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The Impact of Junk Food Marketing Regulations on Food Sales: An Ecological Study

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The Impact of Junk Food Marketing Regulations on Food Sales: An Ecological Study

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The Impact of Junk Food Marketing Regulations on Food Sales:

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Abstract

Objectives. To evaluate the impact of junk food marketing policies implemented worldwide from 2003 through 2014 on nationwide junk food sales and to identify the most effective policy characteristics in reducing junk food sales.

Methods. Junk food marketing policy data were obtained and categorized through a thorough literature review. These data were analyzed using a repeated measures design against EuroMonitor junk food sales data from 2002 and 2016.

Results. Countries with junk food marketing policies saw a decrease in junk food sales after implementation, while those without said policies saw an increase in sales. Countries with statutory policies saw a decrease in junk food sales, while those with only self-regulation saw an increase. Comprehensive audience restrictions, standardized nutrition criteria and mandated messaging were policy characteristics significantly associated with a decrease in junk food sales.

Conclusion. This study utilizes a novel approach to evaluate the effectiveness of junk food marketing policies by measuring changes in country-level junk food sales. Countries with statutory junk food marketing policies have demonstrated a significant decrease in junk food sales that is not seen in countries with only self-regulatory policies. This is consistent with previous studies that have found statutory policies to be successful in reducing children's exposure to junk food advertisements, while self-regulatory efforts have little to no impact. In order to effectively reduce the exposure and impact of child-targeted junk food marketing, governments should establish strong and comprehensive statutory regulations.

Introduction

Today we have reached a point where illnesses from nutrient-rich diets outweigh the global burden of hunger. These diet-related chronic illnesses, such as heart disease, obesity and diabetes, pose an even greater burden on health than “sex, drugs, alcohol and tobacco combined” [1]. In many countries, such as the United States, overweight has become the new norm.

While medical advances in developed nations have been able to significantly reduce deaths from diet-related illnesses each year [4], the prevalence of these diseases continues to rise and encroach into the lives of our youth. Worldwide, 42 million children and infants under five are overweight or obese, an increase of over 10 million since 1990.

It is known that the overconsumption of unhealthy foods is a major contributing factor to cardiovascular disease, obesity and diabetes [5]. It is also understood that dietary interventions can prevent and often reverse these diseases [6]. However, in spite of this knowledge, alongside the eruption of a massive epidemic of diet-related illnesses in our adults and youth, food corporations continue to aggressively market their junk food to children [7, 8]. Research shows that although parents are perceived as the primary decision makers, child preferences are the major influencing factor behind snack purchases and meal preparation [9]. Additionally, studies consistently find that exposure to food advertisements is linked to increased consumption patterns and obesity in children [10, 11, 12].

Junk food marketing policies have been implemented worldwide in the form of government statutes and self-regulatory codes. While self-regulation has been largely ineffective in reducing even the number of unhealthy food advertisements [8], government legislation has been successful in reducing child exposure to marketing, mirrored by a fall in advertising budgets [13].

The aim of this study is to evaluate the effectiveness of junk food broadcast marketing policies by measuring changes in country-level junk food sales. We hypothesized that countries with junk food broadcast marketing policies would experience a decrease in junk food sales on average after implementation, while countries without said policies would not. Secondly, we hypothesized that

countries with statutory policies and stricter policies would experience a decrease in junk food sales after implementation, while countries with only self-regulation or less strict policies would not.

Background

Prevalence of overweight and obesity worldwide

The prevalence of obesity worldwide has more than doubled in the past four decades. In 1975, less than five percent of the world population was obese and 22% overweight; in 2014, the number of obese persons rose to 13% and 39% overweight [14]. Overweight and obesity are major risk factors for diet-related illnesses such as cardiovascular disease, diabetes and cancer [15]. Children who are obese are at a higher risk of being obese in adulthood, and often express metabolic risk factors at a young age. In a study of Brazilian schoolchildren, 39% of obese children had high blood pressure, compared to just nine percent of healthy weight children [15].

The prevalence of child overweight and obesity has increased rapidly over the past four decades [16]. In the United States, the number of overweight and obese children has more than doubled since 1972. Today, one in three American children are overweight. In countries such as Mexico, the prevalence has quadrupled. While obesity has traditionally been a disease of the Western world, emerging nations harbor the majority of overweight and obese children, and are burdened with more than 30% higher incidence rates [17]. Unfortunately, while the prevalence of overweight and obesity for children under five has been widely surveyed, less is known about the overweight and obesity status for youth over five [16].

Lobstein *et al.* observed that in conjunction with the rise in childhood overweight and obesity, children are undergoing a parallel decline in height [16]. The populations of stunted and overweight children appear to overlap. In Vietnam, five percent of overweight children were stunted, and in Brazil it was observed that childhood obesity was more commonly associated with stunting than not. This indicates that while children are consuming more calories overall, their nutritional status may in fact be

declining. The increasing prevalence in stunting may be interfering with overweight and obesity measurements, which are commonly determined through BMI. Thus policymakers must be wary of overweight and obesity interventions that may increase the risk of undernourishment.

Food culture

In recent decades, food culture has increasingly gravitated towards convenience foods and snacking habits [9]. Convenience and snack foods are a relatively new phenomenon, supported by the increasing trend for working mothers and time-strapped parents. Unfortunately these foods are more likely to be high in fat, salt and sugar (HFSS), and less likely to be eaten with fruits and vegetables. In the United Kingdom, while parents and children alike appear to be still aware that they should eat more fruits and vegetables and less HFSS foods, children prefer the taste of HFSS products and parents more often defer to child preferences [9]. At the same time, schools often serve HFSS products for meals, such as hot dogs, pizza and chips, and rely on vending machines selling sodas and HFSS snacks for income [9].

Junk foods

The term “junk food,” or unhealthy food, has a range of definitions sculpted by diet fads, scientific findings and regulatory efforts. Nutrition criteria for the purpose of advertising regulation typically categorize the healthfulness of foods based on nutrient components. For example, the United Kingdom Nutrient Profiling Model uses a system that scores food based on its calorie, sugar, salt and fat content to determine if a food is fit for advertising [18]. The European Union Pledge sets nutrition limits specific to food type [19] and Chile sets strict limits for nutrient components regardless of food type [20] to determine if a food is healthy.

Perhaps more important than defining what is junk is defining what is healthy. One study revealed that 84% of children’s foods labelled as ‘healthy’ by the American Heart Association’s heart-healthy symbol did not meet basic nutritional standards [21]. Often children’s foods are less healthy than

teen and adult alternatives. Schwartz *et al.* found that 66% of cereals marketed to American children did not meet basic nutritional standards and were higher in calories, sugar and sodium when compared to adult cereals [22]. The Federal Trade Commission (FTC) similarly found that foods marketed to children are higher in calories and sodium compared to teen products [23]. However, children's products were lower in sugar and higher in fiber, whole grain, calcium and vitamin D. The FTC speculates this is partially because soda and candy are advertised more so to teens than children.

Following the implementation of the United States Children's Food and Beverage Advertising Initiative (CFBAI) in 2006, corporations reformulated many youth-directed products to both increase valued nutrients such as fiber, whole grain, and calcium, and to decrease nutrients like calories, saturated fat, sodium, and sugar [23]. Yet, corporate efforts to reformulate were not mirrored by changes in marketing tactics. In 2009, cereals using attractive marketing techniques such as licensed characters or other cross-promotions (i.e., toys, movies, video games) had less than half the whole grain of children's cereals marketed without these techniques. Additionally, reformulation has made small progress in nearly all food categories surveyed by the FTC. No youth-directed snacks met the United States Food and Drug Administration's standard for "low calorie" and just three percent of child-directed cereals met the standard for claiming "low sodium." Strangely, while children's prepared foods decreased in sodium, sugar was increased by 50% and calories by 16%.

The largest strides for reformulation have been made for youth in-school drink marketing, dairy marketing, and quick-service restaurants [23]. All advertised quick-service children's meals met the United States Food and Drug Administration standard for "low calorie" and "low sodium," and 64% met the standard for "low saturated fat" in 2009. Additionally, quick-service children's meals marketed with licensed characters and other cross-promotions were more nutritious than meals advertised without cross-promotions.

Overall, the lines between what is healthy and what is junk are difficult to define. Regulators have tended to judge foods based on nutrient components rather than the type of food (i.e., fruits and

vegetables versus confectionary). Such guidelines give the opportunity for corporations to reformulate existing products to meet advertising criteria rather than investing in more naturally nutritious foods.

Junk food corporations are targeting children

In 2012, the total advertising spending for healthier foods in the United States, including milk (\$169 million), bottled water (\$81 million), vegetables (\$72 million), and fruit (\$45 million), was still less than one-twelfth of fast food restaurant advertising alone, which totaled a booming \$4.6 billion [24]. There is reason to believe the massive bombardment of junk food marketing is contributing significantly to the overconsumption of junk foods, and thus the epidemic of diet-related illnesses.

Much of this advertising is targeted towards children. In 2009, the FTC identified that nearly \$1.8 billion (18.5% of all food marketing expenditures) were spent on marketing food and beverages to children in the United States [23]. These dollars have not been going to waste. The Rudd Center found that the average American child watches nearly 4,700 food-related ads per year, with 84% of these ads marketing junk food [25].

Advertising to children impacts diet and family purchases

Industry groups argue that parents are primarily responsible for their children's diets [58], but research would suggest otherwise. In grocery store observations by O'Dougherty, Story and Stang [26], 52% of the time food was considered for purchase by families, it involved a child's request, over half of which were for sweets and snacks. Similarly, a UK-wide survey by Ofcom found that even when parents were paying, snacks were more often chosen by children [9]. When compared to non-HFSS foods, children were more likely to cite marketing techniques, such as packaging, promotional offers, and TV advertising, as reasons for purchasing HFSS products. When the choice was left solely to the parents, whether a child liked a food was cited as the primary reason for meal choices. Unlike in children, advertising was far less likely to influence parental food purchases.

Advertising acts by directly impacting children's food choices, but is also theorized to act indirectly by altering peer norms and parental expectations, which in turn impact child and family preferences and purchases [9]. Research has shown that TV advertising can normalize unhealthy diets, encourage pestering of parents to purchase particular foods, and prime consumers to be further influenced by in-store promotions.

For the purpose of advertising, kids are easy targets. Due to their stage of development, children are more vulnerable to marketing tactics as they may not yet be able to comprehend the intent of advertisements [27]. Junk food corporations are exploiting this vulnerability to effectively alter the food children like, the food they eat and the food they buy [28]. Indeed, based on an accumulation of academic research on the effects of TV advertising, Livingstone of Ofcom concluded that there is a "tacit consensus" that TV advertising has "modest direct effects" on child food preferences [9]. Even the appearance of media characters on packaging alters a child's perception on how a food tastes [29]. The implications of these findings are large. American children influence \$200 billion of parent spending each year [30] and the Institute of Medicine estimated the total purchase influence for children at \$500 billion [28].

Child-targeted advertising is linked to childhood obesity

Research has shown that junk food marketing to youth may be linked to increased caloric intake and childhood obesity. McClure *et al.* found a direct relationship between receptivity to TV fast-food advertising and obesity in 15-23 year olds, independent of sedentary time [10]. Receptivity was calculated as the sum of whether a child had seen an ad, liked an ad and recognized the brand of the digitally unbranded ad. Using a general behavioral questionnaire, Bruce *et al.* found that obese children were significantly more impulsive than healthy weight children [11]. Additionally, on MRI imaging these obese children indicated greater activation in the reward regions of the midbrain when shown food logos, while healthy weight children had greater activation in regions associated with self-control. These studies suggest children who are obese may be more likely to act in response to food advertisements.

Unfortunately, both of these studies do not demonstrate whether these differences are present before or after a child becomes obese.

Halford *et al.* found that both healthy weight and obese children consumed significantly more calories (14-17%) after viewing a food advertisement compared to a non-food advertisement [12]. Body weight did not have an effect on consumption, which the previously mentioned studies failed to account for. Interestingly, study foods consumed by the children were not associated with any brand advertised, therefore suggesting that food advertisements increase immediate consumption regardless of brand.

An ecological study demonstrated a positive and highly significant relationship between the prevalence rates of overweight children in various countries and the number of sweet/fatty food advertisements [31]. While healthier food advertisements composed from zero to six percent of all advertisements in a country (in contrast, food advertising accounted for 38-84% of all advertising), healthier ads were negatively correlated to the prevalence of overweight children ($p < 0.10$). Ofcom also found a dose-dependent association between the number of hours United Kingdom children watched TV and overall consumption of HFSS products [9]. In this type of landscape, any advocacy by parents, health professionals and educators for healthy foods is being drowned out by the advertising budgets of junk food corporations.

Regulatory action is hindered by corporate backlash

In 2004, the World Health Organization (WHO) called on Member States and the private sector to address the influence of food marketing on dietary choices [32]. This was later followed by the more specific 2010 WHO resolution WHA63.14, which urged countries to regulate food and beverage marketing for products high in saturated fats, *trans*-fatty acids, sugars and/or salt to children [33]. That same year, the resolution was endorsed by 192 member states. However, in 2016, Kraak reported that many member states had relied on industry self-regulation, and no member state or company had implemented comprehensive restrictions on junk food marketing [33].

The lack of strong junk food marketing regulations, despite WHO recommendations, may be attributed to corporate push-back. In 2011, the Obama administration called on food manufacturers to adopt voluntary marketing restrictions of unhealthy foods to children [34, 35]. The food industry, under guise of the Sensible Food Policy Coalition, responded with claims that such restrictions would have no impact on the obesity crisis and unjustifiably restrict the industry's right to free speech, though the restrictions were unenforceable by nature [35]. The proposal was subsequently delayed.

When San Francisco moved to require health warning labels on advertisements for sugary beverages and ban their advertising on city property, the city was sued by the American Beverage Association. The corporate alliance claimed that the city was in violation of the First Amendment [36]. Resistance can also be seen in industry advertising codes such as the Spanish PAOS (Publicidad, Actividad, Obesidad y Salud) Code, which tried to shift the blame of the obesity epidemic on sedentary lifestyles. The industry group went on to say "it serves no purpose to place the burden of responsibility" on industry nor the foods advertised [37]. Most notably, since the 1960s public opinion had blamed fat for the rise in heart disease; it wasn't until 2016 that internal documents revealed how the sugar industry paid scientists to promote fat as the culprit, effectively directing consumers to eat low-fat foods while denying sugar's role in heart disease [38]. Recently the corporate-sponsored International Life Sciences Institute funded a 2017 review claiming that "no clear link exists between added sugar intake and health outcomes" [39].

While shocking, the corporate backlash against regulatory advances and manipulation of scientific research parallel the playbook used by the tobacco industry, which had purposely and successfully denied the link between smoking and lung cancer since the 1950s [40]. While reminding us of the all too familiar industry tactics to dissuade regulatory action, now used by food corporations today, Brownell and Warner plead us to not let history repeat itself again.

In this context, it is important to underline that any industry commitment to restrict junk food marketing is likely to be ineffective at best until governments demand stronger regulation.

Self-regulatory efforts

Self-regulatory efforts have mainly taken two forms: those regulated by established self-regulatory organizations or industry pledges. Both forms are run by industry groups and have little to no government oversight. Today, the majority of industry pledges that address food and beverage marketing to children come from the International Food and Beverage Alliance (IFBA). IFBA pledges were first instituted in 2006, and have since been established as national, regional and now global pledges [41]. Prior to IFBA's global pledge, effective in 2017, the mishmash of pledges covered 51 countries, including countries under the European Union.

The inherent problem with industry-led initiatives to restrict junk food advertising is that such restrictions are directly detrimental to their bottom line. As a result, these self-defined regulations and nutritional standards are typically less restrictive than government regulation, and largely ineffective. For instance, while the CFBAI was followed by an inflation-adjusted reduction of 19.5% of the United States food marketing budget directed to youth by 2009, the FTC found that children are seeing more food advertisements now than ever [10]. The Rudd Center found that between 2009 and 2012, three years after the formation of CFBAI, 60% of fast food restaurants had actually increased television advertising, including McDonald's, Domino's and Wendy's [24]. The decrease in advertising budgets may be explained by the increased utilization of websites, mobile devices and social media to capture the attention of children and teens – cheaper mediums with higher impact. Additionally, the potential effectiveness of the initiative is highly questionable. For instance, CFBAI's corporate-defined nutrition criteria determined that Popsicles, Reese's Puffs and Fruit Gushers were products fit for children's health [42].

Due to the clear conflict of interest and disappointing results of corporate-led initiatives, it is no surprise that statutory actions are the preferred method to restrict and/or ban junk food marketing [43, 44]. Statutory action in South Korea resulted in nearly total compliance one month after the legislation came into effect [13]. In 2010, South Korea restricted TV advertising of energy dense, nutrient poor (EDNP) “children preferred foods”, which includes foods such as confectionary, candies and baked goods, from

7pm to 9pm each day and during children's programs at any time. Across five TV channels, Kim *et al.* found only six EDNP ads in October 2010 between 7pm to 9pm compared to 295 ads in October 2009. The researchers found advertisements also decreased significantly during non-regulated hours, overall seeing a 58% reduction in EDNP ads for regulated and non-regulated hours. Strikingly, advertising budgets plummeted by 31% for all hours and by 77% for regulated hours.

Statutory action in the United Kingdom also resulted in nearly "universal adherence" six months after implementation of restrictions on HFSS advertising in children's channels and around programs of interest to children [45]. However, despite high compliance, the authors noted that overall child exposure to unhealthy foods had not changed due to the range of television shows children engage with outside of child-dedicated programs and channels.

It must also be noted that even if statutory restrictions are effective, the majority of such statutes arise from highly developed countries. Thus, as transnational junk food corporations are pushed out of wealthy states, they will increasingly target the consumers of emerging nations [46]. This underlines the importance of global cooperation and transnational marketing codes.

Measurement of policy effectiveness

In 2010, the WHO devised a set of recommendations for the formation of policies that reduce the impact, power and exposure of food marketing to children [43]. The WHO recommends the use of a government-led, comprehensive approach that clearly defines the audience, communication channels, settings, techniques and foods that may be allowed or restricted. Countries should cooperate to reduce exposure to non-compliant cross-border marketing, and should implement enforcement, monitoring and evaluation measures to enhance policy compliance and effectiveness.

The WHO highlighted the importance of evaluating effectiveness through a policy's ability to reduce the *impact* of junk food marketing [43]. Impact can be studied by measuring changes in HFSS product sales and consumption patterns in response to policy. The present study provides an opportunity to measure these changes by utilizing food sales data for countries that implemented food marketing

policies, and to correlate these changes to the stringency and characteristics of relevant policies. In doing so, we attempt to assess the effectiveness of junk food broadcast marketing policies worldwide.

Methods and Materials

The present study will explore the following hypotheses:

H1: Countries that enacted policies regulating junk food broadcast marketing will experience a decrease in junk food sales after implementation.

H2: Countries that enacted policies regulating junk food broadcast marketing will experience a greater decrease in junk food sales after implementation compared to countries that did not.

H3: Countries that enacted statutory policies regulating junk food broadcast marketing will experience a greater decrease in junk food sales after implementation compared to countries with self-regulatory policies.

H4: Countries with stricter policies regulating junk food broadcast marketing will experience a greater decrease in junk food sales after implementation compared to countries with less strict policies.

Study Design

This study used EuroMonitor data on junk food sales to identify countries that were then evaluated in a thorough literature review for the evidence of junk food broadcast marketing policies implemented between 2003 and through 2014. Various sources were used to identify and characterize policies, including WHO-Europe and the World Cancer Research Fund International. A series of repeated-measures ANOVA analyses was used to evaluate EuroMonitor food sales data pre- and post-policy implementation.

EuroMonitor Data

Retail/off-trade and foodservice volume sales data were obtained through the EuroMonitor International (EuroMonitor) Passport Global Market Information Database [47]. This information was collected by EuroMonitor analysts who identified data on food sales through a variety of official government statistics, trade associations, trade press, company and other sources. EuroMonitor defines retail/off-trade product volume as the volume of product sold to consumers through retail channels. These products are sold primarily for household use, with retailers including grocery stores, convenience stores, and outdoor markets, among others. Foodservice sales serve the public in non-captive environments including restaurants, cafés, delivery, cafeterias and street vendors. Captive foodservice units, including hospitals, schools and prisons, are not included. Data are available from 2002-2016, as well as forecast data up to 2021. EuroMonitor data have been used in various health-related food sales analyses [48, 49, 50]. For instance, Baker and Friel used EuroMonitor data on per capita sales volumes of packaged food products through retail and food service channels to estimate the trend in country-level sugar, fat and salt consumption across Asia [48].

For this project, EuroMonitor data were collected in the form of kg per capita country-level sales of select, packaged food categories. Packaged food categories were selected based on their relevance to HFSS products, as defined by the Committees of Advertising Practice (CAP) of the United Kingdom as foods or beverages high in fat, salt or sugar [51].

In Baker and Friel's [48] analysis of processed foods consumption in Asia using EuroMonitor data, baked goods, biscuits, carbonated soft drinks, confectionary, ready meals and sweet and savory snacks ranked as the top five contributors for salt, fat and/or sugar consumption. Of note, baked goods ranked as a top contributor in sugar, fat and salt consumption for all country income brackets. Other top contributors included dairy and ice cream; however, EuroMonitor data for these categories were not available. The FTC identified that in 2006, 72% of United States youth-directed food marketing expenditures were for quick-service restaurants, carbonated beverages and breakfast cereals [23]. WHO-Europe also identified that the food categories most heavily advertised were soft drinks, sweetened

breakfast cereals, biscuits, confectionary, snack foods, ready meals and quick-service restaurants [52]. For the above reasons, baked goods, breakfast cereals, confectionary, ready meals, savory snacks, and sweet biscuits, snack bars and fruit snacks for both retail/off-trade and foodservice sales were selected for this analysis (Table 1). Packaged food categories, which are mutually exclusive, were summed into a value for total junk food consumption.

Table 1. Descriptions of Selected EuroMonitor Packaged Food Categories [47].

Packaged Food Category	Description
Baked Goods (BG)	Bread, pastries, dessert mixes, frozen baked goods and cakes; in-store bakery products are classified as unpackaged, and thus not included here
Breakfast Cereals (BC)	Ready-to-eat and hot cereals
Confectionary (CO)	Chocolate confectionery, sugar confectionery and gum
Ready Meals (RM)	Defined as meals requiring no or few outside ingredients; includes shelf stable, frozen, dried, chilled ready meals, dinner mixes, frozen pizza, chilled pizza and prepared salads
Savory Snacks (SS)	Fruit snacks, chips/crisps, extruded snacks, tortilla/corn chips, popcorn, pretzels, nuts and other sweet and savory snacks
Sweet Biscuits, Snack Bars and Fruit Snacks (SB)	Biscuits, snack bars and fruit snacks
Total (TF)	Sum of baked goods, breakfast cereals, confectionary, ready meals, savory snacks, and sweet biscuits, snack bars and fruit snacks. Carbonates were excluded.

Carbonates were excluded due to their uniqueness in driving policy formation. Specifically, many transnational soft drink corporations have already committed to stop advertising for all beverages to children on either a nationwide, regional and/or company-wide basis. For example, the Union of European Beverages Associations (UNESDA) committed to stop advertising to children under 12 in countries of the European Union beginning in 2006. UNESDA company members include PepsiCo, Coca-Cola and Red Bull, among others [53]. While these policies appear to be more comprehensive compared to other industry pledges, the FTC revealed in 2009 that 97% of youth-directed marketing for soft drink expenditures in the United States were directed towards teenagers, while only 3% were directed towards children under 12 [23]. Thus, a comprehensive marketing restriction does not affect the majority of their youth targets. This is in contrast to United States food marketing expenditures in general, for which \$1 billion was spent on children and \$1 billion on teens. Often children are more heavily targeted than teens for foods like breakfast cereals where \$173 million of \$186 million of youth-directed marketing expenditures were directed towards children, and \$103 million towards teens (including

overlap). Therefore, sales of such foods are more likely to fluctuate in the presence of junk food marketing policies, which primarily focus on children.

EuroMonitor provided data on per capita retail/off-trade and foodservice volume sales of packaged foods for 80 countries. Taiwan was excluded due to lack of Human Development Index data, which was used later as a covariate. This left a sample size of 79 EuroMonitor countries for which policy status was evaluated.

To identify countries with junk food broadcast marketing policies, a country had to have, at the minimum, a policy that satisfied the following inclusion criteria:

1. Addresses junk foods specifically OR affects junk food marketing in a significant way
2. Applies to television marketing
3. Applies to the country nationwide
4. Implemented on January 1, 2003 or later, and before December 31, 2014

Inclusion Criteria 1. Due to the variety of policy definitions, policies addressing junk foods were defined broadly. Policies were identified as addressing junk foods if they restricted or provided ethical guidelines on marketing for unhealthy foodstuffs, foods high in fat, salt or sugar (commonly known as HFSS foods), or specific junk food categories included in Table 1. Policies were also included if they restricted marketing methods for all foods except healthy or “better-for-you” products [54]. Policies that addressed food marketing or marketing to children generally were included if they impacted junk food marketing in a significant way. Significance was assigned if the policy imposed audience restrictions or restrictions on marketing techniques.

Inclusion Criteria 2. Application to television marketing was established as a minimum as it is traditionally the most popular form of advertising food and beverages, and is the most commonly regulated medium amongst food marketing regulations [55].

Inclusion Criteria 3. Policies that only applied to a region within a country (i.e., the Quebec Consumer Protection Act) were not included. Policies that affected global regions, such as the European Union and Gulf Cooperation Council, were included for all countries under that region.

Inclusion Criteria 4. EuroMonitor packaged foods sales data ranged from 2002 – 2021, with 2016 as the last year of real, non-projected data. Due to this limitation, policies must have been enacted on January 1, 2003 or later, and before December 31, 2014, leaving two years for policy impact to be observed.

Policies were excluded from analysis based on the following exclusion criteria:

1. Applies exclusively to soft drinks and/or energy drinks
2. Applies exclusively to non-television mediums or environments
3. Implemented before January 1, 2003 or on December 31, 2014 or later.

Exclusion Criteria 1. Policies specific to soft drinks or energy drinks were not included for reasons stated earlier, and because they would likely affect only one EuroMonitor category, while general junk food marketing policies could potentially affect a range of food categories.

Exclusion Criteria 2 and 3. As noted in inclusion criteria 2 and 4.

Countries with one or more junk food broadcast marketing policy satisfying inclusion and exclusion criteria will be referred to as “policy countries.” Countries absent of any such policy will be referred to as “non-policy countries.”

Policy Data

The following materials (Table 2) were used to identify and characterize junk food broadcast marketing policies.

Author	Title	Year Published	Link Source
Hawkes, Lobstein	Regulating the commercial promotion of food to children: A survey of actions worldwide	2011	doi: 10.3109/17477166.2010.486836
WHO-Europe	Marketing of foods high in fat, salt and sugar to children: Update 2012-2013	2013	http://www.euro.who.int/data/assets/pdf_file/0019/191125/e96859.pdf
European Advertising Standards Alliance	Information request on food advertising	2014	http://www.easa-alliance.org/sites/default/files/2014_Food%20advertising.pdf
International Food and Beverage Alliance	Voluntary Regional and National Pledge Programmes	NA	https://ifballiance.org/our-commitments/responsible-marketing-advertising-to-children/
World Cancer Research Fund International	Nourishing framework: Restrict food advertising and other forms of commercial promotion	2016	http://www.wcrf.org/sites/default/files/Restrict-advertising.pdf
International Food and Beverage Alliance	Food and beverage marketing to children: The global regulatory agenda	2015	https://ifballiance.org/?s=global+map+and+overview+of+marketing+restrictions
UNICEF, DLA Piper	Advertising and marketing to children: Global report	2016	https://www.dlapiper.com/~media/Files/Insights/Publications/2016/12/3169756_UNICEF_Advertising_To_Children_Update_V8.pdf
European Commission, Directorate-General for Health and Consumers, WHO-Europe	Current implementation status of the strategy for Europe on nutrition, overweight and obesity related health issues	2010	http://ec.europa.eu/health/sites/health/files/nutrition_physical_activity/docs/implementation_report_a6_en.pdf
World Obesity Federation	Policies on marketing food and beverages to children	2010	http://www.worldobesity.org/what-we-do/policy-prevention/projects/marketing-children/policy-map/
UConn Rudd Center for Food Policy and Obesity	Pledges on food marketing to children	2014	http://pledges.uconnruddcenter.org/search.aspx

Policy data were confirmed by sourcing the original policy document, when available, through industry and government websites, publications and news articles. After exhausting the above resources, if no policy information was found on a country relevant to junk food broadcast marketing, it was assumed the said country had no relevant policy.

Characterization of Policies

Countries were characterized across ten categories (Table 3) under two domains: policy type and implementation. This design was modeled after the template by Hawkes and Lobstein [32]. The United Kingdom CAP Code [51] and the Broadcasting Authority of Ireland’s Children’s Commercial

Communication Code [56] were used to identify key marketing technique restrictions for characterization. WHO recommendations [43] and recommendations by Consumers International (CI) and International Association for the Study of Obesity (IASO) [57] were used to establish measures for audience restrictions.

Policy was assessed using the inclusion and exclusion criteria above. When a country had multiple policies, the maximum subcategory was entered for each category except marketing techniques and media, which are continuous in nature. Countries were assigned a score of 0 for each category when a junk food broadcast marketing policy was not identified.

Table 3. Characterization of Policies.		
Domain	Categories	Subcategories
Policy type	Policy	No Yes
	Regulatory type	Self-regulation Statutory regulation
	Audience restrictions	Multi-step approach Comprehensive approach
	Nutrition Criteria	No Guidance Standardized
	Implementation	General method
	Application	Applies to all food marketing Applies specifically to junk food marketing Applies to all marketing to children
	Marketing techniques	Licensed characters Equity brand characters Celebrities and/or sports stars Health and nutrition claims Sponsorship Product placement Promotional offers
	Media	Television Radio Internet School
	Child age definitions ^a	None 12 years and younger 13 years and older
	Monitoring and Enforcement	None Either Both

Self-regulation was assessed as policies formed and overseen by self-regulatory organizations and/or industry. Government regulations are policies regulating junk food broadcast marketing through regulations and statutes. In many cases, governments may write legislation encouraging or mandating that self-regulatory organizations or industry players introduce junk food broadcast marketing policies. Encouragement was not considered to be government regulation, however, government mandates for such policies were included as government regulation. For example, in 2011 the Spanish government published the Food Security and Nutrition Act which mandated that self-regulatory codes extend to minors 15 years and under, otherwise the government would enact its own regulations.

Audience restrictions refer to the method a policy used to define which audiences can and cannot be advertised to. Multi-step approaches encompass the strategies which restrict advertisements based on specified time slots or the percentage of children making up an audience, or policies may cap the percent of advertising space that junk foods can fill. Comprehensive approaches are those that ban junk food advertising entirely to a specific audience across specific mediums.

Nutrition criteria identified as guidance are those which ask industries to develop individual guidelines based on accepted scientific evidence or dietary guidelines. Standardized nutrition criteria include those policies that explicitly define at baseline which foods may or may not be advertised, applicable uniformly across all industry players.

General method refers to whether a policy is suggestive in nature, which usually takes on the form of ethical guidelines, or restrictive, in which policies prohibit specific methods of marketing, marketing to specified audiences, or marketing of specific products [32]. Additionally, countries were coded for whether they required messaging to accompany junk food advertisements in the form of healthy messaging or warning labels. Hawkes and Lobstein's definitions of guidance, restrictions and messaging were used to classify policies into either category [32]. For example, the ICC Framework for Responsible Food and Beverage Communication states that while the use of fantasy is appropriate for child-directed marketing, "care should be taken not to exploit a child's imagination in a way that could mislead him/her

about the nutritional benefits of the product involved” [58]. Codes written in this form give the impression of regulation, but in actuality do not impose any restriction on marketing capability.

Child age definitions are a common method of defining which audiences a policy applies to. For measurement purposes, the ages for which a policy applied was recorded and grouped into the subcategories shown in Table 3.

Countries that specified methods within their policy document(s) for carrying out monitoring or enforcement measures were identified. Monitoring includes methods such as the use of a monitoring body, a complaints procedure, or clearance of applicable advertisements prior to airing. Enforcement includes a range of sanctions for non-compliance, including expulsion of a company from a membership organization, adverse publicity, withdrawal of advertisements, and fines, among others.

The category “Application” was not further pursued as 47 out of 49 policy countries had a policy that satisfied “applies specifically to junk food marketing.” Under category “General Method,” 47 out of 49 countries had a policy restrictive in nature and one country had a policy only utilizing guidance. Therefore “general method” was condensed to compare countries with policies containing only guidance and/or restrictions versus those which mandated messaging. “Marketing techniques” and “Media” were coded as continuous variables ranging from 0 to 7 and 0 to 4 respectively. All categories underwent typical data cleaning.

Statistical Analysis

IBM SPSS Statistics 24 was used to perform a series of repeated measures ANOVA (significance level ≤ 0.05) for each category under Table 3. Two samples were used based on domain: policy type variables were analyzed for policy and non-policy countries; implementation variables were analyzed for policy countries only. Policy type and implementation variables were adjusted with the following covariates: the 2015 Human Development Index [59] was used to adjust for development status and socioeconomic variables across countries, including life expectancy, education and gross national income per capita. Development level of a country is likely to be associated with food culture, purchasing habits and obesity

prevalence [60]. The 2015 Corruption Perceptions Index [61] was used to adjust for the ability of a country to fully implement and enforce a policy. Since policies measured in this study are age-specific, variables were adjusted for the 2016 median age of each country's population [62]. Lastly, only implementation variables were adjusted for year of implementation of the policy in order to adjust for variable effect size due to time passed since implementation. Policy type variables were not adjusted for year of implementation as this sample included policy and non-policy countries.

Results

From the original EuroMonitor sample, 49 countries of the 79 had at least one junk food broadcast marketing policy that fit the inclusion criteria. These countries were identified as policy countries, while the remaining 30 countries were identified as non-policy countries. Policy countries had between one to four policies in place that met inclusion criteria.

Region and development

Countries in the study came from all regions of the world, including Asia (15 countries), Australia (2), Eastern Europe (18), Latin America (13), Africa (12), North America (2), and Western Europe (17), as defined by EuroMonitor. Countries with policies included all Western Europe and North American countries, most of Eastern Europe (13), half of Australian (1) and Asian (7) countries and less than half of Latin American (5) and African (4) countries.

Based on the Human Development Index (HDI), countries in the EuroMonitor inventory represented varying levels of human development: low (5%), medium (13%), high (37%) and very high (46%). No very low human development nations are included. Policy countries had medium (8%), high (29%) and very high (63%) levels of human development. Policy countries did not include countries from low human development status. Policy and non-policy countries were significantly different in HDI ($p < 0.001$) with a mean HDI of 0.73 for non-policy countries and 0.84 for policy countries.

Regulatory type

In terms of regulatory type, policies came in the form of statutory regulation or self-regulation. Self-regulatory policies were generally developed by self-regulatory organizations or industry alliances in the form of pledges. From 2003 through the end of 2014, 16 countries had enacted one or more statutory policies (Table 4), and the remaining policy countries were covered by self-regulation. Pledges covered countries on a national or regional basis (i.e., European Union Pledge).

Table 4. Sample Countries According to Regulatory Type

Statutory regulation	Self-regulation	Non-policy countries		
Brazil	Australia	Lithuania	Algeria	Kazakhstan
Denmark	Austria	Netherlands	Argentina	Kenya
Ecuador	Belgium	Philippines	Azerbaijan	Macedonia
France	Bulgaria	Poland	Belarus	Morocco
Indonesia	Canada	Portugal	Bolivia	New Zealand
Ireland	Chile	Romania	Bosnia-Herzegovina	Nigeria
Malaysia	Colombia	Russia	Cameroon	Pakistan
Mexico	Croatia	Saudi Arabia	China	Tunisia
Norway	Czech Republic	Singapore	Costa Rica	Ukraine
Peru	Estonia	Slovakia	Dominican Republic	Uruguay
Serbia	Finland	South Africa	Egypt	Uzbekistan
Slovenia	Germany	Sweden ^b	Georgia	Venezuela
South Korea	Greece	Switzerland	Guatemala	Vietnam
Spain ^a	Hungary	Thailand	Hong Kong, China	
Turkey	India	United Arab Emirates	Iran	
United Kingdom	Italy	United States	Israel	
	Latvia		Japan	

^a Spain's PAOS code is self-regulated, but government legislation has directed the language of the PAOS code by mandating specific restrictions be in place; ^b Swedish legislation banned child-directed advertising in 1996, but was not included under "statutory regulation" as the policy was implemented prior to study timeframe

Characterization of policies

Table 5 shows the characterization of policies by category. Seven countries undertook a comprehensive approach to audience restrictions by banning child-directed marketing of junk foods or all foods, or banning child-directed marketing as a whole. These countries include Indonesia, Brazil, Ecuador, Peru, Ireland, Norway, and the United Kingdom. Sweden and Quebec similarly undertook a comprehensive approach to audience restrictions, but these policies were implemented prior to the sample timeframe. The majority of countries used a multi-step approach for audience restrictions (42 countries), which came in

the form of marketing prohibitions during specific time slots, on certain television channels, or to audiences that had a minimum percent of child viewership.

Eleven countries established standardized nutrition criteria that defined foods that could and could not be advertised, while 34 countries provided non-enforceable guidance on the food types that should be advertised. Policies were applied to all marketing to children (Indonesia, Brazil, Ecuador, Ireland, Norway, and the United Kingdom), to all food marketing (11 countries), or specifically to junk food marketing (47 countries). Policy method was dominantly in the form of restrictions (47 policies), followed by guidance (22 policies) and mandated messaging (8 policies). Countries with messaging requirements include Slovenia, Colombia, Ecuador, Peru, France, Ireland, the Netherlands, and Turkey. Policy countries could be classified as having one or more applications or methods in the case that a country had more than one junk food marketing policy.

Overall, 22 countries had restrictions of one to six marketing techniques, with Ireland as the only country to restrict six marketing techniques. Use of licensed characters and celebrities and/or sports stars were the most popular marketing techniques that were restricted (restricted in 15 and 14 policies respectively). Restriction of equity brand characters was not identified in any policy. Equity brand characters are characters developed for the purpose of promoting a product or service (i.e., Ronald McDonald). Licensed characters are borrowed equities whose original purpose is unassociated with promotion of the product or service (i.e., Dora the Explorer). For the purpose of analysis, if a policy restricted the use of “characters” generally, this was taken to mean licensed characters, but not equity brand characters. Thus while some laws through legal interpretation may indeed cover equity brand characters, this was not reflected in these data. Use of health claims was restricted in five policies, sponsorship in six policies, product placement in eight policies and promotional offers in nine policies.

All policy countries had a junk food marketing policy that regulated television. Marketing in schools was the second most regulated media form (43 countries), followed by internet (42 countries) and radio marketing (30 countries). While the internet is covered by the majority of policy countries, this is mainly due to the European Union Pledge. Policies were most often applied to child-directed advertising,

for which the definition of children was capped at a specified age. Countries usually defined children as under 12 years of age (33 countries). Sixteen countries set the age limit for children above 12 years of age. France's Public Health Act of 2004, which implemented healthy messaging to accompany junk food radio and television marketing, is applicable to all junk food commercials regardless of audience age.

Thirty-four countries had specified methods for monitoring compliance. Methods included the use of a monitoring body, a complaints procedure, or clearance of applicable advertisements prior to airing. Twenty-eight countries specified sanctions for cases of non-compliance, which included the expulsion of a company from a membership organization, adverse publicity, withdrawal of advertisements, fines, and revoking of a broadcasting license. Twenty-seven countries had both monitoring and enforcement measures.

Domain	Categories	Subcategories	N	Total junk food sales, kg per capita (sd)			Δ (%)
				2002	2016		
Policy type (n = 79) ^a	Policy	None	30	44.0 (31.6)	50.1 (36.9)	+	6.1 (13.9)
		Yes	49	79.6 (44.4)	78.0 (40.3)	-	1.6 (2.0)
	Regulatory type	None	30	44.0 (31.6)	50.1 (36.9)	+	6.1 (13.9)
		Self-regulation	33	78.1 (35.4)	79.4 (37.0)	+	1.3 (1.7)
		Statutory regulation	16	82.7 (58.8)	75.3 (47.5)	-	7.4 (8.9)
	Audience restrictions	None	34	49.5 (35.4)	55.5 (40.0)	+	6 (12.1)
		Multi-step approach	38	81.5 (45.0)	79.1 (40.0)	-	2.4 (2.9)
		Comprehensive approach	7	62.6 (45.6)	62.1 (40.5)	-	0.5 (0.8)
	Nutrition criteria	None	34	48.8 (33.6)	54 (38.0)	+	5.2 (10.7)
		Guidance	34	73.3 (39.0)	73.8 (38.7)	+	0.5 (0.7)
Standardized		11	97.5 (60.7)	89.1 (47.2)	-	8.4 (8.6)	
Implementation (n = 49)	Application	None	0	--	--	--	--
		All food marketing	11	--	--	--	--
		Specific to junk food marketing	47	--	--	--	--
		All marketing to children	5	--	--	--	--
	General method	None	0	--	--	--	--
		Guidance and/or restrictions	41	77.4 (41.1)	77.4 (39.0)	0	0 (0)
		Messaging	8	90.7 (60.7)	81.2 (49.3)	-	9.5 (10.5)
	Marketing techniques	None	27	78.1 (43.4)	77.2 (41.0)	-	0.9 (1.2)
		1 restrictions	6	68.2 (46.7)	65.0 (44.5)	-	3.2 (4.7)
		2 restrictions	6	100.2 (65.3)	98.8 (52.9)	-	1.4 (1.4)
		3 restrictions	3	66.0 (32.5)	72.2 (33.3)	+	6.2 (9.4)
		4 restrictions	6	77.8 (34.8)	73.5 (29.5)	-	4.3 (5.5)
		5 restrictions	0	--	--	--	--
		6 restrictions	1	116.0	99.3	-	16.7 (14.4)
	Media	None	0	--	--	--	--
		1 media restriction	0	--	--	--	--
		2 media restrictions	5	43.7 (50.2)	48.5 (55.5)	+	4.8 (11.0)
		3 media restrictions	22	84.2 (40.6)	82.8 (37.7)	-	1.4 (1.7)
		4 media restrictions	22	83.2 (45.1)	80.0 (38.3)	-	3.2 (3.8)
	Child age definitions	None	0	--	--	--	--
		12 years and under	33	78.5 (48.7)	76.2 (43.2)	-	2.3 (2.9)
		13 years or older	16	81.8 (35.1)	81.9 (34.4)	+	0.1 (0.1)
	Monitoring and enforcement	None	14	74.6 (34.9)	74.5 (36.0)	-	0.1 (0.1)
Either		8	80.0 (50.8)	82.6 (50.9)	+	2.6 (3.3)	
Both		27	82.1 (48.1)	78.5 (40.5)	-	3.6 (4.4)	

^a Non-policy countries (n = 30) were rated as “none” in policy type categories

Changes in junk food sales over time

Figure 1 illustrates the change in junk food sales over time for each independent variable. On average, policy countries saw a decrease (-2.0% on average) in junk food sales between 2002 and 2016, while countries which had not implemented policies observed an increase (+13.9%) in sales. By regulatory type, only countries that enacted statutory regulation saw a decrease (-8.9%) in sales, while countries with only self-regulatory policies saw an increase in sales (+1.7%). Analyses according to audience restrictions

showed that countries with either multi-step or comprehensive approaches had a decrease in sales (-2.9% and -0.8% respectively). Countries with nutrition criteria classified as guidance saw a slight increase in sales (+0.7%), while those with standardized nutrition criteria saw a decrease in sales (-8.4%).

When looking at the general method of a policy, those utilizing only guidance or restrictions had no change in sales on average, while countries utilizing messaging had a 10.5% decrease in junk food sales. A decrease in sales was observed for countries with three or four media restrictions (-1.7% and -3.8% respectively), while countries with only two media restrictions saw an increase in sales (11.0%). For policies that defined the maximum age of a child at 12 years or younger, a decrease in sales was observed (-2.9%), while policies that defined the maximum age of a child at 13 or above, there was a minimal increase in sales (+0.1%). In order to explore this further, child age definitions at age 13 or above were broken down into age 13-15, and 16 or above. Countries with a child age definition of 16 or above saw a decrease in sales similar to child age definitions at 12 or younger, while age 13-15 saw an increase in sales. Five of the six countries with age definitions between 13-15 had only self-regulation, while eight of the ten countries with age definitions 16 or above had statutory regulation, thus it is likely that regulatory type is influencing the data trend in this case. Countries with methods for both monitoring and enforcement saw a decrease in sales (-4.4%); those with only monitoring or enforcement saw an increase (+3.3%) and countries with neither had minimal change (-0.1%). Here again, the majority of countries (7 out of 8) with only monitoring or enforcement had self-regulation only, which may explain why this group saw an increase in sales. For marketing techniques (Figure 2), only countries with three restrictions had an increase in sales (+9.4%), while the remainder experienced a decrease in sales, without a clear trend. Countries with three restrictions were majorly self-regulatory (two of three), while for countries with any other number of restrictions, at least half of the countries had statutory policies. Thus again it appears regulatory type is influencing the data.

Figure 1. Total Junk Food Sales over Time by Policy Type and Implementation Method^a

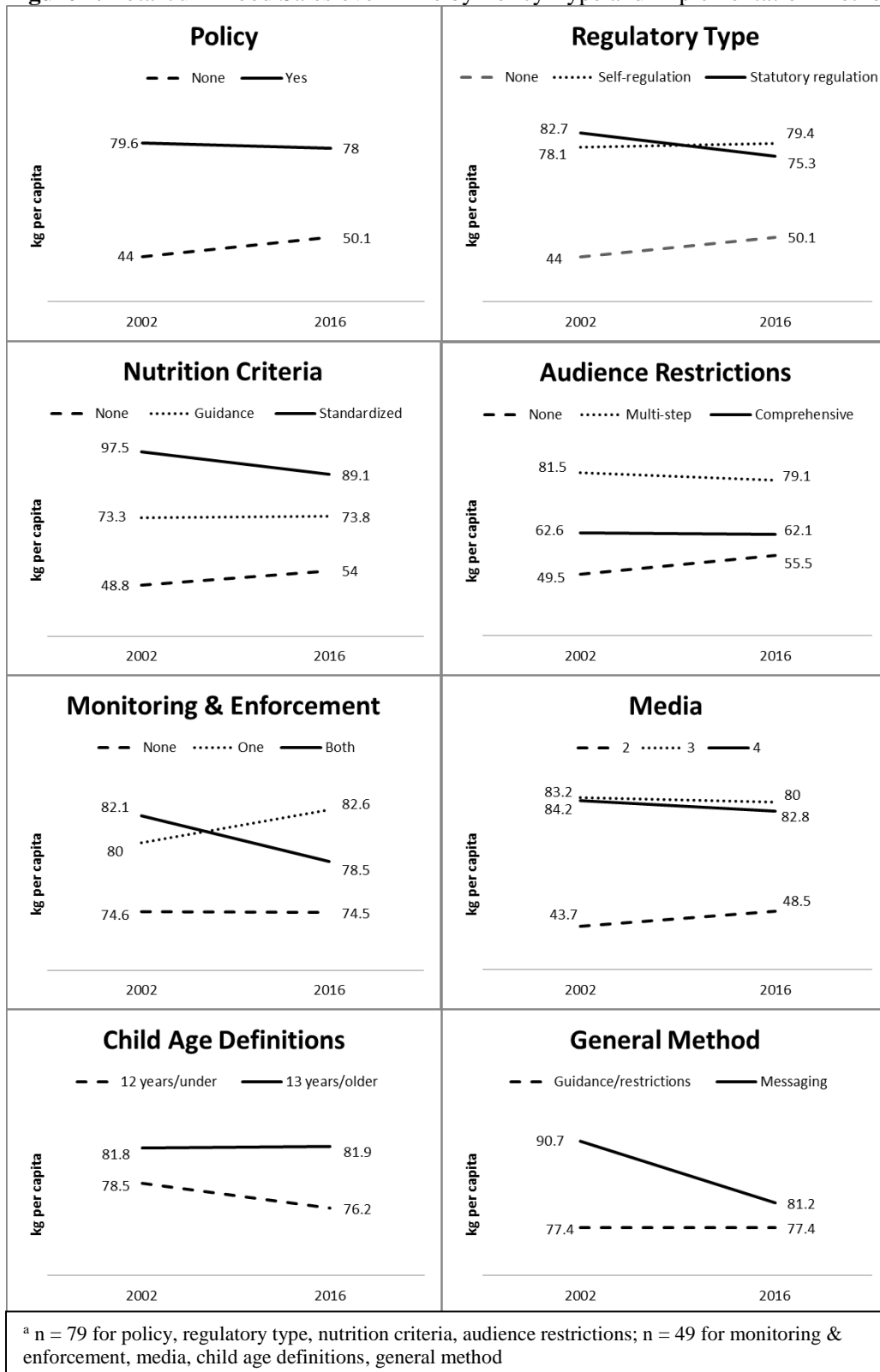
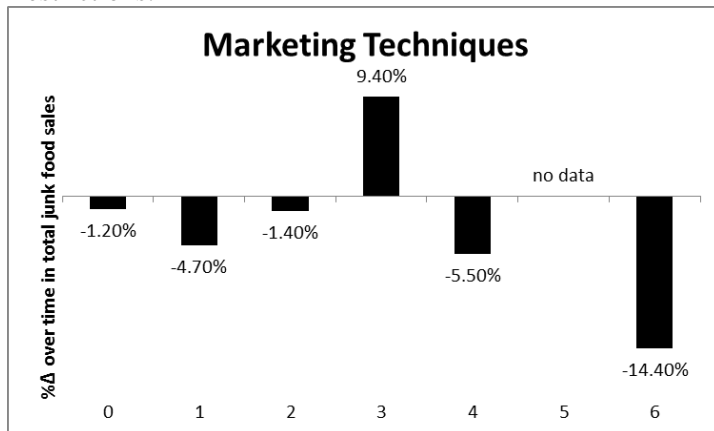


Figure 2. Percent Change in Junk Food Sales over Time by Number of Marketing Technique Restrictions.



Before adjustment with covariates, presence of a policy, regulatory type, audience restrictions, nutrition criteria and general method were significantly associated with a change in junk food sales over time (Table 6). Note that regulatory type was also statistically significant when compared amongst only policy countries and adjusted for covariates ($n = 49$, $p = 0.020$). After initial adjustment, the above variables were still significant. After a second adjustment for the same covariates and regulatory type, audience restrictions, nutrition criteria and general method were non-significant.

Marketing techniques, media, child age definitions and monitoring and enforcement were not found to be significant before or after adjustments. However, child age definitions showed trend association after adjustment for regulatory type ($p = 0.061$).

Regulatory type proved to be a significant covariate for the following models: audience restrictions, marketing techniques, media, and child age definitions. For the remaining variables, regulatory type had a trend association as a covariate: nutrition criteria ($p = 0.082$), general method ($p = 0.072$), and monitoring and enforcement ($p = 0.057$).

Table 6. Association of Policy Type by Change in Junk Food Sales

Domain	Categories	Unadjusted			Adjusted ^a			Adjusted + regulatory type ^b		
		F	df	sig	F	df	sig	F	df	sig
Policy type (n = 79)	Policy	7.179	1,77	0.009	6.427	1,74	0.013	--	--	--
	Regulatory type	6.659	2,74	0.002	5.839	2,73	0.004	--	--	--
	Audience restrictions	4.336	2,76	0.016	3.910	2,73	0.024	1.396	2,72	0.254
	Nutrition criteria	5.433	2,76	0.006	5.127	2,73	0.008	1.052	2,72	0.355
Implementation (n = 49)	General method	4.704	1,47	0.035	3.944	1,43	0.053	1.650	1,42	0.206
	Marketing techniques ^c	0.535	1,47	0.468	0.934	1,43	0.339	0.017	1,42	0.896
	Media ^c	1.611	1,47	0.211	1.521	1,43	0.224	0.514	1,42	0.514
	Child age definitions	0.432	1,47	0.514	0.319	1,43	0.575	3.692	1,42	0.061
	Monitoring and enforcement	1.001	2,46	0.375	0.982	2,42	0.383	0.157	2,41	0.856

^a Adjusted for HDI, corruption index, and median age of country; ^b Policy type variables adjusted for HDI, corruption index, median age of country, and regulatory type (none, statutory, self-regulatory); implementation variables adjusted for above and year of implementation; ^c inputted as continuous variables

Discussion

H1/H2: Policy countries saw a decrease in junk food sales

It was hypothesized that countries that initiated one or more junk food broadcast marketing policies would experience a decrease in junk food sales, which would be greater than countries that did not implement said policies. For policy countries, the present study observed a decrease in mean total junk food sales between 2002 and 2016, while non-policy countries saw an average increase in sales. Changes in total junk food sales over time in policy countries were significantly different from non-policy countries. Decreased sales in policy countries are likely due to a reduction in junk food advertisements, which were targeted in these policies.

Indeed, studies have shown that junk food broadcast marketing policies can affect a decrease in junk food marketing. In Brazil, just a year after the government’s implementation of Conanda Resolution 163, Britto, Viebig and Morimoto found that food and drink advertisements directed to children made up only 5.6% of TV ads observed [63]. In contrast, studies before the ban identified up to four times as many food and drink commercials [64,65 , 66]. Thus, the presence of broadcast marketing restrictions for junk

food products may predict a decrease in junk food advertisements, which would hypothetically be followed by decreased sales and consumption of junk food products.

H3: Statutory policies were associated with a decrease in junk food sales

The present study hypothesized that countries with statutory junk food broadcast marketing policies would experience greater decreases in junk food sales compared to self-regulatory policies. Changes in junk food sales over time were significantly different between regulated and nonregulated policies. Only countries with statutory regulation saw an average decrease in junk food sales, while countries with only self-regulation saw an increase in sales on average. This is most likely a reflection of the ineffectiveness of self-regulatory efforts, as discussed below.

In Australia, where three separate self-regulatory codes were implemented in 2009 to restrict junk food marketing, studies found that little to no progress had been made in reducing children's exposure to food advertising. One group found that in 2011, two years after policy implementation, the rate of "non-core" food commercials were not significantly different from 2006 [67]. In fact, the rate of fast food commercials were significantly higher (1.8 per hour in 2010 compared to 1.1 per hour in 2006). While non-core foods took up less advertising space as a whole in 2010 compared to 2009, the frequency of non-core food commercials during peak children viewing times did not change [68].

Spain has relied on self-regulation through its PAOS Code. The code was strengthened in 2012 when the government required that the PAOS code regulate internet advertising for child audiences under 15. Despite government interaction with self-regulatory forces, Spain's self-regulation has had minimal impact. A study found that between 2007 and 2013 there was a marginal decrease in food advertising of non-core foods (56% in 2007 to 52.2% in 2013), however, non-core foods still made up the majority of foods advertised to children on TV [69].

As discussed previously, government-led initiatives to reduce marketing to children have been able to achieve high compliance rates that result in a significant reduction in junk food advertisements. In contrast, self-regulatory efforts often report high compliance rates, yet countries with only self-regulatory

policies in place saw increases in junk food sales. This is likely a result of lenient policies influenced by corporate agendas. For instance, in 2016 the European Union Pledge reported a compliance rate of 98.7% for television, 95% for company brand websites, and an 83% reduction in children exposure to marketing for products that do not fit the pledge's standardized nutrition criteria [70]. However, nutrition criteria by the European Union Pledge still allow for advertising of savory snacks up to 900mg sodium / 100g, sweet snacks (i.e., cereal bars, biscuits, cakes) up to 35g total sugars / 100g, and breakfast cereals up to 30g total sugars / 100g [19]. Many of the products that meet the pledge's nutrition limits would not be allowed for advertising in the United Kingdom according to the United Kingdom nutrition profiling model [18]. Despite the pledge's leniency, half of children's breakfast cereals in European countries will not meet the 30g sugar limit [19].

H4: Strictness of policies had limited association with junk food sales

It was hypothesized that stricter junk food broadcast marketing policies would experience a greater decrease in junk food sales compared to less strict policies. After adjustment with covariates including regulatory type, no policy type or implementation variables, besides presence and regulatory type, were found to be significant. However, without adjustment, audience restrictions, nutrition criteria and general method predicted significant differences in the change of junk food sales over time.

Those countries that imposed audience restrictions demonstrated that both multi-step and comprehensive approaches saw a decrease in junk food sales, compared to all other countries which saw a general increase in sales. Only countries with standardized nutrition criteria saw a decrease in sales, while all others, including countries utilizing only guidance for nutrition criteria, saw an increase. With respect to general method, there was a large difference between countries that mandated healthy messaging and/or warning messages with junk food advertisements versus those that utilized only guidance or restrictions. Countries with mandated messaging saw a sales decrease of 10.5%, while other countries saw no change.

While these policy types are not significant after adjustment for regulatory type, it must be noted that more stringent characteristics are inherently linked to statutory legislation. For instance, eight out of 16 countries with statutory policies established standardized nutrition criteria, compared to only three out of 33 countries (9%) with only self-regulation. With respect to audience restrictions, no self-regulatory policy took on a comprehensive approach, while seven countries (44%) with statutory regulation did. Only two countries taking a self-regulation approach (6%) implemented messaging, while six countries with statutory regulations (38%) did. Therefore, because stricter policy characteristics are much more likely to belong to statutory policies, in combination with the limited number of statutory policies available for study, adjusting for regulatory type appears to be washing out the significance of these measured characteristics. Additionally, it appears that regulatory type was influencing the data trend for child age definitions, monitoring and enforcement, and marketing techniques. Given a larger sample of statutory policies to analyze, it is possible these variables may be statistically significant with adjustment for regulatory type.

Self-regulation remains the dominant type of policy

The majority of industry pledges surveyed in this study originated from IFBA. Due to the European Union and Gulf Cooperation Council regional pledges and worldwide infiltration of IFBA national pledges, most policy countries (90%) had at least one industry pledge in place. All surveyed industry pledges were written and implemented after 2003, with the first industry junk food marketing pledges initiated in 2006. Thus it can be assumed that all industry pledges through the end of 2014 were captured in the study timeframe for this analysis. Since Hawkes and Lobstein's 2011 analysis [32], more countries have implemented statutory regulations on food marketing to children.

Limitations

This study has many limitations. The limited sample size of countries made it difficult to establish differences across subcategories. A small sample size also makes it difficult to generalize these findings to all countries in the world. Additionally, because EuroMonitor reported packaged food sales data for only 80 countries starting from 2002, not all policies (i.e., Sweden's 1996 General Marketing Act) were available for analysis under study conditions.

Policy data were not confirmed with country informants, therefore it is not certain whether the information is correct nor whether policies are fully implemented and/or actively enforced. Additionally, it is possible that some non-policy countries had junk food marketing policies in place that were not measured.

Countries with policies were disproportionately more likely than countries without such regulations to be from Europe and North America and those of very high development status. In addition to a lack of junk food marketing policies, less developed countries tend to have younger populations [71]. Tobacco companies have been widely criticized for purposefully targeting youth populations, most iconically through the use of cartoon character Joe Camel, marketing techniques that the food industry has adopted today [40]. The large youth populations of developing nations make them a ripe target for junk food sales, especially as food corporations are increasingly criticized and regulated in wealthier states. Additionally, while countries without policies saw an increase in junk food sales over time in this study, they also had lower junk food sales compared to countries regulating junk foods in any given year. Thus the increase in junk food sales in non-policy countries may be partially explained by the growing market of and move of food corporations into the less developed world.

Regional voluntary pledges obscure the lines between policy and non-policy countries. In this study regional industry pledges were coded as a self-regulatory policy for all countries in the region. The presence of regional industry pledges may have no relation to a government's intent to establish statutory policies or encourage self-regulation. Thus it can be imagined that without government intent to establish or encourage junk food marketing policies, industry pledges in these countries would have minimal oversight and impact.

Monitoring and enforcement methods were defined broadly, which decreased the ability to detect an effect. Self-regulatory policies tended towards less stringent enforcement methods such as expulsion from voluntary alliances, withdrawal of advertisements or citation of non-compliant cases on their website. Government policies often cited the revocation of advertising licenses or punishment by fines and imprisonment. The vast differences in enforcement methods under self-regulatory and government forces may impact corporate incentive to comply, therefore diminishing the ability to detect the impact of enforcement on junk food sales.

Advertising via new media (i.e., online, mobile devices) is on the rise, poorly regulated and often not addressed in junk food marketing policies. The FTC reported that food companies spent 50% more between 2006 and 2009 to reach American children through new media [23]. For this reason, the successful implementation of junk food marketing policies may not actually reduce youth exposure to junk food advertisements if new media are not properly regulated.

Outside of junk food marketing policies, a number of countries have initiated efforts to control obesity through health education and public awareness campaigns, taxation of unhealthy foods and beverages, nutritional labelling, and increased access to healthy foods [34]. Thus, it is likely this study is detecting the impact of multiple obesity control policies.

Likewise, broadcast advertising represents only one form of influence over food purchases. Ofcom demonstrated the “web of causality” in which children’s food preferences are impacted by family habits and demographics, school characteristics and policies, social pressures, media literacy and exposure to advertising [9]. While TV advertising has been shown to have direct and indirect effects on preferences and purchases, the absolute size of the effect has yet to be determined. In the context of the “web of causality,” it is reasonable as to why TV advertising has only a modest *direct* effect, further complicating our ability to correlate marketing policies and sales. However, while difficult to measure, it is likely that the *indirect* effects of advertising influence the aforementioned factors, especially social pressures and family habits, thus increasing the overall impact of TV advertising.

It must also be noted that national efforts to restrict or ban junk food advertising to children are complicated by cross-border marketing. For example, Sweden's 1996 ban on child-targeted television and radio advertising was challenged by the European Court of Justice that ruled that the policy restrained trade and discriminated against transnational broadcasters [72]. This allowed for the presence of child-targeted advertising from international broadcasters despite Swedish law. Thus regardless of the strength of a nation's policy, restrictions can appear to be ineffective if cross-border marketing is not addressed. In this survey of junk food marketing policies, only Ecuador's 2013 Law on Communications restricted foreign advertisements. Canada and Ireland's junk food marketing policies both specified that they were not to be applied to foreign media.

In addition to junk food sales, this study originally aimed to investigate the correlation of policy implementation with changes in healthy food sales and childhood overweight/obesity trends. Unfortunately, EuroMonitor has limited data available for healthy food sales such as fruits and vegetables. Additionally, childhood overweight/obesity data were not available in a consistent format for all countries studied. In future research, the use of such data could possibly validate the findings expressed here.

Future research and recommendations

In light of the present study's findings, the authors recommend those countries that have adopted statutory or self-regulatory policies study food sales and health data within their country before and after implementation. Food sales data allows countries to observe policy impact and the role of junk food advertising in their population's decision-making. Health data, especially childhood and adult overweight/obesity and type II diabetes, will allow countries to observe whether policy implementation has a large enough impact to affect health outcomes. Countries can also be studied individually using a combination of outcome data such as junk food advertisements, junk food sales and health outcome measures in order to determine overall impact of a particular policy.

Additionally, governments should be wary of compliance rate reports. As mentioned previously, self-regulatory policies often report near-perfect rates of compliance likely due to policy leniency. High rates of compliance can mask the actual impact of a policy on outcomes such as number of advertisements, shopping and eating behaviors, and disease. To avoid this, countries should focus on reductions in junk food advertisements measured using unbiased, standardized nutritional criteria in addition to the measurement of food sales and health data.

Conclusion

This study utilizes a novel approach to evaluate the effectiveness of junk food marketing policies by measuring changes in junk food sales in an ecological study design. Countries with junk food marketing policies saw a decrease in junk food sales after implementation, while those without said policies saw an increase in sales. Countries with statutory policies saw a decrease in junk food sales, while those with only self-regulation saw an increase. Comprehensive audience restrictions, standardized nutrition criteria and mandated messaging were policy characteristics significantly associated with a decrease in junk food sales, but no effect was observed after adjustment for regulatory type.

While this study suggests junk food marketing policies, specifically statutory policies, are associated with a decrease in junk food sales, policy implementation may not be the sole cause for the change in sales observed. However, in the context of previously cited studies which unveil how marketing techniques influence children to consume and prefer unhealthy foods, and the success of statutory policies in reducing child exposure to junk food marketing, there is great reason for governments to restrict child-directed marketing of junk foods.

Appendix A

Policies Studied			
	Country	Regulatory type ^a	Policy studied
Countries with statutory regulation	Brazil	G	Conanda Resolution No. 163
		S	Brazil Public Commitment on Food and Beverage Advertising to Children
	Denmark ^b	G	Executive Order No. 801 of 21 June 2013 on Radio and Television Advertising
		S	Forum of Responsible Food Marketing Communication
		S	Consumer Ombudsman
	Ecuador	G	National Assembly of Ecuador Law on Communications
	France ^b	G	Public Health Act of 2004
		S	Autorité de Régulation Professionnelle de la Publicité, Food Behaviors Code
	Indonesia	G	Regulation of the Ministry of Health No. 1787 of 2010
		S	Indonesian Advertising Code of Ethics
	Ireland ^b	G	Broadcasting Authority of Ireland, Children’s Commercial Communications Code
		S	Code of Standards for Advertising, Promotional and Direct Marketing in Ireland
	Malaysia	G	National Plan of Action for Nutrition
		S	Malaysian Food and Beverage Industry’s “Responsible Advertising to Children” Initiative (The Malaysia Pledge)
	Mexico	G	National Strategy for Prevention and Control of Overweight, Obesity and Diabetes
		S	Mexico Marketing to Children Pledge
	Norway	G	Broadcasting Act No. 127 of 1992 (Chapter 3.1) <i>in conjunction with</i> Broadcasting Regulation No. 153 of 1997 (Section 3.6)
		S	Code for Marketing of Food and Drink Aimed at Children
	Peru	G	Promoting Healthy Eating for Children and Adolescents Law No. 30021
		S	Peruvian Advertising Commitment
Serbia	G	The Law on Advertising	
Slovenia ^b	G	Audiovisual Media Services Act (ZAVMS)	
	S	Slovenian Advertising Chamber Code	
South Korea	G	Special Act on the Safety Management of Children’s Dietary Life, Article 10 Korea Federation of Advertising Associations, Code of Advertising Ethics	
	G	Food Safety and Nutrition Act, Law 17/2011 <i>in conjunction with</i> PAOS (Publicidad, Actividad, Obesidad y Salud) Code	
Turkey	G	Law No. 6112 ‘Law on the Establishment of Radio and Television Enterprises and their Media Services’ (RTUK Law) <i>in conjunction with</i> RTUK Regulation No. 28103	
	S	The Turkey Pledge	
United Kingdom ^b	G	Code of Broadcast Advertising (BCAP) <i>in conjunction with</i> Code of Non-Broadcast Advertising and Direct and Promotional Marketing (CAP)	
Countries with only self-regulation	Australia	S	Australian Food and Grocery Council Responsible Children’s Marketing Initiative (RCMI)
		S	Quick Service Restaurant Initiative for Responsible Advertising and Marketing to Children (QSRI)
		S	Australian Association of National Advertisers Food and Beverage Advertising and Marketing Communications Code
	Austria ^b	S	Code of Conduct for the Austrian Radio Broadcasting Organizers
	Belgium ^b	S	The Belgium Pledge
	Bulgaria ^b	S	Framework for Responsible Commercial Communication of Food and Drinks
	Canada	S	Advertising Standards Canada, the Broadcast Code for Advertising to Children
		S	Canadian Children’s Food and Beverage Advertising Initiative (CAI)
	Chile	S	Chilean Code of Advertising Ethics
	Colombia	S	Columbian Code of Advertising Self-Regulation (CCAS)
	Croatia ^b	S	<i>European Union Pledge only</i>
	Czech Republic ^b	S	Czech Advertising Standards Council Code of Advertising Practice
		S	<i>European Union Pledge only</i>
	Finland ^b	S	Finnish Advertising Council (Maionnonnan eettinen neuvosto) <i>applies ICC Code</i> Finnish Competition and Consumer Authority Consumer Ombudsman Guidelines

	S	
Germany ^b	S	German Standards Advertising Council (Deutscher Werberat) Code of Conduct on Commercial Communications for Foods and Beverages
Greece ^b	S	<i>European Union Pledge only</i>
Hungary ^b	S	The Hungarian Advertising Code of Ethics, Article 18
India	S	The India Pledge
Italy ^b	S	<i>European Union Pledge only</i>
Latvia ^b	S	<i>European Union Pledge only</i>
Lithuania ^b	S	<i>European Union Pledge only</i>
Netherlands ^b	S	The Dutch Advertising Code, Advertising Code for Food Products
Philippines	S	Philippines Responsible Advertising to Children Initiative
Poland ^b	S	Federation of Food Producers Code on Advertising Food to Children
Portugal ^b	S	Portuguese Food Industry and Pledge on Diet, Physical Activity and Health: Advertising and Marketing Directed to Children
Romania ^b	S	Romanian Advertising Council
Russia	S	The Russian Pledge 'On Limitations on Advertising to Children'
Saudi Arabia ^c	S	<i>Gulf Cooperation Council Pledge only</i>
Singapore	S	Singapore Responsible Advertising to Children Pledge
Slovakia ^b	S	<i>European Union Pledge only</i>
South Africa	S	Advertising Standards Authority of South Africa (ASASA) Code of Advertising Practice, Appendix J
	S	The South African Pledge
Sweden ^b	S	<i>European Union Pledge only</i> <i>General Marketing Act (1996) banned advertising targeting children under 12 on radio and television; this was not included in the present study due to its implementation prior to the study timeframe</i>
Switzerland	S	The Switzerland Pledge
Thailand	S	Thailand Children's Food and Beverage Advertising Initiative (Thai Pledge)
United Arab Emirates ^c	S	<i>Gulf Cooperation Council Pledge only</i>
United States	S	Children's Food and Beverage Advertising Initiative

^a G = statutory policy, S = self-regulatory policy; ^b European Union Pledge; ^c Gulf Cooperation Council Pledge

Appendix B

CFBAI and European Union Pledge Member Companies

CFBAI Member Companies

American Licorice Company
Burger King Corporation
Campbell Soup Company
The Coca-Cola Company
ConAgra Foods, Inc.
The Dannon Company
Ferrero USA, Inc.
General Mills, Inc.
The Hershey Company
Kellogg Company
The Kraft Heinz Company
Mars, Inc.
McDonald's USA, LLC
Mondelēz Global, LLC
Nestlé USA
PepsiCo, Inc.
Post Foods, LLC
Unilever United States

European Union Member Companies

Bel Group
Burger King
Coca-Cola
Danone
European Snacks Association
Amica Chips
ICA Foods
Intersnack (including Estrella Maarud)
KiMs (owned by Orkla Confectionery and Snacks)
Lorenz Snack-World
Unichips – San Carlo
Zweifel Pomy-Chips
Ferrero
General Mills
Kellogg's
Mars
McDonalds Europe
Mondelēz
Nestlé
PepsiCo
Royal FrieslandCampina
Unilever

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