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Public Health

The impact of junk food marketing regulations on food sales: an ecological study

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Summary

Objective: To evaluate the impact of junk food broadcast marketing policies on nationwide junk food sales and identify policy characteristics effective in reducing sales. **Methods:** Country policy data ($n = 79$) were categorized in a thorough literature review and analysed using a repeated measures design against data on food sales per capita. Study conducted in United States, 2017.

Results: Countries with junk food broadcast marketing policies saw a decrease in junk food sales per capita after implementation, while those without said policies saw an increase ($p = 0.013$). Countries with statutory policies saw a decrease in sales per capita, while those with only self-regulation saw an increase ($p = 0.004$). Audience restrictions ($p = 0.024$) and standardized nutrition criteria ($p = 0.008$) were policy characteristics significantly associated with a decrease in sales per capita.

Conclusions: Utilizing a novel approach to evaluate junk food broadcast marketing policies, the study demonstrated that countries with statutory policies saw a significant decrease in junk food sales per capita not seen in countries with no or only self-regulatory policies. To effectively reduce exposure to child-targeted junk food marketing, governments should establish strong, comprehensive statutory regulations. Additionally, countries that implement junk food marketing policies can use food sales data to track policy effectiveness.

Keywords: Food marketing policy, non-communicable diseases, processed foods.

Abbreviations: US, United States; FTC, US Federal Trade Commission; WHO, World Health Organization; HFSS, Foods high in fat, salt or sugar; UK, United Kingdom; HDI, Human Development Index; CPI, Corruption Perceptions Index; IFBA, International Food and Beverage Association.

Introduction

Today, we have reached a point where diet-related illnesses linked with the over-consumption of food outweigh the global burden of hunger (1). Cardiovascular disease is the world's leading cause of death, 9% of the world population suffers from diabetes (2) and over two billion adults are overweight or obese (1). In many countries, such as the United States (US), overweight has become the new norm. The prevalence of diet-related illnesses continues to rise, particularly among youth, despite medical advances that

have significantly reduced deaths due to diet-related disease (3). Worldwide, 50 million girls and 74 million boys were obese in 2016, compared with just five million girls and six million boys in 1975 (4). While obesity has traditionally been thought of as a disease of the Western world, emerging nations now harbour the majority of persons that are overweight and obese (3), most likely due to a shift towards the Western diet (5).

The overconsumption of unhealthy foods is a major contributing factor to childhood overweight and obesity, but dietary interventions can prevent and often reverse

overweight and obese status (2). However, families are challenged by aggressive food marketing tactics that continue to promote junk food to children (6). In 2012, the total advertising spending for healthier foods in the US, including milk (\$169 million), bottled water (\$81 million), vegetables (\$72 million) and fruit (\$45 million), was less than one-twelfth that of fast food restaurant advertising alone (\$4.6 billion) (7). In 2009, the US Federal Trade Commission (FTC) determined that nearly \$1.8 billion (18.5% of all food marketing expenditures) was spent on marketing food and beverages to US children (6). These dollars are not going to waste: the average American child watches nearly 4,700 food-related ads per year, with 84% of ads marketing junk food (8). It has been well-established that the massive bombardment of junk food marketing is contributing significantly to the overconsumption of junk foods in children, and thus the epidemic of childhood overweight and obesity (9).

Due to their stage of development, children are more vulnerable to marketing tactics than adults as they may not yet be able to comprehend the intent of advertisements (10). Indeed, based on an accumulation of research on the effects of broadcast marketing, TV advertising likely has a direct impact on child food preferences (11). Even the appearance of media characters on packaging alters a child's perception on how food tastes (12). Child-targeted advertising also impacts family purchases. 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 (11). Additionally, studies consistently find that exposure to food advertisements is linked to increased consumption patterns and obesity in children (13–15), while healthier food advertisements have been negatively correlated to the prevalence of overweight children (15).

In 2010, the World Health Organization (WHO) urged countries to regulate food and beverage marketing for products high in saturated fats, *trans*-fatty acids, sugars and/or salt to children (16). Although the resolution was endorsed by 192 member states, many have relied on industry self-regulation, wherein the food industry regulates their own marketing practices (17).

The lack of statutory food marketing regulations 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 (18). The food industry, under the 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, despite the fact that the standards were voluntary (18). The proposal was subsequently delayed. 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' (19).

Junk food marketing policies have been implemented worldwide in the form of government statutes and self-regulatory codes (17). While self-regulation has been largely ineffective in reducing the number of unhealthy food advertisements (20) and youth marketing exposure (21), government legislation, such as in South Korea, has been shown to reduce child marketing exposure, mirrored by a fall in advertising budgets (22). Quebec imposed legislation in 1980 that prohibited advertising to children under 13 years old, which resulted in a US\$88 million reduction in fast-food consumption per year (23). This ban did not impact American TV channels, and it was subsequently found that compared with French-speaking children, English-speaking children tended to watch more American children's TV channels and thus had more children's cereals in the home and were able to recognize significantly more advertised toys. After adjusting for cultural differences, it was confirmed that the Quebec ban was the likely reason for these differences (24). Despite these findings, few research studies have investigated the role of food marketing policies on food consumption behaviours. The aim of this study was to survey the current status of national junk food broadcast marketing policies worldwide and to evaluate the effectiveness of said policies by measuring changes in junk food sales per capita per country. It was hypothesized that countries which enacted policies regulating junk food broadcast marketing would experience a greater decrease in junk food sales per capita after policy implementation compared with countries that did not. Additionally, it was hypothesized that countries with statutory policies and stricter policies would experience a greater decrease in junk food sales per capita compared with self-regulatory policies and less strict policies, respectively. Strictness was determined for each individual variable, such that policies that applied more comprehensive or more clearly defined restrictions within a measured variable were determined to be stricter than those that were less so.

Methods

Junk food consumption

Data were collected from the Passport Global Market Information Database by EuroMonitor International, which has been used in various health-related food sales analyses (25–27). Retail/off-trade and foodservice volume food sales data from 2002 and 2016 were collected in the form of kg per capita country-level sales for select, packaged food categories. The identification of packaged food categories used in this analysis took on a two-stage process. The United Kingdom (UK) Code of Broadcast Advertising (28) definition of HFSS products, those foods high in fat, salt

or sugar, was used as the framework to identify types of HFSS foods. EuroMonitor provides sales data on broadly defined packaged food categories; thus, processed food consumption and advertising data from Baker and Friel (25), the FTC (6) and WHO-Europe (29) were used to identify the following EuroMonitor packaged food categories as top contributors to fat, salt and sugar consumption: baked goods, breakfast cereals, confectionary, ready meals, savoury snacks, and sweet biscuits, snack bars and fruit snacks (Table S1). EuroMonitor packaged food categories, which were mutually exclusive, were summed to create the variable *total per capita junk food sales*. EuroMonitor notes that in its data compilation, ‘packaged’ foods are synonymous with ‘processed’ foods.

Carbonates (i.e. soda) were also identified as a top contributor to sugar consumption (25). However, carbonates were analysed separate from the original data set as they were found to be advertised almost exclusively to teenagers, not children, in the US. In 2009, the FTC found that 97% of youth-directed marketing for soft drink expenditures were directed towards teenagers, and only 3% towards children under 12 (6). This is in contrast to food marketing expenditures. For example, \$173 million of \$186 million of youth-directed marketing expenditures for breakfast cereals were directed towards children. Because little information on food advertising in developing countries has been published, the assumption is made that a similar disparity between carbonate and food marketing expenditures exists in all countries. Moreover, junk food marketing restrictions most often apply to children 12 years and younger; thus, junk food broadcast marketing policies were expected to have minimal impact on carbonate sales compared with their impact on the selected EuroMonitor packaged food categories. Additionally, in EuroMonitor, carbonates volume sales data were provided in litres whereas foods were provided in kilograms.

National food marketing policies

Countries ($n = 80$) for which EuroMonitor data were available were evaluated in a thorough literature review for the evidence of junk food broadcast marketing policies implemented between 2003 and the end of 2014. Taiwan was excluded due to lack of Human Development Index (HDI) data, which was used as a covariate, leaving a sample size of 79 countries. Countries were identified as having a junk food broadcast marketing policy if (i) the policy addressed junk food specifically or affected junk food marketing in a significant way; (ii) the policy applied to at least television marketing and the country nationwide; and (iii) the policy was implemented on January 1, 2003 or later, and before December 31, 2014. Policies were excluded if they applied exclusively to soft drinks and/or energy drinks, or applied exclusively to non-television mediums or

environments. Countries with one or more junk food broadcast marketing policy satisfying the inclusion and exclusion criteria were considered ‘policy countries.’ Countries absent of any such policy were considered ‘non-policy countries.’

Nine sources were used to identify and characterize national junk food broadcast marketing policies, including journal articles, policy databases and official documents from organizations on health and advertising (Table S2). 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.

Individual policies were characterized across ten variables (Table 1) under two domains: policy type and implementation variables. For countries with multiple policies, data from each policy were aggregated into single values per variable per country. For marketing techniques and media, data were first dummy coded (1 = restriction present; 0 = not present) for each category, and then all categories were summed to create a single index variable (e.g. Country A restricts junk food marketing in television and radio under variable ‘media’, thus is categorized as ‘2 media restrictions’). All other variables were coded as categorical data according to the strictest policy in a country per variable. Categories refer to groups within each variable. For general method, 47 out of 49 countries had a policy restrictive in nature and one country only utilized guidance. Therefore, guidance and restrictions were combined into one category.

This design was modelled after the template by Hawkes and Lobstein (17). The UK Code of Broadcast Advertising (28) and the Broadcasting Authority of Ireland’s Children’s Commercial Communication Code (30) were used to identify key marketing technique restrictions for characterization. WHO recommendations (16), and recommendations by Consumers International and International Association for the Study of Obesity (31), were used to establish measures for audience restrictions.

Data analysis

IBM SPSS Statistics 24 was used to perform a series of repeated measures ANOVA ($\alpha \leq 0.05$) to evaluate EuroMonitor food sales data pre- and post-policy implementation for the above policy characteristics. Policy variables were analysed for policy and non-policy countries; implementation variables were analysed for policy countries only. Policy type and implementation variables were adjusted with the following covariates: 2015 HDI from the United Nations Development Programme, 2015 Corruption Perceptions Index (CPI) from Transparency International

Table 1 Characterization of policies

Domain	Variable ¹	Category
Policy type	Policy	No Yes
	Regulatory type	None Self-regulation Statutory regulation
	Audience restrictions ²	None Multi-step approach Comprehensive approach
	Nutrition criteria ³	None Guidance Standardized
	Implementation	General method ⁴ Marketing techniques
Implementation	General method ⁴	Guidance Restrictions Messaging
	Marketing techniques	Licensed characters Equity brand characters Celebrities/sports stars Health/nutrition claims Sponsorship Product placement Promotional offers
	Media	Television Radio Internet School
	Child age definitions	None 12 years and younger 13 years and older
	Monitoring and enforcement ⁵	None Either Both

¹For countries with multiple policies, the maximum category was entered for each variable except marketing techniques and media, which are continuous in nature. Countries were assigned a score of 0 for each variable when a junk food broadcast marketing policy was not identified.

²Multi-step approaches restrict advertising based on time of day, percent children in audience or percent advertising space junk foods can fill; comprehensive approaches ban junk food advertising entirely to a specific audience (i.e. children).

³Guidance-type criteria are non-standard across advertisers, and may be based on accepted or scientifically-based guidelines; standardized refers to clearly defined criteria standardized for all advertisers.

⁴Guidance are non-specific and non-enforceable principles, and restrictions are prohibitions of specific methods, audiences or products; messaging refers to policies that require healthy or warning messages to accompany junk food advertisements.

⁵Monitoring includes methods such as the use of a monitoring body, complaints procedure or clearance of applicable advertisements prior to airing. Enforcement includes a range of sanctions for non-compliance (i.e. expulsion of company from membership organization, fines, etc.).

and 2016 median age of each country's population from the Central Intelligence Agency.

The HDI is a comprehensive measure of country development that includes life expectancy, education and standard of income by gross national income per capita, with higher

values indicating greater development. HDI was included because advances in social and economic development are associated with the transition towards diets high in fat, sugar and salt (32). The CPI quantifies corruption in the public sector, and higher values indicate less government corruption. Each year, tens of billions of dollars in bribes allow corporations to disregard the law (33), and regulatory bodies that wish to implement junk food marketing policies must perform the difficult task of achieving corporate buy-in and/or persist in the face of corporate backlash. In this context, the CPI adjusts for a country's ability for effective policy implementation. The median age of each country's population was included because the majority of junk food marketing policies target youth populations. Therefore, countries with proportionally larger youth populations are expected to demonstrate a larger effect size. Implementation variables were additionally adjusted for year of policy implementation in order to account for the impact of time on effect size. Years of policy implementation ranged from 2004 to 2014; thus, values of 2009 were set at 0, with all other values ranging from -5 to +5.

Results

In all, 49 countries (62%) had at least one junk food broadcast marketing policy. Policy and non-policy countries were significantly different in HDI ($p < 0.001$), CPI ($p < 0.001$) and median age ($p < 0.001$). Non-policy countries had a mean HDI of 0.73, CPI of 39.9 and median age of 31.1. Policy countries had a mean HDI of 0.84, CPI of 59.2 and median age of 37.8. Countries with statutory policies and those with only self-regulatory policies were not significantly different in HDI ($p = 0.61$), CPI ($p = 0.33$), median age ($p = 0.12$) or year of policy implementation ($p = 0.60$).

Policy countries had between one to four policies in place. Sixteen countries (33%) had enacted one or more statutory policies. The remaining policy countries relied on self-regulation ($n = 33$, 67%), which occurred on a national or regional basis (i.e. European Union Pledge).

Table 2 illustrates the change in junk food sales over time for each independent variable. On average, policy countries saw a decrease (-2.0%) in junk food sales per capita 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 per capita, while countries with only self-regulatory policies saw an increase in sales (+1.7%).

Countries that employed audience restrictions ($n = 45$, 57%) or nutrition criteria ($n = 45$, 57%) observed a decrease in junk food sales per capita compared with countries that did not employ these methods. Standardized nutrition criteria ($n = 11$, 14%) were associated with a greater

Table 2 Change in total junk food sales per capita by policy type

Domain	Variable	Category	N	Total junk food sales, kg per capita (sd)		Δ (%)	
				2002	2016		
Policy type (n = 79)	Policy	No	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)	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	-	-	-	
Media		6 restrictions	1	116.0	99.3	- 16.7 (14.4)	
		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)	
Child age definitions		4 media restrictions	22	83.2 (45.1)	80.0 (38.3)	- 3.2 (3.8)	
		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)		

decrease in sales per capita (-8.6%) compared with countries using only guidance (n = 34, 43%) who saw an increase in sales per capita (+0.7%). Countries utilizing messaging (n = 8, 16%) had a 10.5% decrease in sales per capita; countries without messaging observed no change in sales.

A decrease in sales per capita occurred for countries with three (n = 22, 45%) or four (n = 22, 45%) media restrictions (-1.7% and -3.8% respectively), while countries with two media restrictions (n = 5, 10%) saw an increase in sales (+11.0%). For policies that defined the maximum age of a child at 12 years or younger (n = 33, 67%), a decrease in sales per capita was observed (-2.9%), while policies that defined the maximum age of a child at 13 or above (n = 16, 33%), there was a minimal change 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 (n = 6, 12%), and 16 or above (n = 10, 20%). Countries with a maximum child age definition of 16 or above saw a decrease in sales per capita similar to child age definitions at 12 or younger, while age 13-15 saw an

increase in sales. Five of six countries with age definitions between 13 and 15 had only self-regulation, while eight of the ten countries with age definitions 16 or above had statutory regulation, suggesting that the variation in junk food sales with child age definitions was heavily influenced by the regulatory type of a policy.

Countries with methods for both monitoring and enforcement (n = 27, 55%) saw a decrease in sales per capita (-4.4%); those with only monitoring or enforcement (n = 8, 16%) saw an increase (+3.3%) and countries with neither (n = 14, 29%) had minimal change (-0.1%). The majority of countries (seven out of eight) with only monitoring or enforcement had self-regulation only. For marketing techniques, only countries with three restrictions (n = 3, 6%) had an increase in sales per capita (+9.4%), while the remainder experienced a decrease in sales, without a clear trend. Countries with zero and three restrictions were primarily self-regulatory (89% and 67% self-regulatory countries respectively); all other groups were made up of half or more countries with statutory regulation.

After adjustment for covariates, presence of a policy ($p = 0.013$), regulatory type ($p = 0.004$), audience restrictions ($p = 0.024$) and nutrition criteria ($p = 0.008$) predicted significant differences in the change of junk food sales per capita over time (Table 3). Messaging was significant before adjustment ($p = 0.035$) and became non-significant after adjustment ($p = 0.053$). Regulatory type was a significant covariate for the following models: audience restrictions ($p = 0.016$), marketing techniques ($p = 0.036$), media ($p = 0.039$) and child age definitions ($p = 0.004$).

A separate analysis was performed for carbonate sales per capita for each of the policy variables. Before adjustment with covariates, policy ($p = 0.027$), audience restrictions ($p = 0.017$), nutrition criteria ($p = 0.016$) and media ($p = 0.049$) were significantly associated with a change in carbonate sales per capita. After adjustment with covariates, no variable was significantly associated with carbonate sales per capita. Time and HDI were significantly associated in the change of carbonate sales per capita for all variables.

Discussion

In the present study, countries with statutory policies on junk food broadcast marketing observed a decrease in mean total junk food sales per capita between 2002 and 2016, while non-policy countries and countries relying on industry self-regulation saw an increase in sales per capita. Both presence of policy and regulatory type were significantly associated with the change in total junk food sales per capita over time.

Decreased sales per capita in policy countries are likely due to a reduction in junk food advertisements, which were targeted by these policies. As mentioned earlier, studies have shown that junk food broadcast marketing policies can decrease junk food marketing. In Brazil, one year after the implementation of Conanda Resolution 163, food and drink advertisements directed to children made up only 5.6% of TV ads observed. In contrast, studies before the

ban identified up to four times as many child-targeted food and drink commercials (34). Thus, the presence of broadcast marketing restrictions for junk food products may predict a decrease in junk food advertisements, which may be followed by decreased junk food consumption.

Decreased sales per capita in countries with statutory policies, but not those with only self-regulatory policies, is likely a reflection of the ineffectiveness of self-regulation. For example, 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. In 2011, two years after policy implementation, the rate of 'non-core' food commercials was not significantly different from 2006 (35), and the rate of fast food commercials was significantly higher (1.8 per hour versus 1.1 per hour) (36).

Stricter junk food broadcast marketing policies were associated with a greater decrease in junk food sales per capita compared with less strict policies. Specifically, countries that employed standardized nutrition criteria (versus guidance nutrition criteria or none) and messaging (versus no messaging requirements) saw a decrease in junk food sales per capita after policy implementation. It must be noted that more stringent policy characteristics are inherently linked to statutory legislation. For instance, eight out of 16 countries (50%) with statutory policies established standardized nutrition criteria, compared with three out of 33 countries (9%) with self-regulation. Only two countries using self-regulation (6%) implemented messaging, while six countries with statutory regulations (38%) did. Messaging produced a large decrease in junk food sales (-10.5%) that was significant before adjustment with covariates ($p = 0.035$) but became non-significant after adjustment ($p = 0.053$). This is likely due to the small sample size of the study. In a future study with a larger number of countries utilizing messaging techniques, messaging may produce a significant result after adjustment with covariates.

Table 3 Association of policy type by change in junk food sales per capita

Domain	Variable	Unadjusted			Adjusted ¹		
		F	df	sig	F	df	sig
Policy type ($n = 79$)	Policy	7.2	1,77	0.009	6.4	1,74	0.013
	Regulatory type	6.7	2,74	0.002	5.8	2,73	0.004
	Audience restrictions	4.3	2,76	0.016	3.9	2,73	0.024
	Nutrition criteria	5.4	2,76	0.006	5.1	2,73	0.008
Implementation ($n = 49$)	General method	4.7	1,47	0.035	3.9	1,43	0.053
	Marketing techniques ²	0.5	1,47	0.47	0.9	1,43	0.34
	Media ²	1.6	1,47	0.21	1.5	1,43	0.22
	Child age definitions	0.4	1,47	0.51	0.3	1,43	0.58
	Monitoring and enforcement	1.0	2,46	0.38	1.0	2,42	0.38

¹Adjusted for HDI, CPI and median age of country; implementation variables adjusted for above and year of implementation.

²Inputted as continuous variables.

The lack of association between policy variables and carbonate sales per capita after adjustment with covariates may indicate that current junk food broadcast marketing restrictions are not strict enough to have a significant impact on carbonate sales. Additionally, food broadcast marketing restrictions may simply be too broad in their scope, and soda-specific restrictions are needed to produce a significant impact on soda sales.

The majority of industry pledges surveyed in this study originated from the International Food and Beverage Association (IFBA). Due to the IFBA's European Union and Gulf Cooperation Council regional pledges in addition to worldwide infiltration of IFBA's 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 is likely that all industry pledges through the end of 2014 were captured in the study. Since Hawkes and Lobstein's 2011 analysis (17), more countries have implemented statutory regulations on food marketing to children.

Regional voluntary pledges obscure the lines between policy and non-policy countries. In this study, regional industry pledges were coded as self-regulatory policies 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, industry pledges in these countries may have minimal government oversight and public health impact. Within this study, monitoring and enforcement methods were defined broadly, which decreased the ability to detect an effect among highly variable enforcement methods. 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 licences or punishment by fines and imprisonment. The vast differences in enforcement methods under self-regulatory and government forces may impact corporate incentive to comply, thereby diminishing the ability to detect the impact of enforcement on junk food sales.

Regardless of the strength of a nation's policy, restrictions can appear to be ineffective if cross-border marketing is not addressed. 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 (37). In the present study, only Ecuador's 2013 Law on Communications restricted foreign advertisements. Canada and Ireland's junk food marketing policies specifically excluded application to foreign media.

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. Tobacco companies have been widely criticized for purposefully targeting youth populations, a tactic that the food industry has adopted today (38). 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 with 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 HFSS food sales in developing countries.

Limitations

This study has several limitations. The limited sample size of countries made it difficult to establish differences across categories and to generalize findings to all countries. Additionally, because EuroMonitor reported packaged food sales data for only 80 countries starting from 2002, not all policies (e.g. 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 policies are fully implemented and/or actively enforced. It is also possible that some non-policy countries had junk food marketing policies in place that were not measured. Additionally, while countries without policies saw an increase in junk food sales per capita over time in this study, they also had lower junk food sales compared with 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 food market within developing countries. While EuroMonitor packaged food categories were selected based on their high contributions to fat, sugar and salt consumption, these categories are broadly defined and likely included a number of non-HFSS foods. Due to the nature of EuroMonitor data, we were unable to only include foods that correspond to the definition of HFSS foods. Finally, the study did not consider advertising via new media (e.g. online, mobile devices) or national healthy food initiatives or obesity control policies. Because the former is most likely to increase junk food consumption while the latter is most likely to decrease consumption, these exclusions may have a null effect on the present analysis.

Conclusion

This study utilized a novel approach to evaluate the effectiveness of junk food marketing policies by measuring

changes in junk food sales per capita in an ecological study design. In light of this study, 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 to confirm the present findings. Food sales data allows countries to observe policy impact and the role of junk food advertising in their population's decision-making. Incorporating health data, especially on childhood and adult overweight/obesity and type II diabetes, which the present study was unable to do, would allow countries to observe whether policy implementation has a large enough impact to affect health outcomes. Diverse outcome measures, such as junk food advertisements, junk food sales and health outcome measures, should be used to determine the overall impact of a junk food marketing policy. Additionally, future studies may investigate the impact of new media advertising, which is largely unaddressed in junk food marketing policies, on junk food sales.

Conflict of interest statement

The authors have nothing to disclose.

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Supporting information

Additional Supporting Information may be found online in the supporting information tab for this article. <https://doi.org/10.1111/obr.12678>

Table S1. Descriptions of selected EuroMonitor packaged food categories.

Table S2. Sources for policy data collection, United States, 2017

Table S3. Study countries according to regulatory type, United States, 2017

Table S4. Policies studied, United States, 2017

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