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Influence of child-targeted fast food TV advertising exposure on fast food intake: a longitudinal study of preschool-age children.

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Abstract

Introduction: Fast food (FF) advertising is a potential risk factor for FF consumption among children, yet the impact of such advertising on children's FF intake has not been assessed in a longitudinal, naturalistic study. Whether parents' FF consumption mitigates advertising effects is also unknown.

Methods: One-year, longitudinal study among 624 preschool-age children, 3–5 years old, and one parent each recruited from New Hampshire, 2014–2015. Parents completed six online surveys every eight weeks and, at each, reported the number of times their children consumed FF in the past week. Each child's advertisement exposure was determined by counting the brand-specific FF advertisements aired within the programs they viewed on children's TV networks during the study.

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At baseline, parents reported the frequency of their own FF consumption. Data were analyzed in 2017–2018.

Results: Three FF brands targeted TV advertising to children during the study: McDonald's, Wendy's and Subway. Few children were exposed to child-targeted advertising for Wendy's or Subway. Results from adjusted Poisson regression models focused on McDonald's showed a differential effect of advertisement exposure on children's McDonald's intake in the past week (any or mean intake) by parental FF consumption ($P<0.01$). Specifically, McDonald's intake was consistently high among children whose parents consumed FF more frequently (≥monthly), regardless of children's advertisement exposure. However, advertisement exposure increased the risk of McDonald's intake among children nearly two-fold when parents consumed FF less frequently (<monthly) (*P*-values <0.01).

Conclusions: Results suggest that child-targeted FF advertising may mitigate the protective effect of infrequent parental FF intake on children's FF intake.

Introduction

Childhood obesity remains a public health epidemic. Nearly one in four US preschool-age children have overweight or obesity,[2] and children with overweight by the age of 5 years face a 4–5-fold increased risk of having overweight as adolescents[3,4] and a significantly increased risk of having obesity as adults.[5] The preschool years are also a formative time in which to shape food preferences and eating behaviors.[6–8] For example, the dietary patterns that are formed during childhood largely persist into adulthood.[9] Fast food (FF) intake likely contributes to excess weight gain and poor dietary quality among young children. FF meals, even children's meals, are characterized by large portions and are high in saturated fat and added sugar.[1,2] FF intake is common among children: one-third of US children consume FF on any given day.[3–5] Thus, reducing FF intake during the preschool-years is an actionable way to improve child health.

Fast food (FF) is heavily marketed to children. In 2009, FF companies spent nearly $600 million on child-targeted marketing, defined as marketing to children under the age of 12 years.[6] FF companies target young children through highly appealing tactics, including tie-ins with licensed children's characters and "premium" toy giveaways with children's meals.[7] TV is the primary medium used to advertise FF to young children,[8,9] and TV advertisements often promote meal premiums.[10] Preschool-age children are uniquely vulnerable to advertising because of their inability to comprehend the persuasive intent of advertising.[11]

Children as young as 3 years recognize and form positive impressions about child-targeted FF brands. In a study among 38 3–4 year old children, children were presented with images of 50 brand logos without any identifying brand mascots or product images; half of the logos were for brands that marketed to young children and half were for brands that marketed to adolescents or adults. Children were asked to explain the image, and researchers coded whether children correctly identified the branded product. Children identified the correct products for 54% of the brands marketed to young children but only 24% of the brands marketed to older children or adults, signifying that child-directed marketing effectively reaches young children and that children associate products with their brand logo. Images

included one FF restaurant that marketed to children, which was identified by 93% of the preschool-age children.[12]

Experimental studies have demonstrated that children are more likely to select branded over non-branded FF items[13] and rate branded FF meals as tastier than equivalent unbranded FF meals.[13–15] For example, in a study among 63 preschool-age children, researchers presented each child with two sets of the same five foods: 1/4 of a McDonald's hamburger, one McDonald's chicken McNugget, three McDonald's French fries, 3 ounces of low-fat milk, and 2 baby carrots. The two sets of foods differed only by their packaging. One set included the standard McDonald's food wrappers or containers, while the other set included white wrappers or containers without images or text. Children tasted each item from the two sets and asked if the items tasted the same or if one was better. With the exception of the hamburger in which the branded and non-branded items were rated equivalent, children overwhelmingly selected the branded items as tasting better. The preference for branded items was stronger as the number of TVs in the home increased, suggesting that advertisement exposure played a role in children's preference for the branded foods.

Outside of a laboratory setting, cross-sectional studies have documented positive associations between exposure to child-targeted FF TV advertising and FF intake among preschool-age children.[16,17] For example, a previous study among 548 parents of preschool-age children[16] demonstrated that children with moderate or high exposure to child-targeted FF TV advertisements were approximately 30% more likely to have consumed FF from those restaurants in the past week, even after adjusting for their parents' fast food intake. However, cross-sectional studies cannot establish that the advertising exposure preceded the intake, and to date, no longitudinal study has compared children's exposure to child-targeted FF TV advertisements and their intake of the advertised foods.

Parents play a primary role in shaping young children's diets,[18–21] and preschool-age children's FF intake is strongly, positively correlated with parental FF consumption.[16,22] Child-targeted FF advertisements are crafted to promote child-pestering to visit the advertised restaurant,[6,10] and it is possible that the effectiveness of such advertising depends upon the parents' own FF habits. Thus, we investigated the influence of FF TV advertisement exposure on children's intake of advertised FF, and whether that effect would differ according to the frequency of the parent's own FF consumption. It was hypothesized that exposure to child-directed FF advertisements would increase the risk of subsequent FF consumption among all children and that the frequency of parental FF consumption could moderate this association.

Methods

Study sample

Participants were recruited March 2014–0ctober 2015 from community-based sites in two New Hampshire, US cities, including pediatric outpatient clinics, Women, Infant, and Child (WIC) clinics, childcare centers, and community and recreational events; solicitation through Facebook and participant referrals were also used. Eligibility criteria included child age (3–5 years), absence of health condition significantly impacting food intake, and living

with parent ≥ three days/week or every other week; parent literacy (English), residence ≤ one hour drive from recruitment site, and no plan to relocate within 12 months. If parents had multiple age-eligible children, the child at the recruitment site was selected; if two or more age-eligible children were present, one was randomly selected. Study activities lasted one year. Parents who completed all study components received $150 in gift cards and children received two toys. Parents provided signed informed consent before participation, and the Dartmouth College Committee for the Protection of Human Subjects approved the study.

Among the 667 parent-child dyads screened and eligible, 624 (93.6%) enrolled and 579 (92.8%) completed the final survey. Parents completed a baseline survey and then six follow-up online surveys. The mean time to the first follow-up survey after baseline was 6.4 (SD=2.3) weeks. Then each follow-up survey were spaced approximately 8 weeks apart. The sixth follow-up survey was completed, on average, 46.6 (SD 2.8) weeks after baseline. Surveys were pre-tested with a demographically comparable sample for comprehension, face validity and completion time.

Children's fast food TV advertising exposure

Children's exposure to brand-specific FF TV advertisements was based on the TV programs each child watched throughout the study period. At each follow-up survey, parents were given a list of 11 national children's TV networks and asked to indicate which networks their child watched in the past week; six of the networks were advertisement-supported: Boomerang, Cartoon Network, Disney XD, Discovery Family Channel (previously The Hub), Nickelodeon, and NickToons. For each network reported, parents used a list of currently aired programs to indicate which programs their child watched. Network-specific program lists were updated prior to each follow-up survey using TV listings from Zap2it.[23] For the weeks between surveys, it was assumed that children watched the programs reported at the subsequent follow-up survey. A database from Kantar Media[24] spanning May 2014-August 2016 was used to count brand-specific FF advertisements aired during the programs each child watched throughout the study period. Three FF restaurants advertised in these programs during this study: McDonald's, Wendy's, and Subway.

Children's cumulative exposure to child-targeted FF TV advertisements throughout the study was computed as advertising stock, or adstock. Adstock is an established economic concept that quantifies the cumulative, diminishing effect of advertisement effectiveness over time.[25–27] Adstock has been used to characterize the long-term, brand-specific effects of advertising on product sales,[25,27–29] brand awareness[30] and consumption[31,32] across a variety of products. In this current study, the total number of FF advertisements (overall and by restaurant brand) that each child was potentially exposed to during each week of the study was computed. A cumulative total for advertisement exposure since baseline was computed for each child by summing each week of exposure; past weekly totals were discounted by a constant rate with each week since exposure. That weekly discounting rate was selected using an empirical grid search,[29] where discount rates were modeled from 0% to 100%, in increments of 1%, to find the value that maximized the log likelihood function of the final adjusted regression model. In summary, for each child at each follow-up survey,

adstock reflected his/her potential cumulative exposure to child-targeted FF TV advertisements since baseline, with greater weight placed on more recently viewed advertisements.

To assess pre-baseline advertisement exposure, parents selected the children's TV networks their children usually watched at baseline from the same list of 11 national children's networks noted above. Children were considered to have pre-baseline exposure to child-targeted FF TV advertising if parents selected any one of the 6 advertisement-supported networks. Each FF restaurant was advertised on these children's TV networks.

Children's fast food intake

At each follow-up survey, parents reported on their child's intake in the past week from 11 popular chain quick-serve restaurants, including McDonald's, Wendy's and Subway. Responses for each restaurant were 0, 1,2, 3, 4, or 5 or more time. Analyses considered both any versus no intake and mean intake in the past week. To assess children's usual FF intake pre-baseline, parents also reported at baseline whether their children usually consumed FF from the same list of 11 popular chain quick-serve restaurants. Children were considered to be usual consumers of each restaurant if their parents selected it from the list.

Parent fast food intake frequency

At baseline, parents reported the frequency with which they consumed any FF (never, less than once a month, more than once a month but less than once a week, 1–2 times a week, 3–4 times a week, 5 or more times a week); responses were collapsed into less frequently (i.e., <monthly) versus more frequently (i.e., >monthly) to approximate non-consumers versus usual FF consumers. A sensitivity analyses was completed dichotomizing parent FF intake frequency at <weekly versus ≥weekly, but dichotomizing at monthly resulted in the better fitting model based Akaike's information criterion (AIC).[33]

Covariates

Baseline covariates included child age, gender, race/ethnicity; parent education, and whether the parent lived with a spouse or partner. Parents reported their children's usual TV (regular, cable, satellite) viewing and other screen time (DVD's/VHS, streaming, apps, internet use, electronic games) at baseline as the number of days per week and hours per day spent on each activity; responses were multiplied to compute hours per week.[16] Past-week TV viewing time was also collected at follow-up surveys; missing data were imputed using the method of last observation carried forward.[34]

Statistical Analysis

Mixed-effects Poisson regression, with a random effect at the child-level and robust standard errors,[35] was used to model the unadjusted associations between each baseline characteristic and the relative risk (RR) of any FF intake over the study. Similar Poisson regression models were used to compute adjusted RRs of any FF intake by children's cumulative FF advertisement exposure. Cumulative advertisement exposure was included in the model as no exposure versus increasing levels of exposure based on tertile cut-points of adstock to

assess for non-linear trends. Models were adjusted for all covariates and children's usual consumption of brand-specific FF pre-baseline. To note, children's pre-baseline advertisement exposure was not included in the regression models. Analyses were repeated to calculate incidence rate ratios (IRR) for mean FF intake by cumulative advertisement exposure. Interaction terms between children's FF advertisement exposure and parental frequency of FF consumption were included in each model to assess for effect modification. The adjusted frequency of any FF intake and adjusted mean FF intake were computed from each regression model and plotted by children's FF advertisement exposure, stratified by the frequency of parental FF consumption. In all models, the threshold for statistical significance was $P<0.05$ based on two-sided tests. Analyses were completed in 2018 using Stata version 15.0 and the R language for Statistical Computing.

Results

Three FF restaurants advertised in the programs viewed by children during the study: McDonald's, Wendy's and Subway. McDonald's accounted for 72.1% of the advertisements aired. On average, 21.1% of children were exposed to a FF advertisement in the week prior to any follow-up survey, and 97.5% of those children viewed a McDonald's advertisement. Also, while 6.2% and 8.6% of children viewed advertisements from Wendy's or Subway, respectively, at any one follow-up survey, nearly all (>99%) of these children were also exposed to McDonald's advertisements at the same time. Additionally, McDonald's accounted for the majority of children's FF intake. On average, 34.1% of children ate FF from any of the three FF restaurants in the week prior to a follow-up survey, and 91.8% of these children ate at McDonald's. While 10.0% and 5.0% of children ate FF from Wendy's and Subway, respectively, about half of those children also ate McDonald's during the same week. Because McDonald's accounted for nearly all of children's FF advertisement exposure and the majority of their FF intake, analyses focused primarily on McDonald's.

Children's mean age was 4.3 (SD 0.8) years, 44.7% were male and 85.3% were white, non-Hispanic; 92.6% of parents were mothers. In unadjusted models (Table 1), any intake of McDonald's was positively associated with child age, weekly screen time, pre-baseline exposure to child-targeted FF TV advertisements, pre-baseline consumption of McDonald's, and parent frequency of FF intake. Intake was inversely associated with the parent cohabitating with a spouse/partner and with parent educational level.

The percentage of children who were exposed to McDonald's advertisements increased over the study period, ranging from 18.7% at the first follow-up survey to 26.6% at the last follow-up survey; the mean percent of children exposed to child-targeted McDonald's TV advertisements was 20.6% when averaged over all follow-up surveys.

The discount rate for children's cumulative exposure to McDonald's advertisements, computed as adstock, was determined to be 8%, translating into a half-life of 8.3 weeks per advertisement. In the fully adjusted model that included children's usual consumption of McDonald's pre-baseline (Table 2), children's cumulative McDonald's TV advertisement exposure did not significantly predict subsequent McDonald's intake. However, the effect of advertisement exposure on subsequent McDonald's intake differed by parent frequency of

FF consumption (*P-for-interaction*=0.001). In the absence of McDonald's advertisement exposure, children's risk of consuming McDonald's FF was more than doubled (RR: 2.38) for those whose parents frequently consumed FF, compared to those whose parents did not. In addition, among children whose parents frequently consumed FF, exposure to McDonald's FF advertisements did not appreciably increase children's risk of McDonald's FF intake. In contrast, among children whose parents infrequently consumed FF, the risk of consuming McDonald's FF was approximately doubled with McDonald's advertisement exposure: the RRs were 1.85, 1.84, and 2.04 for exposure to 1–38, 39–208, and 209+ advertisements, respectively.

Results were similar for mean intake of McDonald's FF (Table 3). Among children whose parents less frequently consumed FF, children's advertisement exposure was significantly associated with an elevated subsequent mean intake of McDonald's (range of IRRs: 1.47–1.97). Mean McDonald's FF intake was elevated among children whose parents frequently consumed FF, compared to those whose parents did not, but was not appreciably affected by increasing advertisement exposure *(P-for-interaction*=0.01).

Among children whose parents less frequently consumed FF, the adjusted frequency of any McDonald's intake was 15% for those with no McDonald's advertisement exposure and doubled to approximately 30% for those exposed to advertisements (Figure 1). In comparison, among children whose parents more frequently consumed FF, the adjusted frequency of any McDonald's intake was approximately 35%, regardless of children's advertisement exposure (Figure 1). The results for adjusted mean intake of McDonald's followed a similar pattern (Figure 2).

Secondary analyses were completed to assess the associations between children's exposure to child-targeted McDonald's, Wendy's, or Subway TV advertisements and their intake from any of these restaurants, and the results were similar to those for McDonald's only (data not shown).

Discussion

The current study examined whether exposure to child-targeted FF TV advertising predicted subsequent FF intake among preschool-age children during a one-year follow-up in a natural setting. McDonald's advertisements accounted for virtually all of children's FF advertisement exposure. Analyses focused on McDonald's indicated that McDonald's intake was highest among children with parents who more frequently consumed FF, regardless of children's advertisement exposure. That finding is not surprising, given the strong correlation between parent and child FF intake.[16,22] However, results also indicated an interaction between the frequency of parent FF consumption and children's exposure to McDonald's TV advertising in relation to children's risk of consuming McDonald's. Specifically, among children whose parents infrequently consumed FF, exposure to child-targeted McDonald's TV advertising approximately doubled children's risk of consuming McDonald's. Findings suggest that FF TV advertisement exposure overrides the protective influence of conservative parental FF habits on children's FF intake.

Young children do not purchase food on their own, but can influence parent food purchases through their requests.[6,36,37] Thus, child requests likely mediated the observed associations between advertisement exposure and intake among children whose parents infrequently consume FF. Prior research documents that parents who less frequently consume FF have high self-efficacy in preparing or selecting healthier meals or snacks for themselves[38] and their children.[21,38] For example, children with lower FF intakes also have a higher diet quality, independent of FF intake.[39] Yet, parents report many reasons in selecting food for their preschool-age children,[40–42] including as a treat, for emotional reasons, or because of child requests. Thus, child requests for FF may indeed be effective even among parents who rarely consume FF themselves. The apparent lack of association between McDonald's advertisement exposure and intake among children whose parents frequently consumed FF probably reflects a previously established, high rate of McDonald's intake among these children. Also, parents may be the primary exposure to McDonald's FF among these children, an influence much greater than that of advertising.

This study presents what may be the first longitudinal data documenting the relationships between children's exposure to child-targeted FF TV advertisements and subsequent intake of advertised FF. Addressing that gap is important to know if child-targeted advertising may causally shape children's food preferences in a real world setting. Findings from this study align with previous cross-sectional studies regarding the positive relationships between FF advertisement exposure and the intake of advertised FF among children. This study also supports that the findings from previous experimental studies on FF advertising on children's preferences and requests, generalize to the real world setting.

Many children in this study (60%) usually consumed McDonald's at baseline, and more research is needed to understand if McDonald's advertisement or marketing exposure shapes children's McDonald's intake at an even younger age than 3 years, regardless of parental FF intake. Also, the percent of children exposed to child-targeted McDonald's TV advertisements increased over time in this study, and it is possible that a longer study would have detected a stronger advertising effect on children's FF intake.

McDonald's is the primary FF restaurant that directly markets to young children through TV advertising[9,10,16] and spent $32.9 million in 2016 on TV advertising for Happy Meals®,[9] the FF meal targeted to young children. McDonald's also exceeds other FF restaurants in the use of child-appealing strategies, such as toy premiums.[43] FF intake is associated with a higher caloric intake, poorer dietary quality[4,5] and a greater BMI[44] among children. Thus, reducing or preventing FF intake during the preschool years is important to help children develop sustainable, health-promoting dietary behaviors. Given young children's inability to understand the persuasive intent of advertising[11] and the impact of advertising exposure demonstrated in this study, McDonald's should eliminate advertising that directly targets young children. McDonald's participates in the Children's Food and Beverage Advertising Initiative self-regulatory program.[45] However, unlike most other food manufacturers participating in that initiative, including Burger King, McDonald's has not pledged to avoid advertising products to children under the age of 6 years.[46] It is important to note that McDonald's has taken steps to address public health concerns by pledging to remove sugary drink options from menu boards for Happy Meals and to further improve the nutritional

quality of those meals. Such continued engagement from McDonald's is also needed to ensure that young children have limited or no exposure to TV advertisements for nutritionally poor foods, for example, by pledging to not directly advertise or market FF to children under the age of 6 years.

Study strengths and limitations

Strengths of this study include the longitudinal design in a natural setting, repeated measures, brand-specific advertisement exposure defined by the TV programs children viewed, a socioeconomically diverse sample, and a high survey completion rate. Additionally, the adjustment for McDonald's consumption at baseline helped to isolate the association between advertisement exposure and subsequent intake. However, there are study limitations to note. While adstock is an established metric of cumulative, decaying advertisement exposure among adolescents, young adults and adults, whether a cumulative, decaying model for advertisement exposure effectively explains the influence of advertisement exposure on the behaviors of preschool-age children is unconfirmed. This analysis did not include children's advertisement exposure on general audience networks or other media (e.g., online), and parents' exposure to FF advertisements was not collected. Study measures were parent-reported, which may have been affected by social desirabilty bias. Also, the study outcome was the number of times children had something to eat or drink from McDonald's in the past week, and the specific foods and drinks children consumed were not measured. The study sample was primarily white, non-Hispanic, and while the proportion of children who consumed McDonald's in the past week was similar to that for an independent sample from the same geographical region,[16] rates are lower than that reported in a more racially and ethnically diverse sample of 2–5-year-olds.[47] Also, black children are disproportionally exposed to food advertising because of higher TV viewing;[48] thus, TV advertisement effects may be even greater in more diverse samples.

Conclusions

Parental FF habits are strongly predictive of children's FF intake, and children whose parents consumed FF more frequently were at highest risk of consuming McDonald's. Among children whose parents consumed FF less frequently, high exposure to FF TV advertising was as influential as having a parent who more frequently consumed FF. Continued efforts are needed at the family-level to reduce children's FF intake. However, given that the poor nutritional quality of children's FF meals and the vast reach of child-targeted FF TV advertising, greater efforts to limit preschool-age children's exposure to TV FF advertising are needed.

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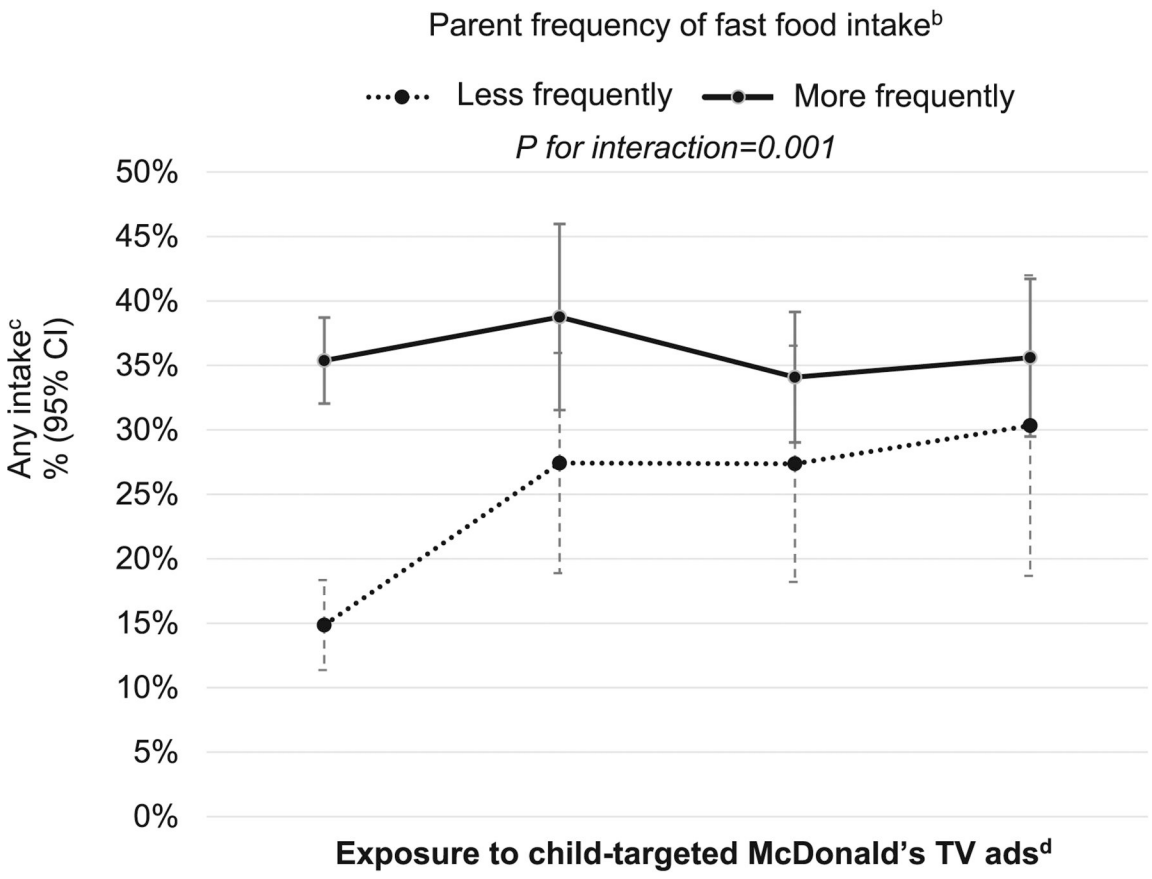


No ad exposure	T_1 adstock 1-38 ads	T_2 adstock 39-208 ads	T_3 adstock 209+ ads
	% of Participants[e]		
65.9%	11.3%	11.3%	11.6%

Figure 1.

Adjusted frequency of any McDonald's intake by exposure to child-targeted McDonald's TV advertisements, stratified by parent fast food intake frequency.[a]

Among 624 preschool-age children enrolled in a prospective study in southern New Hampshire, US, 2014–2016.

[a]Adjusted probabilities computed using repeated measures Poisson regression with robust standard errors; model was adjusted for child's baseline consumption of McDonald's (yes vs. no) and child age, gender, race/ethnicity, non-TV screen media use at baseline (hours per week) and TV screen media use at each time point (hours per week); parent education and whether the parent lived with a spouse or partner.

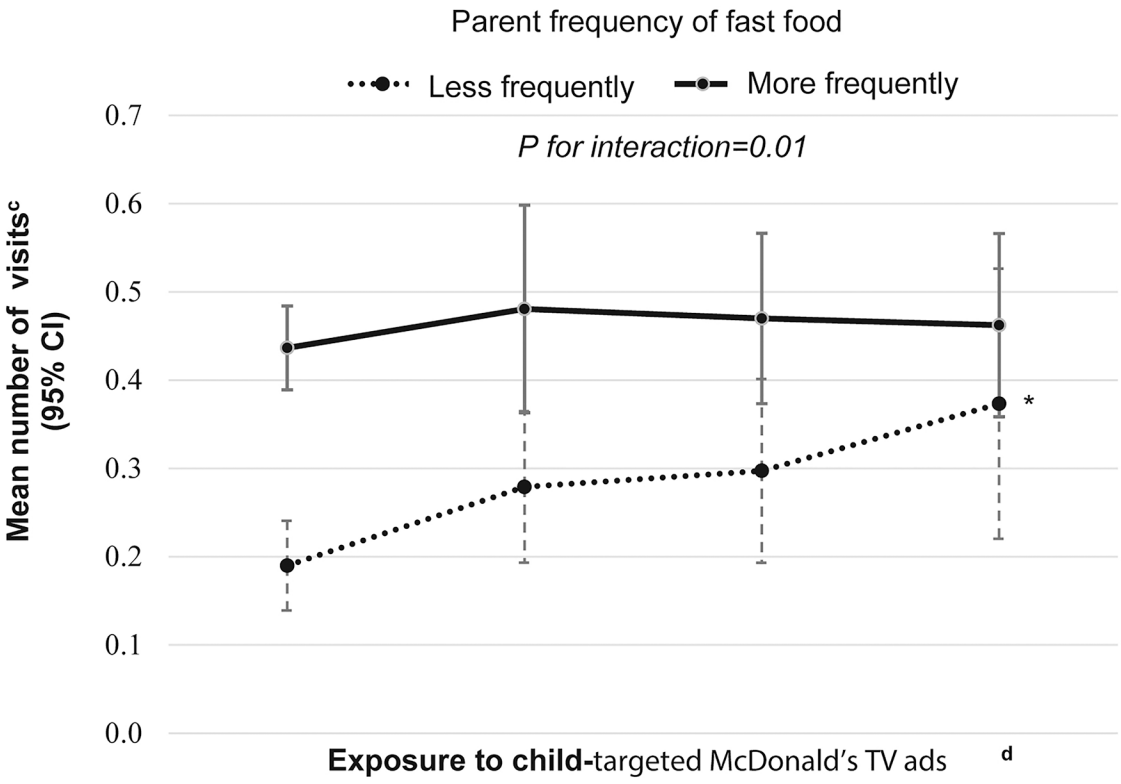
[b]Less frequently defined as consuming fast food less than once a month; more frequently defined as consuming fast food at least monthly.

[c]Any versus no McDonald's intake in the week prior to each follow-up assessment.

[d]Advertisement exposure quantified as adstock, or cumulative ad exposure that includes a discounting rate of 8% for each week since exposure. Adstock categorized as no ad exposure

or ordered categories of exposure based on tertiles of adstock: T_1=l–38, T_2=39–208, and T_3=209+ adstock.

[e]The % of children within each advertisement exposure level at each follow-up survey was averaged over all surveys.



No ad exposure	T_1 adstock 1-38 ads	T_2 adstock 39-208 ads	T_3 adstock 209+ ads
% of Participants[e]			
65.9%	11.3%	11.3%	11.6%

Figure 2.

Adjusted mean intake of McDonald's by exposure to child-targeted McDonald's TV advertisements, stratified by parent fast food intake frequency.[a]

* *P* for linear trend=0.03.

Among 624 preschool-age children enrolled in a prospective study in southern New Hampshire, US, 2014–2016.

[a]Adjusted probabilities computed using repeated measures Poisson regression; model was adjusted for child's baseline consumption of McDonald's (yes vs. no) and child age, gender, race/ethnicity, non-TV screen media use at baseline (hours per week) and TV screen media use at each time point (hours per week); parent education and whether the parent lived with a spouse or partner.

[b]Less frequently defined as consuming fast food less than once a month; more frequently defined as consuming fast food at least monthly.

[c]The number of times a child had something to eat or drink from McDonald's in the week prior to each follow-up assessment (0, 1, 2, 3, 4 or 5 or more).

[d]Advertisement exposure quantified as adstock, or cumulative ad exposure that includes a discounting rate of 8% for each week since exposure. Adstock categorized as no ad exposure

or ordered categories of exposure based on tertiles of adstock: T_1=1–38, T_2=39–208, and T_3=209+ adstock.

[e]The % of children within each advertisement exposure level at each follow-up survey was averaged over all surveys.

Table 1.

Baseline sample characteristics, and associations between each characteristic and children's risk of consuming McDonald's over the study period.

	n	%	Any McDonald's intake[a,b] RR (95% CI)
Child characteristics			
Age, years, mean (SD)	624	4.3 (0.8)	1.14 (1.03, 1.26)*
Male	219	44.1	1.02 (0.81, 1.20)
Racial or ethnic minority	92	14.1	1.03 (0.81, 1.32)
Screen time, hours per week, mean (SD)			
TV (regular, cable or satellite)	624	8.2 (1.1)	1.02 (1.01, 1.03)†
Other screen time	624	10.1 (12.2)	1.01 (1.01, 1.02)†
Pre-baseline exposure to child-targeted fast food TV advertisements[c,d]	188	30.1	1.49 (1.21, 1.14)*
Pre-baseline consumption of McDonald's	319	60.1	3.13 (2.93, 4.16)†
Parent characteristics			
Educational attainment			
High School or less	151	24.2	1.00 (Reference)
Associate's or Technical degree	113	18.1	0.89 (0.13, 1.10)
Bachelor's degree	199	31.9	0.65 (0.53, 0.80)†
Graduate degree	161	25.8	0.54 (0.43, 0.68)†
Annual household income[d]			
Less than $25,000	80	12.8	1.00 (Reference)
$25,001–$75,000	210	33.1	0.11 (0.62, 0.96)*
$75,001–$125,000	225	36.1	0.68 (0.54, 0.85)†
More than $125,000	109	11.5	0.53 (0.40, 0.12)†
Lives with spouse or partner	529	84.8	0.13 (0.60, 0.88)†
Parent fast food intake frequency[e]			
Infrequently	195	31.3%	1.00 (Reference)
Frequently	429	68.8%	2.10 (1.61, 2.62)†

*$P<0.05$;

†$P<0.01$

Among 624 preschool-age children enrolled in a prospective study in southern New Hampshire, US, 2014–2016.

[a]Any intake defined as any intake in the week prior to each follow-up assessment.

[b]Relative risks computed using repeated measures Poisson regression with robust standard errors, and RRs presented reflect the average risk difference of any McDonald's intake over the course of the study.

[c]Pre-baseline exposure to child-targeted fast food TV advertisements was based on usual viewing of at least one advertisement-supported children's networks include Boomerang, Discovery Family Channel, Disney XD, Nickelodeon, Nicktoons, and Cartoon Network.

[d] Pre-baseline advertisement exposure and annual household income are included here to show the associations, but they were not included as covariates in the adjusted regression models.

[e] Less frequently defined as consuming fast food never to less than once a month; more frequently defined as consuming fast food at least monthly.

Table 2.

Adjusted associations between children's exposure to child-directed McDonald's TV advertisements and any intake of McDonald's throughout the study, overall and in relation to parental frequency of fast food intake.

	Any McDonald's intake (yes vs. no), RR (95% CI)[a,b] Child McDonald's TV ad exposure[c]			
	No ad exposure	**$T_{1\ adstock}$ 1–38 ads**	**$T_{2\ adstock}$ 39–208 ads**	**$T_{3\ adstock}$ 209+ ads**
% of participants, mean[d]	65.9%	11.3 %	11.3%	11.6%
All participants (n=624)	1.00 (Reference)	1.20 (1.00, 1.44)*	1.08 (0.92, 1.21)	1.14 (0.95, 1.36)
Stratified by parent frequency of fast food intake at baseline[e]				
Less frequently (n=195)	1.00 (Reference)	1.85 (1.25, 2.13)†	1.84 (1.25, 2.11)†	2.04 (1.29, 3.23)†
More frequently (n=429)	2.38 (1.84, 3.01)†	2.61 (1.93, 3.52)†	2.29 (1.13, 3.05)†	2.40 (1.11, 3.24)†
P for interaction term across strata = 0.001				

*$P<0.05$;

†$P<0.01$

RR: Relative risk.

Among 624 preschool-age children enrolled in a prospective study in southern New Hampshire, US, 2014–2016.

[a]Relative risks from mixed-effects Poisson regression with a random intercept at the child level and robust standard errors. Each model adjusted for child age, gender, race/ethnicity, non-TV screen media use at baseline (hours per week), TV screen media use at each time point (hours per week), and baseline consumption of McDonald's (yes vs. no); parent education and whether the parent lived with a spouse or partner. RRs stratified by parent fast food consumption were computed by including an interaction term between child's advertisement exposure and parent fast food consumption in the model.

[b]Any versus no McDonald's intake in the week prior to each follow-up assessment.

[c]Advertisement exposure quantified as adstock, or cumulative ad exposure that includes a discounting rate of 8% for each week since exposure. Adstock categorized as no ad exposure or ordered categories of exposure based on tertiles of adstock: T_1=l-38, T_2=39–208, and T_3=209+ adstock.

[d]The % of children within each advertisement exposure level at each of the six follow-up surveys was averaged over all surveys.

[e]Parents' fast food consumption measured at baseline. Less frequently defined as consuming fast food less than once a month; more frequently defined as consuming fast food at least monthly.

Table 3.

Adjusted associations between children's exposure to child-directed McDonald's TV advertisements and frequency of McDonald's intake throughout the study, overall and in relation to parental frequency of fast food intake.

	Frequency of McDonald's intake (mean intake), IRR (95% CI)[a,b] **Child McDonald's TV ad exposure[c]**			
	No ad exposure	**$T_{1\ adstock}$ 1–38 ads**	**$T_{2\ adstock}$ 39–208 ads**	**$T_{3\ adstock}$ 209+ ads**
% of participants, mean[d]	65.9%	11.3 %	11.3%	11.6%
All participants (n=624)	1.00 (Reference)	1.15 (0.92, 1.45)	1.14 (0.93, 1.40)	1.18 (0.94, 1.41)
Stratified by parent frequency of fast food intake at baseline[e]				
Less frequently (n=195)	1.00 (Reference)	1.41 (0.98, 2.20)	1.51 (1.05, 2.34)*	1.91 (1.20, 3.22)†
More frequently (n=429)	2.30 (1.12, 3.06)†	2.53 (1.16, 3.63)†	2.41 (1.16, 3.48)†	2.43 (1.69, 3.51)†
P for interaction term across strata = 0.01				

*$P<0.05$;

†$P<0.01$

IRR: Incidence rate ratio.

Among 624 preschool-age children enrolled in a prospective study in southern New Hampshire, US, 2014–2016.

[a]Incidence rate ratios computed using mixed-effects Poisson regression with a random intercept at the child level. Each model adjusted for child age, gender, race/ethnicity, non-TV screen media use at baseline (hours per week), TV screen media use at each time point (hours per week), and baseline consumption of McDonald's (yes vs. no); parent education and whether the parent lived with a spouse or partner. IRRs stratified by parent fast food consumption were computed by including an interaction term between child's advertisement exposure and parent fast food consumption in the model.

[b]The number of times a child had something to eat or drink from McDonald's in the week prior to each follow-up assessment.

[c]Advertisement exposure quantified as adstock, or cumulative ad exposure that includes a discounting rate of 8% for each week since exposure. Adstock categorized as no ad exposure or ordered categories of exposure based on tertiles of adstock: T_1=l–38, T_2=39–208, and T_3=209+ adstock.

[d]The % of children within each advertisement exposure level at each follow-up survey was averaged over all surveys.

[e]Less frequently defined as consuming fast food less than once a month; more frequently defined as consuming fast food at least monthly.