Randomized Exposure to Food Advertisements and Eating in the Absence of Hunger Among Preschoolers

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abstract

BACKGROUND: Preschoolers in the United States are heavily exposed to unhealthy food advertisements. Whether such exposure promotes cued eating has not been documented in this age group.

METHODS: Randomized experiment among 60 children, aged 2 to 5 years, recruited in 2015–2016 from New Hampshire and Vermont. Children completed the experiment at a behavioral laboratory. Children were provided with a healthy snack to consume upon arrival then randomized to view a 14-minute TV program embedded with advertisements for either a food or a department store. Children were provided 2 snack foods to consume ad libitum while viewing the TV program; 1 of those snacks was the food advertised. Eating in the absence of hunger (EAH) was operationalized as the kilocalories of snack foods consumed. *t* tests were used to compare EAH by advertisement condition; linear regression models assessed effect modification by the child's age, sex, BMI percentile, and parental feeding restriction.

RESULTS: Mean age was 4.1 (SD 0.9) years, 55% of children were male, 80% were non-Hispanic white, and 20% were overweight or obese. There were no differences in child or socioeconomic characteristics by advertisement condition. Child BMI was not related to EAH. Mean kilocalories consumed during the EAH phase was greater among children exposed to the food advertisements (126.8, SD: 58.5) versus those exposed to the nonfood advertisements (97.3, SD: 52.3; $P = .04$), an effect driven by greater consumption of the advertised food ($P < .01$). There was no evidence of effect modification.

CONCLUSIONS: Findings suggest that food advertisement exposure may encourage obesogenic-eating behaviors among the very young.

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Dr Emond completed data analysis and drafted the initial manuscript; Ms Lansigan supervised the study including data acquisition and critically reviewed data analyses and the manuscript; Ms Ramanujam aided in study supervision and data acquisition; Dr Gilbert-Diamond conceptualized and designed the study, obtained funding, and critically reviewed data analyses and the manuscript; and all authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Early childhood is an important time for children to learn healthy eating habits. Exposure to food advertisements influences the food preferences and requests of preschool aged children, yet no study has examined the effect on immediate cued-eating in this age group.

WHAT THIS STUDY ADDS: We documented that food advertisement exposure while viewing a typical children's TV program led to increased cued eating among 2- to 5-year-olds. Findings suggest that food advertisement exposure at a young age may prime eating behaviors that promote weight gain.

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US children are heavily exposed to marketing for energy-dense nutritionally poor foods, primarily via TV.[1,2] Preschoolers average >3 hours of traditional TV viewing each day,[3] and TV food advertisement exposure may be increasing among this age group: preschoolers viewed 18% more TV snack food advertisements from 2010 to 2014.[4] Exposure to TV food advertisements prompts cued eating among school-age children,[5] even after consuming a satiating meal.[6] This is concerning if such excess caloric consumption leads to excess weight gain[7] or primes a preference for energy-dense foods.[8] However, no study to date has tested whether food advertisements cue eating among preschool-age children.

Eating behaviors develop during early childhood[9] and may form the basis for dietary preferences and habits later in life.[10] According to the Reactivity to Embedded Food Cues in Advertising Model,[11] children have physiologic and psychological responses to food cues within advertisements that prompt children to eat that food or similar highly palatable foods, foods that are intrinsically rewarding. In turn, the consumption of such foods reinforces those responses. However, because of their age, young children have a limited lifetime exposure to food advertising and thus likely have a less developed conditioned response than older children. Therefore, findings of cued eating in response to food advertisements in older children do not necessarily extend to preschoolers, and it is important to understand how food marketing affects preschoolers specifically.

Here we present findings from a randomized experiment to test the effect of viewing TV food advertisements on cued eating among preschool-age children. We specifically address excess caloric consumption that is not driven by hunger using the "eating in the absence of hunger" (EAH) laboratory paradigm in which participants are fed a meal or snack to satiety and then immediately given the choice to consume additional snacks ad libitum.[12] We hypothesized that children exposed to food advertisements while viewing a TV program would consume more snack foods than children exposed to nonfood advertisements. Importantly, we selected a food not typically marketed to young children to reduce confounding due to a child's previous familiarity with the advertised product.

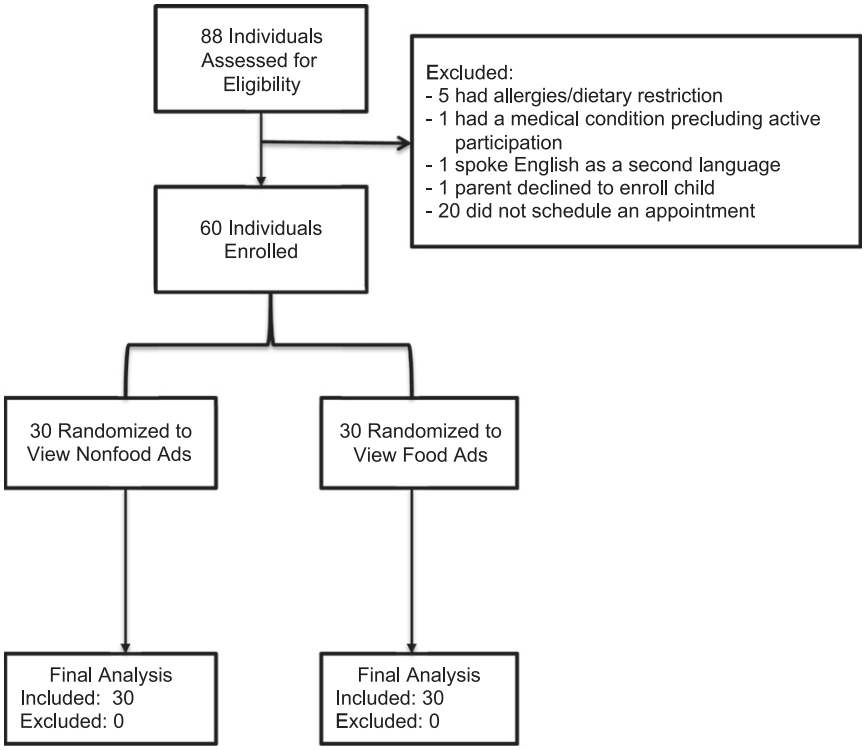

FIGURE 1
Participant flow.

METHODS

Participants

Children aged 2 to 5 years and a parent or guardian were recruited from the greater Hanover, New Hampshire, community during 2015–2016. Eligibility included English fluency, absence of food allergies and dietary restrictions, absence of health conditions or medication use that may affect appetite, willingness to participate in a 1-hour study, lack of familiarity with Bugles corn snacks, and no known previous exposure to Bugles advertisements. Of the 88 participants screened, 81 were eligible, and 60 enrolled. Figure 1 presents the participant flow throughout the study. All enrolled children completed the study. The Committee for Protection of Human Subjects at Dartmouth College approved of all study procedures. Parents provided written consent at the study visit. Each parent completed a questionnaire while his or her child completed the experiment. Data were analyzed in 2016.

Preload Phase

Study visits were completed at a behavioral laboratory space designed to reflect a comfortable home setting. Upon arrival at the laboratory, children were offered 50 g (45 kcal) of peeled banana, 58 g (214 kcals)

of sliced cheese, 28 g (140 kcals) of crackers, and a small cup of water and were given the choice to eat until satiated. After the preload snack, children self-reported their satiety level using a 3-point visual analog scale (1 = hungry, 2 = half hungry/half full, 3 = full); satiety ratings were dichotomized as hungry (1) versus not hungry (2 or 3). Children were next asked to taste a piece of each of the 2 snacks that would be provided during the EAH phase and rate how much they liked each snack using a 5-point visual analog scale anchored at "not at all" (1 = strong frown) to "very much" (5 = strong smile). For analyses, taste test responses were dichotomized as did not like the snacks (refused to taste or selection of a frown face, 1 or 2) versus liked the snacks (slight to strong smile, 3–5).

EAH Phase

Children were randomized 1:1 to view a 14-minute TV segment ("Elmo's World" from *Sesame Street*, Sesame Workshop) embedded with a mix of TV advertisements for either 1 food (ie, 9 advertisements, 15 or 30 seconds each, for Bugles corn chips, food condition) or a national department store (6 advertisements, 30 seconds each, nonfood condition). Total advertisement time in each condition was 3 minutes. The Bugles ads featured children playing and eating the product; the department store ads promoted a sale and food was not featured. Children viewed the program alone with the exception of 3 children who requested that their parent stay in the room with them. All advertisements were placed within the program to reflect a typical airing on traditional TV. Before beginning the TV program, children were provided with two bowls of snacks in separate bowls: 32 g (139 kcals) of Nabisco Teddy Grahams (Nabisco, East Hanover, NJ) and 21 g (112 kcals) of Bugles corn snacks (General Mills, Minneapolis, MN). Children consumed the snacks ad libitum while viewing the TV program. When the program was finished, the remaining snacks were weighed, and the kcals consumed were calculated based on the manufacturer's nutritional information.

Parental Feeding Restriction

Greater parental feeding restriction may lead children to overconsume palatable foods when in an uninhibited environment.[5] Therefore, parents completed the parental feeding restriction subscale of the Child Feeding Questionnaire.[13] The original scale includes 8 items to assess parental feeding practices related to regulating a child's access to and intake of highly palatable foods. Item responses are on a 5-point Likert scale, anchored at 1 (disagree) and 5 (agree). The scale used in this study was slightly modified from the original, in that 2 separate items assessing food as a reward (ie, I offer my child his/her favorite foods in exchange for good behavior; I offer sweets to my child as a reward for good behaviors) were combined into 1 item (ie, I offer my child his/her favorite foods or sweets in exchange for good behavior). Thus, we used a modified 7-item restriction scale (internal consistency, Cronbach's $\alpha = 0.83$). Consistent with the original scale, the final score was the average over the 7 items and higher scores indicated greater parental restriction.

Additional Covariates

Parents reported their child's age, sex, race, ethnicity, and their relationship to the child (eg, mother, father), marital status, household income, and educational attainment for themselves and their spouse as appropriate. The mother's educational attainment was used in analyses because mothers often play a primary role in child feeding.[14,15] The child's weight and height were measured at the end of the study visit using a Seca 763 Medical Scale and Seca 213 Stadiometer (Hamburg, Germany). All measurements were taken in light indoor clothing without shoes. Age- and sex-adjusted BMI percentiles were computed using the Centers for Disease Control and Prevention 2000 growth charts.[16] Overweight or obese was defined as ≥85th percentile. Parents also reported their child's time engaged in physical activity (how much time does your child spend doing physical activity, such as running around, climbing, biking, dancing, swimming, playing sports, etc?) and TV or movie viewing (how much time does your child spend watching TV shows or movies?) on a typical weekday and weekend day; a weighted average was computed to reflect hours per day engaged in each activity.

Statistical Analyses

Child demographics and weight status, household socioeconomic characteristics, and parental feeding restriction were compared by advertisement condition using unpaired, 2-sample *t* tests for continuous measures, or χ^2 or Fisher's exact tests (when sample sizes were ≤5 for any 1 category) for categorical measures. Pearson's correlation coefficients were computed to assess the associations between child characteristics and kcals consumed during the preload or EAH phase. The primary analysis compared total kcals consumed during the EAH phase by advertisement condition using an unpaired, 2-sample *t* test. We also assessed kcals consumed for the advertised and the nonadvertised snack foods separately. As a sensitivity check, we repeated the analyses (1) adjusted for the child's satiety level after the preload snack using linear regression and (2) excluding children who refused to taste or did not like the snacks during the taste test before the EAH phase.

TABLE 1 Baseline Characteristics of Study Participants (n = 60)

Variable	Advertisement Condition		P[a]
	Nonfood (n = 30)	Food (n = 30)	
Age (y), mean (SD)	4.0 (0.8)	4.2 (1.0)	.39
Male, n (%)	17 (56.7)	16 (53.3)	>.99
Race/ethnicity, n (%)			
White, non-Hispanic	24 (80.0)	24 (80.0)	>.99
Hispanic	2 (6.7)	2 (6.7)	
Other	4 (13.3)	4 (13.3)	
Maternal education, n (%)			
Some high school or high school diploma	2 (6.7)	2 (6.7)	.43
Some post–high school or associate degree	3 (10.0)	0 (0)	
College graduate	10 (33.3)	12 (40.0)	
Professional or graduate school	15 (50.0)	16 (53.3)	
Household income, n (%)			
<$25 000	0 (0)	1 (3.3)	.75
$25 000–$64 999	11 (36.7)	10 (33.3)	
$65 000–$144 999	13 (43.3)	13 (43.3)	
$145 000–$224 999	2 (6.7)	4 (13.3)	
>$225 000	4 (13.3)	2 (6.7)	
BMI percentile, mean (SD)	60.0 (22.5)	63.1 (25.8)	.62
Weight status,[b] n (%)			
Healthy weight: BMI <85th percentile	26 (86.7)	22 (73.3)	.29
Overweight: BMI 85th-94.9th percentile	4 (13.3)	6 (20.0)	
Obese: BMI ≥95th percentile	0 (0)	2 (6.7)	
Physical activity (h/d), mean (SD)	3.7 (1.8)	3.3 (1.8)	.36
TV or movie viewing (h/d), mean (SD)	1.4 (1.2)	1.7 (1.2)	.32
Parental feeding restriction (range: 1–5),[c] mean (SD)	3.3 (0.9)	3.5 (0.9)	.40
Calories consumed during preload phase, mean (SD)	75.9 (69.6)	98.3 (89.0)	.28
Taste test results: liked snack foods, n (%)	19 (63.3)	25 (83.3)	.14

[a] Calculated from an unpaired 2-tailed t-test with an unequal variance assumption to analyze the difference in means, or a χ^2 test to analyze the difference in proportions when expected cell counts were >5 and Fisher's exact test when expected cell counts were <5.
[b] Based on US. Centers for Disease Control 2000 growth charts.[18]
[c] From the parental restriction subscale of the Child Feeding Questionnaire.[19]

Test statistics for main effects were considered statistically significant if $P < .05$. Finally, because a child's age, sex, BMI percentile, or parental feeding restriction may modify EAH among children,[5] we used linear regression to assess whether any of those factors modified the main effects between food advertisement exposure and kcals consumed during the EAH phase. Specifically, we included an interaction term between each of those factors and advertisement condition; any $P < .10$ based on a Wald's t test was considered evidence of a statistically significant interaction. All analyses were completed using the R Language and Environment for Statistical Computing, version 3.0.2.[17]

RESULTS

Table 1 presents sample characteristics by advertisement condition. The sample reflected a population with a relatively higher socioeconomic status in comparison with the general US population, as reflected by the distribution of maternal education and household income. Most parents were mothers (88.3%), 6 (10.0%) were fathers, and 1 (1.7%) was a grandmother. Most (98.0%) parents were married. Overall, 20% of children were overweight or obese. Children engaged in >3 hours of physical activity and 1 hour of TV or movie viewing each day. Mean parental feeding restriction was 3.4 (SD: 0.9). Children consumed, on average, 87.1 (SD: 80.0) kcals during the preload phase. There were no differences in any baseline characteristic by advertisement condition. Most (n = 52, 86.7%) children reported they were not hungry after consuming the preload snack, which also did not differ by advertisement condition (Fisher's exact test $P > .99$); satiety level was missing for 1 child.

The associations between kcals consumed during the preload phase and child's age (r = 0.23; P = .08), child's BMI percentile (r = –0.19; P = .15) and parental feeding restriction (r = 0.22; P = .09) did not reach statistical significance. Similarly, there were no statistically significant associations between kcals consumed during the EAH phase and the child's age (r = 0.12; P = .35), the child's BMI percentile (r = 0.02; P = .88), or parental feeding restriction (r = 0.07; P = .59). There were also no differences in the kcals consumed during each phase by the child's weight status when classified as healthy weight versus overweight or obese (Fig 2).

Figure 3 presents the main findings of the study. Mean kcals consumed during the EAH phase are presented as unadjusted values because none of the baseline characteristics differed by advertisement condition. Children exposed to food advertisements consumed, on average, 29.5 kcals more during the EAH phase than children exposed to the nonfood advertisements (P = .04). The main effect was driven by a greater consumption of the advertised food (difference in group means: 21.7 kcals; $P < .01$). Mean consumption of the nonadvertised food did not differ by advertisement condition (P = .43). We repeated each of those between group comparisons using linear regression, and the distribution of standardized residuals supported that each outcome was normally distributed. Findings were consistent when adjusted for the child's satiety rating after the preload phase (data not shown) as well as when excluding

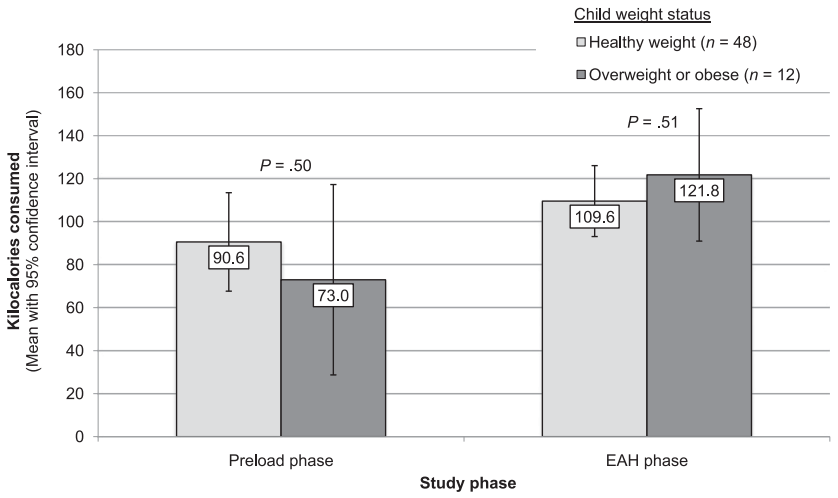

FIGURE 2

Mean kilocalories consumed during the preload and in the absence of hunger by the child's weight status. *P* values from *t* tests to compare mean kilocalories consumed per each condition by child weight status among 60 young children participating in an experiment to measure EAH. Overweight or obese defined as ≥85th percentile for age- and sex-adjusted BMI.

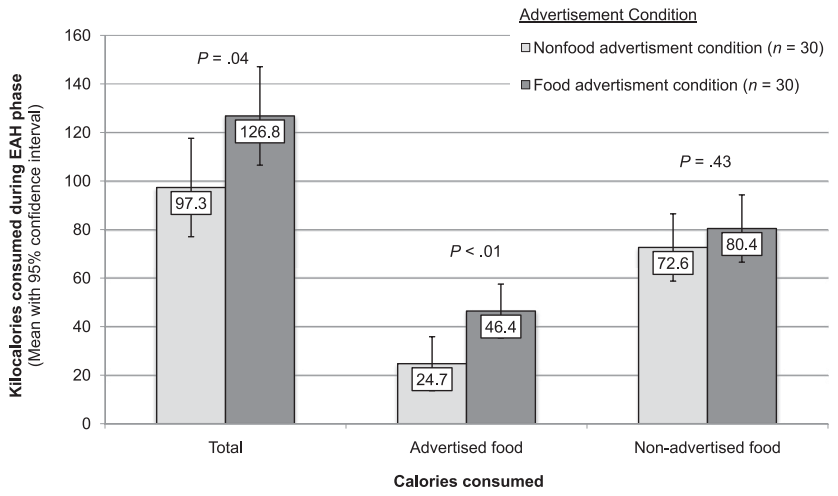

FIGURE 3

Distribution of kilocalories consumed in the absence of hunger by TV advertisement condition. *P* values from *t* tests to compare mean kilocalories consumed by advertisement condition among 60 young children participating in an experiment to measure EAH.

children who refused to taste or who did not like the snack foods provided during the pre-EAH taste test (Supplemental Fig 4).

Finally, there was no evidence to support that the child's age, sex, BMI percentile, or parental feeding restriction modified the main effect of advertisement condition on total kcals or kcals of the advertised food consumed during the EAH phase (data not shown, all *P*s for interaction terms >.20).

DISCUSSION

In this randomized experiment of 60 preschool-age children, exposure to a TV program with food advertisements resulted in greater ad libitum consumption of snack foods compared with exposure to the same TV program with nonfood advertisements. Findings are consistent with experimental studies among preadolescents that documented food advertisement exposure as part of viewing a TV program[5,6] or while playing an Internet advergame[5] led to increased ad libitum consumption of highly palatable snack foods. Our study reflects the first to assess this effect among preschool-age children.

The main effect of food advertisement exposure in our sample was driven by increased consumption of the advertised food. These findings of a brand-specific relationship mirror the results of our previous study among 178 preadolescent children[6] where TV food advertisement exposure led to increased cued eating during the EAH phase only for the advertised food. Previously, exposure to TV food advertisements had been shown to affect the brand-specific preferences and food requests among preschool-age children.[20] For example, in a randomized trial among 46 children aged 2 to 6 years,[21] exposure to TV food commercials related to an increased preference for the advertised brands when given the choice of selecting the advertised item or a similar nonbranded item from a set of photographs. In another experimental study among 57 children aged 3 to 5 years,[22] exposure to TV food commercials related to increased purchase requests for the advertised products by young children in a mock grocery store setting. Our study is the first to demonstrate that food advertisement exposure among preschool-age children increases cued consumption of food, findings that align with those among older children.

Our study used a food children were not familiar with, suggesting that relatively little exposure to a food brand through TV food advertisements can prime excess caloric consumption of that branded food among young children. Such initial exposure may initiate the reciprocal cycle of reactivity to food cues in advertisements and eating as proposed in the Reactivity to Embedded Food Cues in Advertising

Model. We further hypothesize that if children were to develop a familiarity with the food, the conditioned response of eating in reaction to cues for that food would increase. Future studies that incorporate repeated measures are needed to fully test that hypothesis.

Compared with our study, the majority of previous cued eating experiments among school-age children demonstrated a "beyond-brand" effect: exposure to TV food advertisements resulted in increased consumption of highly palatable foods overall. However, in most of those studies,[5] children were not provided with the advertised branded food as a snack choice as they were in our design. Previous studies that did provide that choice reported mixed findings related to brand-specificity. One study among 181 preadolescents[23] reported a brand specific effect on cued consumption where children consumed more branded potato chips versus nonbranded potato chips in response to viewing a TV advertisement for the branded chips with a celebrity endorsement. In comparison, a study among 270 preadolescents found that exposure to advertisements for energy dense candies while playing an Internet advergame related to increased consumption of both the advertised and a nonadvertised candy offered after playing the game,[24] while a similar study from the same research group among 92 preadolescents found that food advertisement exposure while playing an advergame related to an increased consumption of the nonadvertised candy only.[25] Thus, although there is a consensus that food advertisement exposure relates to increased cued consumption of palatable foods among children,[5] more studies are needed to better understand how that exposure might affect the development of brand-specific preferences both immediately and prospectively.

We did not observe an association between the child's current BMI percentile and kcals consumed during the EAH phase. In our other study conducted among 9- to 10-year-olds,[6] current BMI percentile was strongly related to consumption during the EAH phase, suggesting that we were observing an existing behavioral pattern that may have contributed to the children's current BMI percentile. There are known longitudinal associations between EAH behaviors and weight gain,[7,12] even among toddlers.[26] It is critical to next understand how exposures that can prime cued eating might influence the establishment of EAH behaviors prospectively.

The marketing of food to children on media is unregulated in the United States. Instead, major food and beverage manufacturers have voluntarily pledged to limit child-directed marketing of unhealthy foods as part of the Children's Food and Beverage Advertising.[27] However, independent research groups have highlighted several limitations of that program,[28,29] and young children remain highly exposed to TV advertisements for foods that may contribute to unhealthy dietary patterns. Legislative efforts to reduce children's exposures to TV advertising for unhealthy foods in the United States should be encouraged[18] if current self-regulatory efforts do not improve. Pediatricians can also play a vital role in helping to reduce a young child's exposure to food advertisements. For example, the American Academy of Pediatrics screen time guidelines for children[30] emphasize the role that media can play in disrupting healthy eating habits, such as when media is on during family mealtimes. Pediatricians can also emphasize the importance of reducing exposure to food advertisements as an additional way to promote the development of healthy dietary habits.

Strengths of our study include the randomized design, which reduced the effect of unmeasured confounders. We also optimized the ecological validity: children viewed the TV program in a comfortable room, we selected a popular children's TV program, and advertisements were embedded to reflect a typical TV program. However, external validity is limited and epidemiologic studies are needed to assess generalizability to a real-world setting. Our sample was a convenience sample, and sample demographics reflected a rural, mostly white, non-Hispanic population of a relatively higher socioeconomic status. Additional studies are needed to determine how generalizable findings are among more diverse populations. Self-reported satiety ratings among young children are likely limited and should be cautiously interpreted. However, all children consumed a preload snack until they chose to stop, suggesting that children were satiated before the experiment. In addition, EAH may in part be driven by a genetic predisposition to increased food responsiveness,[19,31] and our work in preadolescents suggests a genetic predisposition to excess consumption after viewing food advertisements.[6] Future work should explore the extent to which this genetic disposition manifests itself in young children.

CONCLUSIONS

Our study documented that exposure to TV food advertising as presented in a typical children's TV program had an acute effect on cued eating among preschool-age children. Reducing a young child's exposure to food advertisements is thus an actionable way to reduce the priming and reinforcement of obesogenic dietary behaviors during a critical

period of child growth. Importantly, pediatricians are a trusted source that can help convey such messages to parents and the public.

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ABBREVIATION

EAH: eating in the absence of hunger

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