HHS Public Access
Author manuscript
Pediatr Obes. Author manuscript; available in PMC 2022 April 01.

Published in final edited form as:
Pediatr Obes. 2021 April ; 16(4): e12735. doi:10.1111/ijpo.12735.

Examining Chile's Unique Food Marketing Policy: TV Advertising and Dietary Intake in Preschool Children, a pre- and post- policy study

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Abstract

Background: The Chilean government implemented the first phase of a comprehensive marketing policy in 2016, restricting child-directed marketing of products high in energy, total sugars, sodium or saturated fat (hereafter "high-in").

Objectives: To examine the role that high-in TV food advertising had in the effect of the policy on consumption of high-in products between 2016 and 2017.

Methods: Dietary data were obtained from 24-hour diet recall measured in 2016 (n=940) and 2017 (n=853), pre- and post-policy, from a cohort of 4–6 y children. Television use was linked to analyses of food advertisements to derive individual-level estimates of exposure to advertising. A multilevel mediation analysis examined direct and indirect effects of the policy through advertising exposure.

Results: Children's high-in food consumption and advertising exposure declined significantly from 2016 to 2017 ($p<0.01$). Consumption changes were not significantly mediated by changes in advertising exposure, which might suggest other elements of the Chilean Law potentially driving decreases in consumption to a greater extent than TV ads.

Conclusions: Preschoolers' exposure to high-in advertising and consumption of high-in products decreased post-policy. Further research is needed to understand how marketing changes will relate to dietary changes after full implementation of the law and in the long term.

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[6.]Conflict of interest statement
None of the authors have conflict of interests of any type with respect to this manuscript. Funders had no role in the design, analysis, or writing of this article.

Keywords

food marketing; food advertising; food environment; dietary intake; policy

2. Introduction

Childhood obesity is a public health concern across Latin America[1]. In Chile, 49% of preschool children were affected by overweight or obesity in 2018.[2] Many factors contribute to excess weight gain in childhood, including the food environment.[3] Children worldwide are heavily exposed to food and beverage marketing,[4–6] and most of the marketed products are high in energy, saturated fat, sugars, or sodium, and are of little nutritional value.[6] This is relevant, given that marketing affects children's food preferences, choice, and consumption.[7–11] Although some regulations to reduce children's food marketing exposure have been implemented around the globe, the majority of these have been voluntary industry-led initiatives, which have largely been found to be ineffective.[12] Governmental regulations are less common, with few systematic evaluations of the effects of these policies.[12,13] Most of the policy evaluations have focused on changes related to the advertising itself (ad exposure, ad expenditures, frequency and placement of ads on television, nutrition quality of ads, etc.) or in fewer cases, changes in food sales.[14] Lacking are studies of how changes in advertising due to government restrictions impact dietary intake in a naturalistic setting. This research gap poses an important barrier to policy change in other contexts.

In 2016, the Chilean government implemented the first phase of its Law of Food Labeling and Advertising.[15–17] The first phase of the marketing restriction component of the law banned the marketing of "high-in" foods—foods exceeding government-defined thresholds for added total sugars, saturated fats, sodium, and energy to children under 14 years of age. This included marketing material placed in content (e.g., advertising in television programs) that was either intended for children <14yo or attracted audiences where 20% or more of its audience included children <14yo. This regulation extended across different media and has been considered among the most comprehensive worldwide.[12,18]

An evaluation of this first phase of the regulation found that preschoolers' exposure to televised food advertising of "high-in" products was low at baseline but still decreased significantly.[19] However, it is unknown if this decrease in exposure is associated with changes in children's dietary intake, particularly for products high in energy, saturated fats, total sugars and sodium. Multiple major policy changes were enacted at the same time as the marketing restriction: foods that exceed energy and nutrient thresholds are also subject to a front-of-package warning label, and their sale is prohibited in schools.[16] Therefore, the evaluation of changes in food intake that are due specifically to the marketing restriction is complex, given that these changes occurred simultaneously. Thus, a simple pre-post analysis examining changes in advertising exposure and changes in dietary intake over time is insufficient, because the main independent variable (time) is also associated with a number of other factors that could be driving the change in dietary intake. Mediation analysis offers an opportunity to explore intermediate pathways or mechanisms through which an intervention may have an effect.[20] In this study, the focus is on how the policy may affect diet through changes in television (TV) advertising. We study TV advertising, given TV remains the most popular promotional channel[10] and used widely in Chile;[21] although we understand direct effects are not the only pathway of marketing effects. It is important to note that this policy affected other media, such as marketing on food packages, the internet, and radio, which are not captured by our study.

This quasi-experimental pre-post study aimed to examine the role that high-in TV food advertising had in the effect of the policy on consumption of high-in foods and beverages between 2016 (pre-policy) and 2017 (post-policy). We tested the association between high-in TV advertising and dietary intake at baseline (pre-policy). Then, we examined whether high-in TV advertising exposure mediated any effect of the policy on food consumption. Lastly, we examine whether changes in consumption of high-in products differ by baseline levels of high-in advertising.

3. Methods

3.1 Participants and setting

We used data from two waves (2016 and 2017) of the Food Environment Chilean Cohort (FECHIC), a longitudinal cohort study of preschool children aged 4–6 y upon recruitment in 2016. The study cohort was recruited from low- and middle-income neighborhoods in the southeastern area of Santiago, Chile. Recruitment strategies and inclusion and exclusion criteria are described elsewhere.[22,23] In brief, FECHIC included children who were single births, whose mothers were in charge of food purchases at home and primary caregivers of children, and who (along with their mothers) had no mental health condition or gastrointestinal diseases that would affect food consumption.[22] At baseline in 2016, mothers of 940 children of the original FECHIC sample (n=962) completed dietary intake and TV food advertising assessments. At follow-up, complete data was obtained for 853 (90.7%) of the baseline sample. We obtained written informed consent from parents or legal guardians of participants, and the ethics committees of the Institute of Nutrition and Food Technology and the University of North Carolina at Chapel Hill approved the study protocol.

3.2 Data Collection

In 2016 and 2017, trained dietitians administered questionnaires that included television use items and a 24-hour food recall instrument. Mothers reported their children’s media use and dietary intake with help from the children.

3.2.1 Advertising Exposure—A detailed explanation of how individual-level advertising exposure measures were estimated for this study has been previously published.[19] In brief, mothers of children reported children’s weekly hours and channels of television use with items adapted from the Global Weekly Estimate of children’s television viewing.[24] Reports were used to calculate hours the child viewed specific television channels during different times of day on weekdays and weekends. A separate content analysis of TV advertisements was done in 2016 and 2017. This analysis gathered all ads aired between 6 am and 12 am, during 2 constructed weeks in April and May of each year (2 randomly selected Mondays, 2 randomly selected Tuesdays, and so on), among eight highly viewed

TV channels in Chile.[25,26] We then identified the nutritional quality of the promoted food and beverage ads,[25] including their food and beverage category, regulation status, and time and channel of airing. The regulation status for each advertised product was assigned by linking products appearing in the ad with nutrition facts panel (NFP) data collected pre-regulation in 2015–2016 and post-regulation in 2017.[27,28] Trained nutritionists reviewed and assigned a regulation status to each product based on the nutrition content of the product and the thresholds of the Chilean law, described in Table S1.[16] For this paper, packaged products exceeding these nutrient thresholds are called high-in products, and ads featuring any high-in product are designated high-in ads. High-in advertising minutes were assigned to children based on the channels and time periods they reported viewing.[19]

3.2.2 Dietary Intake—The mother of the child was the primary respondent for completing the child's 24-hour dietary recall, using a multiple-pass method assisted by a computer software developed for such purposes. A second 24-hour recall was collected in 20% of the sample each year (2016 and 2017). Serving sizes of common Chilean food and beverages were assessed with a food atlas that included use of images such as bowls, plates, mugs, and glasses.[29] Nutrient values were calculated from the USDA Food and Nutrient Database,[30] as well as information from the NFP of packaged products in Chilean supermarkets. The NFP data were collected from high- and low-income area supermarkets during the study period, using a standardized photographic methodology.[27] An initial step in the analysis was to update the food composition table from which nutrient information was derived using the NFP data collected for each corresponding year. Therefore, the updated food composition table contained NFP values for two different time periods, pre- and post-regulation. To calculate children's nutrient intakes resulting from recalls collected in 2016, the linkage was done to the NFP values of 2015–2016; likewise, to calculate nutrient intakes for 2017, the linkage was done to the NFP values of 2017. This update was important, so that dietary intakes could reflect nutrient values of products in the Chilean food supply, which might have been reformulated in response to the regulation. The linkage was done at the product-specific level; and in cases in which the NFP value for the exact product was not available, the most similar product was used (for example, if the child reported grape-flavored drink, but only strawberry flavor was available, the linkage was done to this product).

To assign high-in status of foods consumed, we adopted a practical step-wise approach. First, we identified all the individual foods reported by participants. Then, these were manually coded as packaged/non-packaged based on the detailed name of product (for example, searching for a brand name or packaging description). Once packaged products were identified, high-in status was given to those that exceeded the thresholds for energy, saturated fats, total sugars, and/or sodium, based on the packaging information. High-in status was assigned per year, so that products could become non- high-in due to reformulation or threshold changing. According to the Chilean law, nutrient cut points only apply to products with added nutrients of concern (for example, a 100% fruit juice with no added sugar is not considered high-in). Note that high-in status was only assigned to packaged food products, because assigning regulation status required availability of nutrition facts panel data.

3.3 Measures

3.3.1 Outcomes: Food consumption—Our primary outcome variable was consumption of high-in foods and beverages, expressed both in absolute energy intake (kilocalories), and energy-adjusted (percent of total daily energy intake). Consumption of five key food groups and three nutrients of concern were considered secondary outcomes, and only used for analysis when assessing baseline association of marketing with food consumption. The five food groups of interest were: ready-to-eat breakfast cereals, salty snacks, sweets and desserts, sugar sweetened beverages, and milks and yogurts (drinkables and edibles); all expressed in both absolute energy intake (kcal) and energy adjusted (percent kcal). These five food groups are energy-dense products commonly marketed on television to children and adolescents globally[6] and that were also found to be highly advertised in Chile.[25,26] Our food consumption variables were derived from the first dietary recall of all study participants, except in cases in which this recall was unreliable (according to dietitians collecting the data) or not a usual intake day (according to study participant), in which case the second recall available was used instead (86.0% of all recalls were usual). A list of examples of products included in each of the five food groups, is provided in Table S2.

3.3.2. Food advertising—Children's exposure to food advertising was measured in weekly minutes. For each child, the weekly number of minutes of exposure to advertising was obtained for products specifically high in: (i) energy, (ii) total sugars, (iii) sodium, and (iv) saturated fats. Note that these categories were not mutually exclusive, because some ads exceeded the thresholds for multiple nutrients of concern. We also calculated an overall number of weekly minutes of exposure to high-in advertising featuring at least one nutrient exceeding the threshold.

3.3.3. Covariates—Covariates included age (in months), sex at birth (dichotomous), mother's education level (less than high school, completed high school and above high school), marital status (married/living with partner or other), home ownership (yes/no), and day of dietary recall (weekday/weekend).

3.4 Statistical Analyses

First, we examined the association between children's exposure to high-in TV advertising and daily dietary intake (high-in foods, as well as key nutrients of concern and food groups) at baseline. To assess these associations, we categorized participants into four exposure groups: no advertising (zero weekly minutes, n=257) and low, medium, and high high-in advertising exposure (based on tertiles for those with more than zero weekly minutes). Tertiles were considered more appropriate given that the distribution of the exposures of interest were skewed, as well as to ensure similar sample size within each comparison group. We used multivariable regression models adjusting for the aforementioned covariates and post-hoc pairwise comparisons to examine differences in the main outcomes by groups compared to our reference group (no exposure). This analysis was done for the entire sample available at baseline (n=940).

To model possible direct and indirect effects of the policy through TV food advertising, we conducted a mediation analysis. Given that this analysis required pre- and post- policy data, we restricted the analyses to children with complete dietary and advertising data at follow-up (n=853, 95.7% of baseline sample). Mothers with higher education were slightly more likely to remain in the sample at follow-up (Table S3), no other differences between participants with complete data and those lost to follow-up were observed for nutrients, advertising exposure or covariates.

Regression models were used to test whether exposure to TV advertising mediated the association between the pre-post policy implementation period and consumption of high-in products (both in absolute intake [kcal] and energy adjusted [percent calories]). A total of five mediation analyses were performed, each using one of the following mediators (all in weekly minutes): TV advertising with products "high in" (1) total calories, (2) total sugars, (3) saturated fats, (4) sodium, and (5) any of the thresholds. Policy implementation was dichotomous, with 1 = post-policy, and 0 = pre-policy. All models controlled for the aforementioned covariates. To account for inflation of Type I error, a familywise error correction was applied and an alpha value of 0.01 (0.05/5 mediators=0.01) was considered significant.

We estimated indirect effects by using the product of coefficient method [20,31]. To account for the longitudinal nature of the data, a two-level model was fit (Stata GSEM), and a random intercept was included in each equation at the individual level. For each mediation model, the following associations were tested (Figure 1): (i) the association between policy implementation and each advertising exposure variable (a-coefficient); (ii) the associations between each advertising exposure variable and dietary outcomes, controlling for policy implementation (b-coefficient); and (iii) the direct effect of policy implementation, independent of advertising variable (c'-coefficient). The indirect effect of policy implementation through ad exposure in each mediation analysis was calculated by multiplying the a and b coefficients, and then presented as the percentage of the total effect mediated (ab/(c' +ab))*100. To determine the statistical significance of the a*b coefficient, 99% confidence intervals and corresponding p-values were assessed. Mediation exists if a*b is different from zero.

Finally, we examined whether the effect of policy implementation on food consumption differed by baseline levels of advertising using two-level mixed models with a random intercept at the individual level and adjusting for covariates. Interaction terms between baseline levels of advertising (none, low, medium, high) and policy period (2016 vs 2017) were added to the model. To examine the influence of implausible energy reporters, all analyses were repeated excluding outliers for total caloric intake (n=10 and n=18, for baseline and longitudinal analyses, respectively). All analyses were conducted using STATA 16.0 software (StataCorp LP, College Station, Texas, 2019).

3.5 Sensitivity Analyses

Because some research has suggested that children with higher BMI may be more responsive to food advertising[32], we additionally conducted our mediation and stratified analyses adjusting by children's weight status (categorized into three groups -normal, overweight, obesity-)[33].

4. Results

4.1 Participant characteristics

Table 1 displays study participant characteristics at baseline. The mean age was 4.8±0.5 years and 51.8% were female. At baseline, participants were exposed to an average of 2.6±3.2 minutes of any high-in ads per week, and the mean consumption of high-in foods and beverages was 350±260 kcal, representing 28.7±17.5% of daily caloric intake.

4.2 Baseline associations of food consumption and TV advertising

As shown in Table 2, compared to children with no high-in ad exposure, children with low, medium, or high exposure to high-in ads at baseline had higher levels of high-in food consumption, both in absolute intake (kcal) and energy adjusted (percent calories). However, only some of these comparisons reached statistical significance (medium exposure for adjusted energy intake and low exposure for absolute intake). For food groups, children with at least some advertising exposure consumed on average more sweets and desserts, compared to children with no exposure. Total energy (kcal) also trended in this direction, however the difference was not statistically significant.

4.3 Mediation analyses

As displayed in Table 3, policy time period had a significant effect on each type of high-in TV advertising exposure (a-coefficients), ranging from a mean decrease of 0.1 minutes/week for high sodium ads (99%CI −0.06, 0.13) to a decrease of 2.2 min/week (99%CI −1.9, −2.5) for any high-in ad. Advertising exposure did not have a significant effect on high-in consumption in any of the models (b-coefficients), either in absolute intake (kcal) and energy adjusted (percent calories).

Policy implementation had a significant total effect on consumption of high-in foods, both as absolute intake (c=−95 kcal, 99%CI: −138, −50) and energy adjusted (c= −9.7 99%CI: −12.5, −7.0]). After accounting for the advertising mediator in each model, the direct association between policy implementation and high-in consumption (c'-coefficient) remained significant ($p<0.05$).

When examining the indirect effect, or mediating effect of high-in advertising exposure, none of the five models showed an appreciable indirect effect between policy implementation and high-in consumption through advertising exposure.

4.4 Change by Baseline Levels of Advertising

Figure 2 displays changes in consumption of high-in foods by baseline levels of advertising exposure, in absolute intake and energy adjusted, respectively. Results from a Wald test for the interaction term indicated that there were significant differences in these changes both when expressed as absolute intake of high-in (kcal) and energy adjusted (% kcal). In both cases, children with low, medium, and high levels of advertising at baseline decreased consumption of packaged high-in foods slightly more than those with no exposure to advertising at baseline.

4.5 Sensitivity analysis

Additionally adjusting our analysis by children's weight status did not change our main results, including the mediation analyses (Table S4) and the change stratified by baseline levels of high-in advertising (Figure S1).

5. Discussion

In this study, we found that although the initial implementation of the Chilean Law of Food Labelling and Marketing was associated with significant decreases in both exposure to TV advertising of high-in products, and consumption of high-in products after one year of implementation, the percentage of the decrease in consumption that was mediated through TV advertising exposure was small. That is, although the policy seems to be having its intended effect on both advertising exposure and food consumption, the mediation analysis suggests factors other than the decrease in exposure to TV advertising may be important in driving the decrease in high-in consumption in this initial stage. These results are in line with the complexity of the mechanisms of food marketing effects. These effects are multi-level, and range from awareness of products and brands, to changes in attitudes and preferences, which interact with physiological and contextual influences that eventually lead to food purchase and consumption [34]. Furthermore, the effects of branding are important to highlight. Companies seek to create positive experiences with their brands at an early age, and these develop over time [35]. Therefore, we believe changes in dietary intake may take longer than one year to manifest given the extensive brand building that will have proceeded the implementation of a policy.

In this study, high-in TV advertising exposure accounted for 1.6–10.9% of the decrease observed in the consumption of high-in foods and beverages after one year of implementation of the Chilean policy. It is likely that this short-term change in our main outcome is more strongly driven by other components of the Chilean regulation, such as the front-of-package warning labels[36] and the school feeding and vending restrictions that are related to dietary changes on a short-term compared to marketing effects. Given that these policies were implemented concurrently with the marketing ban, it is difficult to disentangle the relative contribution that each of these makes in the decrease in consumption.

In addition, the implementation of the policies was accompanied both by mass media campaigns to inform the consumer about the labeling component of the law, and by ample coverage of the law in the main media outlets, such as newspapers and broadcast news. Both of these could have led to increased societal awareness that could be part of the indirect effect of the policy. It is important to note, however, that some evidence suggests that not many people were aware of the advertising component of the Chilean law, specifically, as opposed to awareness about the front-of-package warning labels[36]. Although we are not yet aware of any systematic evaluation of media coverage of Chile's law, how it changed over time, or how it may have influenced behavior, previous studies of media coverage have shown that they may have some influence on consumer knowledge and attitudes regarding governmental regulation[37,38].

An important methodological consideration in our study is that not all high-in foods consumed by preschool children were necessarily TV advertised, and likewise, not all high-in foods highly advertised are necessarily common in the diet of preschoolers. Therefore, it is possible that existing associations between advertising and diet of preschoolers, might have been obscured given the general approach in our analyses. As an example, sodas are highly advertised in Chilean TV, [25] but not a top contributor to energy intake among preschool children, in comparison to other sugar-sweetened beverages [23,39].

Therefore, a decline in advertising of soda would not necessarily relate to a decline in high-in. We attempted to address this limitation with our baseline analyses, which was food group specific for products highly advertised in Chile [25]; however, there might have still been a mismatch within products of a specific group, as is the case of sugar sweetened beverages.

In addition, this study focused only on television advertising. Studies conducted in other settings have evidenced presence of marketing on digital platforms [40,41], billboards and posters surrounding schools [42], as well as in-store strategies used to capture the attention of children [43]. Even though the Chilean Law prohibits all forms of child-directed marketing, children are likely still exposed to an overwhelming amount of unhealthy food and beverage advertising through other means. Furthermore, this study only assessed changes following the first step in the marketing regulation. In May 2018, an additional law was implemented, which further restricted the regulation to all television programs from 6 am to 10 pm, regardless of percentage of child audience. We expect that this will produce a much larger decline in children’s exposure to television food advertising. More research will be needed to understand how this more stringent restriction relates to changes in food consumption. The small absolute change in exposure to TV advertising after the policy may have limited our ability to detect the contribution of TV advertising to changes on food consumption. Mean decreases in advertising ranged from 0.2 minutes in the low exposure group to 6.5 minutes in the high exposure (data not shown). As previously mentioned, this might not be a large enough change to detect a significant difference in changes in associated food consumption. However, it is important to note that larger changes in high-in consumption were seen for children with higher levels of baseline advertising, which along with the mediation results, suggests that high-in advertising could be playing a role in the change in consumption, although small.

Other studies have found cross-sectional associations between unhealthy food marketing exposure and food consumption in children.[10,11] For example, one study found that being exposed to fast food TV advertising was associated with a 26 to 31% increase in the likelihood of consuming fast food among preschool children, depending on their level of ad exposure [44]. Likewise, exposure to child-directed sugary breakfast cereals was positively associated with sugary cereal brand consumption [45]. In our study, children with higher advertising exposure at baseline consumed more sweets and desserts. However, the differences for other food groups and nutrients were non-significant. One possible reason for the lack of an expected association with other food groups and nutrients is the relative small variability in the amount of TV advertising that children were exposed to in our sample. For example, the mean advertising in the higher category was 7.2 minutes/week, while the mean advertising in the low exposure group was 0.7 minutes, representing a difference of 6.5

minutes/week. The typical duration of an advertising spot is ~30 seconds, and therefore it could be argued that ~12 commercials per week is not enough to detect associated differences in diet in such a short-period of implementation, when for example, estimates for the US reported children view on average 10 food-related ads per day [46]. Also, a key difference between these studies and ours was their ability to assess advertising at a food group specific level (as opposed to combining multiple groups), thereby defining their exposure and outcome more precisely, which could have resulted in increased ability to detect diet-advertising associations.

The stratified analyses by baseline levels of high-in advertising revealed that those with no exposure to high-in ads decreased high-in consumption the least. These analyses did not consider *changes* in advertising, as did the mediation component. Here, we more so explored the role of baseline TV advertising as a moderator in the pre-post policy dietary intake change. These results rather than reflecting an intrinsic policy mechanism, might point towards confounding by unmeasured variables that drive TV viewing. For example, factors such as family TV viewing, parental rules and neighborhood safety are strongly associated with screen viewing behaviors of children.[47] Preschoolers with less exposure to advertising at baseline in our sample were already consuming less high-in foods at baseline (perhaps due to more strict parental rules around healthy eating), which made the relative change smaller in this subgroup. Another important consideration is that this first stage of the Law targeted advertising directed to children, specifically. The expected effect would be that children's exposure to high-in food ads decreased, which would decrease their requests to parents to purchase these foods. However, most of the time and in particular for preschoolers, the ones making the food purchase decisions are the parents, who are still exposed to high-in advertising in the media they encounter, and might hold strong brand loyalty.

Several limitations are worth noting. First, because all our data were self-reported, measurement error is a possibility, both in our TV advertising exposure as in our dietary data. Weekly estimates of TV viewing reported by parents, despite being used in previous studies, relied on participants' memory. While content analyses of TV ads covered eight highly viewed TV channels in Chile, many of the children viewed channels not included in the advertising analyses.[19] Therefore, children in Chile might be exposed to more high-in advertising than the estimated in our study. Additionally, one 24-hour dietary recall is not representative of usual dietary intake, as it is a snapshot of an individual's diet at one point in time. We attempted to address this by asking mothers whether the day was a usual one for their child intake, and considering this in selecting the primary dietary recall used for analysis (86% of recalls reported as usual). Also, mothers might have misreported their child's consumption if they were not with him/her at all times during the previous day. Related to this is the possibility that publicity about the regulations might have increased parents' awareness of societal concern about unhealthy eating in children, which could have led to under-reporting consumption of high-in foods.

An additional limitation is that because the cohort participants were recruited from low- and middle-income neighborhoods in the southeastern area of Santiago, the generalizability of our study is to an extent limited. Because close to 92% of Chilean school age children attend public-funded schools,[48] (and our sample was recruited from public-funded schools) we do believe our results could be generalizable to the majority of this group.

Furthermore, our primary outcome was defined as packaged high-in foods, because it was necessary to have the nutrition facts panel of products to determine their regulation status. While the front-of-package component of the Chilean Law applies only to packaged products, the marketing and school food restrictions, apply to both prepackaged foods and foods sold in bulk. Defining our outcome as packaged high-in foods might have translated to an underestimation of the amount of energy-dense, nutrient-poor foods consumed.

A final limitation of our study was our inability to determine to what extent product reformulation had a large effect on results. Products might have been reformulated before our follow-up assessment of advertising[49], and in this case continued to be advertised to the child, but would not have been captured as 'high-in' advertising to which the child was exposed to in our study.

Despite these limitations, one key strength of this study is that we were able to assess individual level exposure to high-in TV advertising, which is costly and complex and, to our knowledge, only a few studies have done so [44,45]. Another key strength was the use of a longitudinal design to assess the association with subsequent dietary intake, and the use of mediation analyses as a methodological tool to examine the effect of the policy operating through changes in high-in TV advertising.

In conclusion, the initial implementation of the Chilean Law of Food Labelling and Marketing was associated with significant decreases in both exposure to TV advertising of and consumption of high-in products after one year. However, given that the percent of the consumption that was mediated through high-in TV advertising exposure was small, factors other than the decrease in exposure to marketing seem to be driving this short-term decrease in high-in consumption. It is important to continue to monitor how overall marketing restrictions relate to dietary changes as the Law progresses to further stages and after longer-period of implementation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

All authors designed the study; MLJ analyzed the data and drafted the manuscript with contributions from all coauthors; all authors assisted in the interpretation of the results, provided critical intellectual feedback to help revise, and approved the final manuscript. Funding for this study came from Bloomberg Philanthropies with additional support from IDRC Grant 108180 (INTA-UNC) and 107731, CONICYT FONDECYT #1161436, and the NIH National Research Service Award (Global Cardiometabolic Disease Training Grant) #T32 HL129969–01A1. We thank Bloomberg Philanthropies, IDRC, Conicyt, and NIH grant to CPC P2C HD050924 for financial support. We also wish to thank Karen Ritter for exceptional assistance with the data management; Cathy Zimmer and Edward Frongillo for insight and support during data analysis; Natalia Rebolledo, Leonela Muñoz, Cindy Granados, and Catalina Cornejo for assisting with food composition table update and food categorization.

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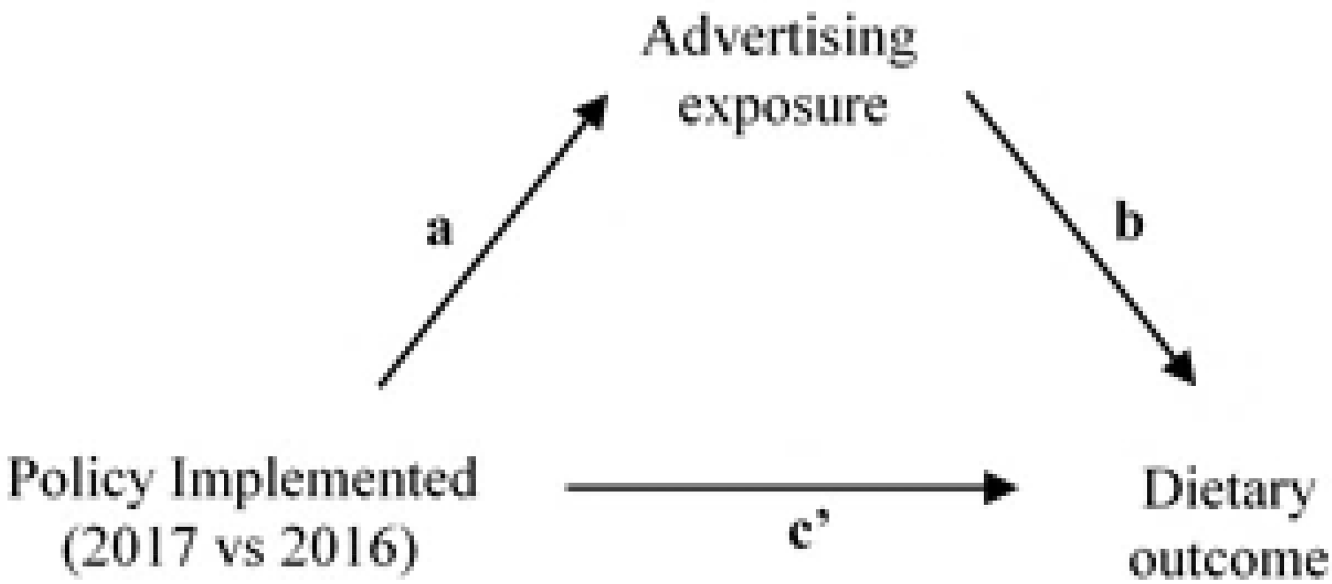

Figure 1.
Mediation pathway between policy implementation, advertising exposure and dietary outcomes. **a-coefficient:** association between the policy implementation and advertising exposure; **b-coefficient**: association between advertising mediators and dietary outcomes; **c'-coefficient**: direct effect of the policy on dietary outcomes, accounting for the advertising mediators. Total effect of the policy on dietary outcomes is given by [(ab)+c']

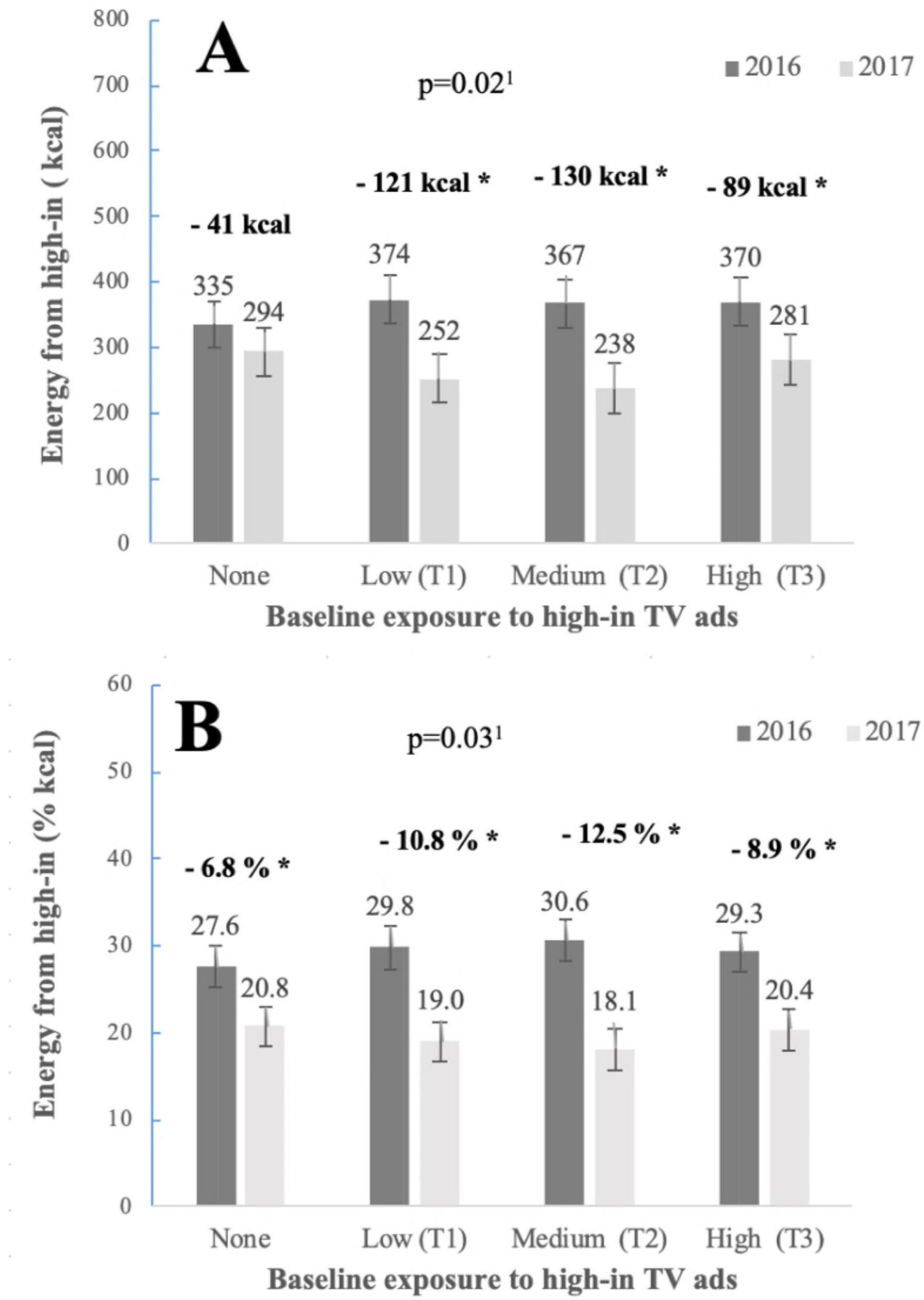

Figure 2.

Participants (n=853) consumption of high-in foods (A: absolute intake, B: energy adjusted) pre- and post-policy by baseline levels of high-in TV advertising. Estimated using mixed model with individuals as a random effect, adjusting for study covariates. [1]Wald test for interaction (year*baseline ad exposure).*indicates p<.05.

Table 1.

Baseline sample characteristics of study participants and their mothers (n=940)

	mean	SD	n	%
Child characteristics				
Age (years)	4.8	0.5		
Female			487	51.8
TV viewing time (hours per week)	11.5	9.4		
Exposure to high-in ads (minutes per week)				
With any high-in product	2.6	3.2		
High in calorie	1.4	1.6		
High in total sugars	1.6	2.1		
High in saturated fat	0.9	1		
High in sodium	0.2	0.3		
High-in intake				
Per capita absolute intake (kcal)	350	260		
Per capita energy adjusted intake (% kcal of total)	28.7	17.5		
Percentage consuming			899	95.6
Per consumer absolute intake (kcal)	366	255		
Per consumer energy adjusted intake (% kcal of total)	30	16.8		
Mothers characteristics				
Age (years)	31.9	6.6		
Education level (%)				
Less than high school			170	18.1
High school complete			454	48.3
More than high school			316	33.6
Married or living with partner			522	55.5
Family owns home			509	54.1

Table 2.

Daily dietary intake by baseline levels of any high-in advertising exposure (n=940)

	No exposure (n=237) Zero minutes/week			**Low exposure (n=235) 0.03 min-1.5 min/week**			**Medium exposure (n=234) 1.5 min-4.1 min/week**			**High exposure (n=234) 4.1 min-22.8 min/week**		
	mean	**95% CI LL**	**95% CI UL**	**mean**	**95% CI LL**	**95% CI UL**	**mean**	**95% CI LL**	**95% CI UL**	**mean**	**95% CI LL**	**95% CI UL**
Overall high-in foods												
Absolute intake (kcal)	319	286	352	366*	332	399	358	325	391	359	326	393
Energy adjusted (% kcal)	26.8	24.5	29.0	29.6	27.3	31.8	30.0*	27.7	32.2	28.6	26.4	30.9
Nutrients												
Energy (kcal)	1173	1126	1221	1188	1140	1236	1158	1110	1205	1217	1170	1265
Total sugars (% energy)	28.9	27.7	30.0	29.1	27.9	30.2	29.0	27.9	30.1	28.7	27.5	29.8
Saturated fat (% energy)	10.4	10.0	10.9	10.2	9.8	10.7	10.6	10.1	11.0	10.6	10.1	11.0
Sodium (mg/1000 kcal)	1277	1217	1338	1265	1205	1326	1277	1216	1337	1312	1251	1373
Food Groups												
Ready-to-eat Breakfast cereals												
Consumers *[n, (%)]*	*69*	*(29.4)*		*63*	*(26.9)*		*63*	*(26.9)*		55	*(23.5)*	
Absolute intake (kcal)	29	22	36	28	21	35	27	20	34	25	18	32
Energy adjusted (% kcal)	2.4	1.8	3.0	2.3	1.7	2.9	2.2	1.6	2.8	2.1	1.5	2.7
Salty snacks												
Consumers *[n, (%)]*	*27*	*(11.5)*		*38*	*(16.2)*		*26*	*(11.1)*		*24*	*(10.3)*	
Absolute intake (kcal)	18	7	29	29	18	39	25	14	35	23	12	34
Energy adjusted (% kcal)	1.5	0.8	2.3	2.1	1.3	2.8	1.8	1.1	2.5	1.7	0.9	2.4
Sweets and desserts												
Consumers *[n, (%)]*	*140*	*(59.6)*		*148*	*(63.2)*		*150*	*(64.1)*		*153*	*(65.4)*	
Absolute intake (kcal)	112	90	133	130	108	151	130	109	152	128	106	150
Energy adjusted (% kcal)	8.9	7.3	10.4	10.1	8.6	11.7	11.0*	9.5	12.6	10.0	8.4	11.6
Sugar-sweetened beverages												
Consumers *[n, (%)]*	*107*	*(45.5)*		*125*	*(53.4)*		*105*	*(44.9)*		*112*	*(47.9)*	
Absolute intake (kcal)	50	40	60	64	54	75	57	46	67	61	50	71
Energy adjusted (% kcal)	4.2	3.4	5.0	5.3	4.5	6.1	4.7	3.9	5.6	4.8	3.9	5.6

	No exposure (n=237) Zero minutes/week			Low exposure (n=235) 0.03 min-1.5 min/week			Medium exposure (n=234) 1.5 min-4.1 min/week			High exposure (n=234) 4.1 min-22.8 min/week		
	mean	95% CI		mean	95% CI		mean	95% CI		mean	95% CI	
		LL	UL		LL	UL		LL	UL		LL	UL
Milks and yogurts												
Consumers *[n, (%)]*	*106*	*(45.1)*		87	*(37.2)*		*97*	*(41.5)*		*102*	*(43.6)*	
Absolute intake (kcal)	74	60	88	61	47	76	67	53	81	73	59	87
Energy adjusted (% kcal)	6.7	5.4	7.9	5.5	4.2	6.7	5.8	4.5	7.1	6.1	4.8	7.4

Model adjusted for age (months) and sex of child, interview day, mother's education level, home ownership and marital state.

* P<0.05 for pairwise comparison with referent group (no exposure).

Table 3.

Associations between policy implementation (2017 vs 2016) and consumption of overall high-in accounting for mediation by advertising exposure (n=853)

	a-coefficient[4] (policy=> advertising)			b-coefficient (advertising=> consumption)			c' (policy=> consumption)			ab (mediation effect)			ab/[(ab)+c'] *100
	β[3]	99% CI		β	99% CI		β	99% CI		β	99% CI		
		LL	UL		LL	UL		LL	UL		LL	UL	%
Absolute intake (kcal)[1,5]													
Any high-in ad	−2.2*	−2.6	−1.8	5	−3	10	−86*	−132	−40	−8	−23	6	8.8
High calorie ads	−1.5*	−1.7	−1.3	7	−7	21	−84*	−133	−36	−10	−31	10	10.9
High sugar ads	−1.2*	−1.5	−0.9	6	−4	15	−88*	−133	−42	−7	−19	5	7.2
High saturated fat ads	−0.9*	−1.0	−0.8	3	−19	24	−92*	−140	−45	−2	−21	17	2.4
High sodium ads	−0.1*	−0.1	0.0	16	−66	97	−93*	−138	−49	−2	−9	6	1.6
Energy adjusted (% kcal)[2,5]													
Any high-in ad	−2.2*	−2.6	−1.8	0.2	−0.2	0.6	−9.3*	−12.2	−6.4	−0.5	−1.4	0.4	4.7
High calorie ads	−1.5*	−1.7	−1.3	0.3	−0.6	1.2	−9.3*	−12.3	−6.2	−0.5	−1.8	0.8	4.8
High sugar ads	−1.2*	−1.5	−0.9	0.3	−0.3	0.9	−9.4*	−12.2	−6.5	−0.4	−1.1	0.4	3.8
High saturated fat ads	−0.9*	−1.0	−0.8	0.4	−1.0	1.7	−9.4*	−12.4	−6.4	−0.3	−1.5	0.9	3.2
High sodium ads	−0.1*	−0.1	0.0	1.7	−1.9	5.3	−9.6*	−12.4	−6.8	−0.2	−0.5	0.2	1.7

[1] Total effect of policy implementation on absolute consumption of high-in products = −95 kcal [99CI: −138, −50]

[2] Total effect of policy implementation on energy adjusted consumption of high-in products = −9.7% kcal [99CI: −12.5, −7.0]

[3] Represents unstandardized regression coefficient.

[4] Expressed in minutes of advertising per week.

[5] Model adjusted for age (months) and sex of child, interview day, mother's education level, home ownership and marital state.

* $p<0.01$