this desire to resist adult control. Fourth graders may not be at that developmental stage and thus might be more receptive to nutrition education. Understanding the difference between receptiveness between the 2 age groups could be a vital step in understanding the most effective advertising messaging. Effects of age cannot be identified because of the incongruities in methodologies used.

Bryan et al (2019), Bezbaruah et al, and Hanks et al also differentiated between outcomes for boys and girls in their studies.^{16,19,22} Overall, the trend was that girls were more receptive to healthy eating interventions than boys were. In Bryan et al (2019), while girls in the intervention group still had higher rates of healthy food consumption compared to the control group, the difference was much smaller than the difference between the control and intervention groups among boys. The reasoning cited was that girls were still receptive to the control intervention because it was a nutrition-focused classroom education intervention that discussed health and calories, whereas this had less appeal to boys. A similar trend was seen in Bezbaruah et al, where more girls than boys ate green beans in the pre-intervention and post-intervention stages. However, although the average amount of green beans consumed per boy decreased post-intervention (because more boys tried a smaller amount of

green beans), the average amount of green beans consumed by girls post-intervention did not decrease even though a higher number of girls also tried the green beans. Finally, in Hanks et al girls in both the vinyl banner-only intervention and in the vinyl banner and TV segment intervention had significantly higher interest in going to the salad bar, whereas boys only had significantly higher interest in the vinyl banner-only intervention. Results from these 3 interventions suggest that girls are more receptive to eating and choosing healthy foods than boys are, especially in the age group of first-eighth graders. As noted by Bryan et al (2019), this age is around the time that girls start to think about body image. Consequently, messages surrounding the topic of nutrition and calories need to be mindful to avoid producing negative body image issues among children. Examining the sex differences of the outcomes for future studies is necessary to ensure that increases in consumption or preference are not driven solely by change in the girls' measures, and that the intervention targets outcomes in boys, as well.

Consumption Data Is More Valuable Than Preference Data

Among the differences in interventions, the most notable was the type of outcome data collected: preference vs consumption data. This distinction is important to make because none of the 8 articles directly address this point as part of the experiment. The difference between preference and consumption can most clearly be dissected in Gustafson et al,¹⁸ which collected both preference data (in the form of how many students selected vegetables to put on their lunch tray) and consumption data (in the form of how much of those vegetables were eaten by the end of the lunch period). In this experiment, the preference in all 3 groups (participation, marketing, and participation and marketing groups) increased in the period where students are exposed to advertisements. However, actual consumption of vegetables differs among the 3 groups. Students that only received the marketing (while they selected more vegetables than baseline) discarded more vegetables than the other groups, resulting in no significant increase in vegetable consumption. Students that were in the participation and marketing groups also discarded about the same amount of vegetables as the previous group, but they selected more vegetables, resulting in an increase in their vegetable consumption by 1 whole serving. Lastly, students in the participation group (those that had created materials) chose more vegetables, but did not discard more vegetables, also resulting in an increase in consumption. This trend also persists over time, with students in the marketing-only condition continuing to have elevated levels of preference, but also elevated levels of waste at the time of follow-up. In the case of the marketing-only groups, increasing preference but not consumption for FV could have negative effects on the willingness of the school administration to continue the marketing intervention if students have disposed

of more FV than they have eaten. On the other hand, intervention groups in the experiments by Grassi et al and Bryan et al (2016) and Bryan et al (2019) all created their own marketing materials,^{17,21,22} similar to the participation group in the Gustafson et al¹⁸ experiment. It is possible that, like the participation group from Gustafson et al, students from the classroom intervention studies in Bryan et al (2016), Bryan et al (2019) and Grassi et al intervention groups could have discarded fewer FVs than their increase in consumption. However, food waste and consumption data were not collected in the Bryan et al (2016), Bryan et al (2019), or Grassi et al studies, so that conclusion cannot be drawn.

Preference and consumption were discussed briefly by Horne et al,²⁰ where the outcomes were discussed in the context of the novelty effect. Past research has proposed that increased exposure to certain foods could increase consumption of those foods, but Horne et al suggested that increased exposure only increases preference towards foods, but not actual consumption. In other words, increasing exposure to fruit would make children more comfortable with eating it, but does not guarantee they will eat more, or any at all. Research shows that when the relationship between preference and consumption of vegetables was examined, preference for a vegetable and consuming that vegetable has a weaker correlation than dislike for a vegetable and not consuming that vegetable.²⁴ Therefore, preference does not always correlate with consumption, underlining the need for conducting consumption measurements

Future Directions

Previous research that measured students' FV consumption in response to FV advertising in schools has been conducted with major differences in age group, interventions, outcome measures, and experimental design. However, since the studies reviewed clearly showed that advertising does influence children's FV consumption and preferences, it is important to continue pursuing this research to draw clear conclusions about which methods are most effective in increasing FV consumption in specific populations. To meaningfully address this question, future research should follow 3 major criteria. First, 1 of the outcome measures must be a measure of consumption, and not simply a measure of preference. Preference does not address actual consumption and could be an inflated measure of consumption. Second, the experiment must not include a novelty effect, ie, studies should not introduce food that was not previously offered at times or in settings that it was not previously offered. The novelty effect also could inflate consumption measurements. Third, follow-up data should be collected to assess both the school's ability to maintain the intervention for a given period of time and how long lasting are the effects of the intervention. These 3 major guidelines would make future studies on this topic more comparable to each other, so that their different methods can be analyzed against 1 another.

The research thus far employed 3 major types of interventions: classroom education, print, and video. An ideal study would directly test these methods simultaneously, separating the 3 different interventions by school, matched on age and socioeconomic status, to prevent spillover effects. Preference and consumption data collected across the 3 intervention groups could give more insight into how these measures change in response to different kinds of interventions. This information could be further leveraged into understanding how changes in both preference and consumption could lead to changes in other factors (such as food waste) in the long and short term. Data should also be broken down by grade level, as students of different ages could be affected differently by each intervention. Finally, in an effort to create standardized FV advertisements in school, socioeconomic, cultural, language, and literacy differences among schools must be considered. For example, advertisements should be translated into different languages in areas where students speak more than 1 language.

Strengths and Limitations

A strength of this review is that it specifically reviews the literature surrounding the effects of FV advertisements in school on FV consumption, which is understudied. This is an important step in determining if advertisements contribute to an increase in FV consumption in children. Including advertisements as a part of the preexisting school infrastructure is a tangible and attainable method of rectifying a small portion of the problematic systems that exacerbate childhood obesity. Furthermore, a strength of this review is its focus on interventional studies. This allows for the highlighting of methodological drawbacks of current work that tests the association of food advertisements and FV consumption. Consequently, this review provides concrete and implementable improvements for future research.

A limitation of the current review is that there is a wide age range across the reviewed articles—3-13 years old. Children throughout this age range have varying responses to and preferences for marketing material. They also have varying levels of cognition, as can be seen in the variable receptiveness to nutrition education across age ranges, as well as the responsiveness to cartoons across age ranges. Future reviews should focus on narrower age ranges, such as just preschoolers, children, or adolescents.

Conclusion

Research shows that advertising is a proven method of affecting children's eating behavior. Currently, children are exposed to a high volume of advertisements for HSFS foods on television, the internet, on the streets, and most importantly, in their schools. The promotion and subsequent consumption of HSFS foods directly contributes to the

childhood obesity epidemic that is rampant in most of the Western developed world today. While many factors impact the type of food consumed by children, controlling advertisements that children see in schools by adding FV advertising, could impact their eating habits. Current research conducted on FV advertising in schools, while limited and scattered, provides a worthwhile foundation and critical evidence towards FV advertisements' efficacy in increasing FV consumption and/or preference.

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