

Food advertising on TV and energy intake in children: results from the OBEY-AD Mexico

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SUMMARY: Food advertising on TV is a common marketing practice, and it is suspected of promoting obesogenic behaviours. The study aimed at evaluating if gadgets (toys) packaged with food increase food consumption, and if contemporary exposure to TV and/or advertising is a further promoting factor. One-hundred and twenty children (balanced according to gender and age groups, 3-6 and 7-10 years old) were randomised in an experimental setting designed as a 2x5 full factorial *ad libitum* eating study. The first factor was represented by the exposure to gadgets, organized on two levels, “food with gadget” (TOY) and “food alone” (NoTOY). The second one consisted in the exposure to TV and advertising along five levels (no exposure to TV, exposure to TV without advertising, exposure to TV and 1, 2, or 3 advertisements). Our results showed no significant differences when considering the groups even after taking into account the dependent variables. The medium spot group showed the lowest energy intake, but the difference between the other groups was not significant. TV advertising and the presence of gadgets (toys) do not influence caloric intake in children.

Key words: TV exposure; advertising; toys as gadgets; obesogenic behaviour; experimental study.

RESUMEN. La publicidad de alimentos en la televisión y la ingesta energética en los niños: resultados de la OBEY-AD México. La publicidad de alimentos en la televisión es una práctica común de comercialización, y se cree que puede promover comportamientos obesogénicos. El estudio tiene como objetivo evaluar si los gadgets (juguetes) empaquetados con alimentos aumentan el consumo de alimentos y si la exposición contemporánea a la televisión y/o la publicidad es un factor promotor adicional. Ciento veinte niños (agrupados por sexo y edad, 3-6 y 7-10 años de edad) fueron asignados al azar en una escuela de San Luis Potosí -México. Los niños fueron asignados al azar en el contexto experimental de un estudio de diseño factorial completo 2x5 de consumo de alimentos *ad libitum*. El primer factor estuvo representado por la exposición a juguetes y estuvo organizado en dos niveles: “alimento con juguetes” (TOY) y “alimento solo” (NoTOY). El segundo consistía en la exposición a la televisión y a publicidad televisiva a lo largo de cinco niveles (sin exposición a TV, exposición a TV sin publicidad, exposición a TV y a 1, 2 o 3 anuncios publicitarios). Nuestros resultados no mostraron diferencias significativas entre los grupos, incluso teniendo en cuenta las variables dependientes. Sólo en el grupo mediano al que se mostraron dos publicidades se observó el consumo de energía más bajo. La diferencia entre los otros grupos no fue significativa.

La publicidad en televisión y la presencia de los pequeños juguetes no influyen en el consumo de calorías en los niños.

Palabras clave: Exposición a la televisión; publicidad; juguetes como dispositivo; comportamientos obesogénicos; estudio experimental.

INTRODUCTION

Obesity, which represents a clear and present risk for health-status of children and adolescents, has become an epidemic with an estimated 17.6

million overweight and obese children on a global scale (1, 2). Mexico has one of the highest obesity rates in Latin America (3) with prevalence of obesity among adolescents ranging from 9.0%

among 10-year-olds boys to 6.1% among 15-year-olds, and from 5.9% among 12-year-old girls to 8.2% among 16-year-olds (4).

The rise of obesity already in early age, as a major risk factor underlying a high rate of non-communicable diseases (NCD), including diabetes mellitus (5), coronary heart disease (6), hypertension and some cancer-related diseases (7), needs to be treated throughout widespread policies for prevention and, in case of a disease in progress, with clinical support (8, 9). A recent WHO report on non-communicable diseases has pointed out that cardiovascular disorders and diabetes represent the most common NCD's caused deaths with 17 million and 1.3 million victims annually, respectively (10). Such data highlights the urgent need to promote prevention policies, especially in the youngest ones.

Despite the fact that genetic factors play a significant role in the development of obesity (11), the increase of its prevalence in the past years strongly suggests that environmental factors are largely responsible (12). Variety of food supply available 24h/day (13), changes in dietary habits due to time constraints, like globalization processes (14, 15) and changes in physical activity due to technological advances create a 'toxic' environment responsible for obesity and eating disorders (16). A generally recognized cause of obesity is the excess of caloric intake in relation to energy expenditure (17, 18), although such an obesity driver could not be isolated as directly associable to weight-gain (19). Therefore the focus of attention has been turned to limit inappropriate (qualitative and quantitative) energy intake, above all where the context turns out to be an obesogenic promoter especially for children. TV viewing, advertising and snacking, indeed, have been recognized as co-causing factors (20-23). TV exposure often prompts physical inactivity (24), and increases at the same time a typical post-modern positioning towards consumption of dense and highly

energetic snack food. Furthermore, several professionals in the public health system have concluded that constant exposure to messages encouraging consumption of snacks or fast food which is communicated to children through food advertising turns out to be the cause of inappropriate eating habits (25). Every day, children, while watching TV, are exposed on average to 15 spots advertising food products (Federal Trade Commission, 2007), and 98% of these marketing campaigns promote aliments high in fat, sugar and/or sodium (26).

Anyway, the results of different studies vary from showing positive association between TV viewing and increased levels of obesity during childhood (27, 28) to short and long-term effects of advertising on children's eating habits. Such mechanisms contribute to the promotion of unhealthy diets (20, 29) often causing ongoing consumption of those food products which were advertised during childhood, later in their life as well (30). Although some associations have been found between exposure to visual commercial messages and caloric intake (31), no evidence could be revealed that a causal link between these two variables could exist (32). Such findings, indeed, are almost due to deductive associations rather than caused by a univocal relation. An intersectional view, instead, frames this phenomenon within a circular interdependence between contextual (culture, society, geopolitical coordinates), biological (genetics and physiology), psychological (emotional and motivational) as well as behavioral factors (inactivity, parental attitudes and social based bias) (21, 33). From this perspective, "snacking" of highly energy-dense food, is seriously compromising the maintenance of "healthy and balanced dietary habits".

Aim of this research, therefore, is to assess the influence of TV, advertising and gadgets on energy intake throughout an experimental model developed by Gregori et al. (1). This experimental

assessment consists in an *ad libitum* eating study, involving children from 3 to 10 years in San Luis Potosi, Mexico.

MATERIALS AND METHODS

Study design

The experiment was designed as a 2x5 full factorial *ad libitum* eating study. The first factor was represented by the exposure to gadgets, organized on two levels, “food with gadget” (TOY) and “food alone” (NoTOY). The second one consisted in the exposure to TV and advertising along five levels: “no exposure to TV” (NoFilmNoSpot), “exposure to TV without advertising” (FilmNoSpot), “exposure to TV and one advertising” (FilmLowSpot), “exposure to TV and two advertising” (FilmMediumSpot), “exposure to TV and three advertising” (FilmHighSpot).

The Film was a cartoon lasting about 22 minutes, chosen to be a non-spoken cartoon in order to propose a culture –free stimulus. Details about the choice of the tool and its role in the experiment are given elsewhere (1).

Sample size computation

Sample size was computed with reference to an alpha equal to 0.05 and a power of 0.90, aimed at detecting at least a difference of 20 Kcal of caloric intake (assuming an equal standard deviation in the two groups of about 10 Kcal) between the two experimental groups “food with gadget” and “food alone” in each of the 10 randomization cells. 120 Mexican children were indicated as needed to accomplish with such study targets, both males and females (50% respectively), ranging from 3 to 10 years of age.

Randomization and ethical conduction of the study

The single children were randomized according to each of the 10 cells of the full-factorial design, and randomization was performed through an

ad-hoc computerized program, including the data collection and study conduction software system used for the research. Randomization was blocked by age (two groups of children 3-6 and 7-10 years old) and by gender (male and female) to ensure complete balance for the two potential confounding factors. Children having any kind of psychological or physical conditions, or presenting allergic reactions to the food items offered in the experimental session were not taken into consideration. Parents’ informed consent was obtained, and all experimental procedures were performed according to the guidelines and ethical standards established by the American Psychological Association (36). Appropriate permission was obtained from the Institutional Review Boards.

Study setting

Children were enrolled in a school setting in San Luis Potosí (Mexico). They were evaluated during a break after lunch inside a classroom, specifically set up for the study. All children within the school received the same meal and had a consistent pattern of programmed physical activity. Parents were invited to position themselves at the lateral or back side of the classroom in order to fill out a questionnaire, without being seen by their children, who were engaged in the experimental session. Children were videotaped by two hidden digital cameras, strategically located to capture the front and side positions of the children. The researcher, instead, was located back-screen, to be readily available for children’s questions without influencing his behavior.

Parents’ questionnaire

The questionnaire given to children’s parents was divided in two sections. The first part was aimed at determining socio-demographic characteristics of the whole family, asking about parents’ education and familiars’ BMI, as well as a detailed set of queries on principal

meals and basic physical activities performed within the family. Questions on child's eating habits were introduced in the second part of the questionnaire, aimed at assessing TV viewing and physical activity of both, the children and their families.

Anthropometrics

Children were weighed and measured in light clothing and without shoes on an electronic stand-up balance scale with a rigid metric belt. Measurements were taken by asking children to position themselves backwards on a wall, making sure the back of their feet touched the wall, thus a straight angle was formed between the wall and the floor. A straight surface was placed over the child's head and a mark was drawn on the wall, representing the initial point. Weights and heights were used in order to calculate body mass index (BMI). Children were considered to be overweight/obese with a BMI ≥ 85 th and underweight with a BMI < 5 th, according to CDC growth standards (37, 38)

Brand Awareness

Another questionnaire to assess children's brand awareness, the IBAI inventory (39), was adopted for this study. The tool consisted of 12

images of both international and country-specific brand marks. The kids were asked to recognize the brand, to recall it, and to match it to an image to be chosen out of 4 different image options (see Figure 1). Finally, the researcher asked the child for the specific name of the product. Brand Awareness Scores (IBAI-score) could range from a minimum of 0 to a maximum of 36, with a cut-off set at 16 points, defining two groups: low-brand awareness children (< 16) and high brand awareness ones (> 16) (39).

Study conduction

Children were first evaluated to assess BMI and basic characteristics. Afterwards, the IBAI questionnaire was administered to children by the interviewer. When the IBAI assessment was fully completed, the interviewer explained the progression of the study to the child.

The snack offered for the study consisted in a sweet aliment composed by two shapes of chocolate containing a small gadget. The snack, which is a commonly commercialized product within Mexican stores and markets, has been selected for two reasons: (i) pointing out the eventual influence of the gadget, which has to be a toy easy to handle then combined to the

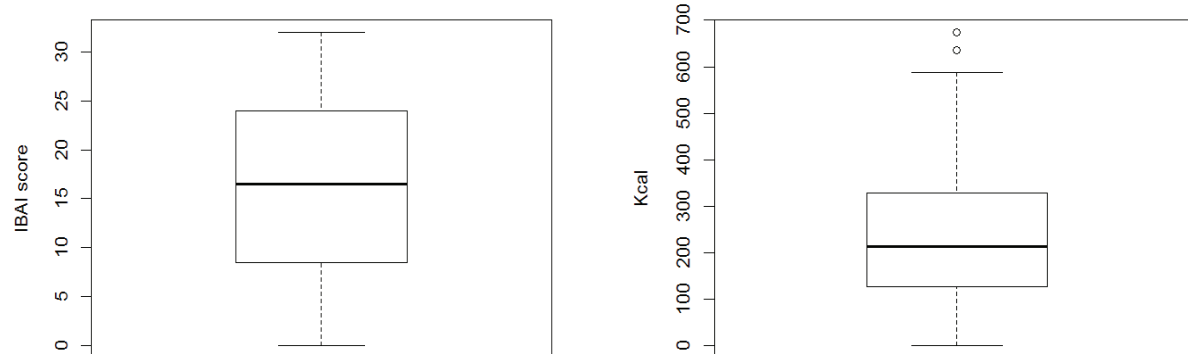


FIGURE 1. On the left side, country IBAI box plot. On the right side, country energy intake box plot.

snack, sold as one, single product, and (ii) the commercial version of the snack must permit a precise weighting of the content before the beginning of the experiment, in order to assess the starting points, and also after the session, offering in this way an accurate estimate of the amount of calories eaten by each kid. The part containing the chocolate was previously weighed and then offered alone to the children randomized to the NoTOY group, while it was given combined with the part containing the gadget to the TOY group. At the time of the first administration of the snack, if the child was assigned to a TV exposed group, the movie started without any interruption. After the first snack-intake, the researcher could show the next one (having first waited for the child's request). Each kid could eat ad libitum up to a maximum of 12 portions. Administration of the snack was performed adopting a pre-developed protocol, in order to control, as much as possible, the investigator's influence on the children's behavior.

Once the experimental session ended, the experimenter weighed the remaining chocolate of each product. All sessions were digitally recorded for subsequent examination and data quality assurance.

Statistical analysis

Basic exploratory data analysis was performed on the sample and reported using median (I-III quartile) for continuous variables and percentages (absolute numbers) for categorical variables, whenever appropriate.

Main analysis was based on a linear model where blocking factors, Gadget, FilmSpot and interaction between FilmSpot and Gadget were inserted in the model. This is the base model used in the analysis, where specific investigations on single factor-level effects were conducted using appropriate linear contrasts.

To further check for additional confounding factors, six models were developed. In each model, variables have been added to the base model:

1. Base: Nation+Age+Gender+Gadget+Film

Spot+ToyFilmSpot

2. M1: BMI + Breast Feed + Hours/Week TV + Physical activity (hours/week)
3. M2: BMI Father + BMI Mother + number Brothers/Sisters
4. BA: IBAI-Score
5. M3: Number of rooms in the house + number of TV in the house + Educational level mother
6. M4: breakfast in the morning + fruit portions/day + vegetables portions/day

Each model was estimated and for the selected variables, the AIC criterion in the backward fashion was used for the selected variables. For each model, significance of the main experimental factors (Toy - FilmSpot and Toy - FilmSpot interaction) was assessed.

Children were classified as "high consumers" if their energetic intake during the sessions exceeded the III quartile of the distribution. Variables associated to the cluster of "high consumer" were modeled using a logistic regression and selected via the AIC criterion in a backward fashion. Analyses were performed using the R System (40).

RESULTS

Sample characteristics

Children enrolled in the study presented a median BMI of 16.40, while parents' BMI showed a median of 24.65 for the mothers and 25.47 for the fathers. Children with no brothers and sisters represented respectively 57% and 68% of the sample.

Parents stated that children had breakfast every day before school in 79% of cases, consuming a daily a portion of fruit (42%) and a portion of vegetables (41%).

When interviewed on TV watching, the median of total hours per week of TV exposure amounted to about 11 hours. The IBAI score showed a median value of 16.50 (Figure 1). All data are presented in Table 1.

TABLE 1. Description of the sample. Summaries for categorical variables are expressed as percentage (absolute numbers in parenthesis) and for continuous variables as median (I and III quartile).

Sample Characteristics		N	Mexico
Child BMI		120	14.88/16.40/18.79
Mother BMI		117	23.32/24.65/25.54
Father BMI		107	24.74/25.47/26.34
Neonatal Feeding:	Breast-feeding	113	50% (57)
	Bottle-feeding		26% (29)
	Mixed (breast + bottle)		24% (27)
Frequency of breakfast before school	2-3 times per week	120	4% (5)
	3-4 times per week		12% (15)
	Never		4% (5)
Daily fruit portions	Everyday		79% (95)
	1	120	42% (51)
	2		48% (57)
	3		6% (7)
	4		2% (2)
	None		2% (2)
Daily vegetable portions	More than 4		1% (1)
	1	120	41% (49)
	2		37% (44)
	3		18% (22)
	4		2% (3)
	None		1% (1)
TV viewing (hours/week)		120	9.00/11.00/13.00
Television set at home (n°)		120	2.00/2.00/2.00
IBAI score		120	8.75/16.50/24.00
Mother Educational Level : degree		117	47% (55)
	elementary school		13% (15)
	high school		12% (14)
	middle school		28% (33)
	no one		0% (0)
Father Educational Level : degree		103	43% (44)
	elementary school		11% (11)
	high school		23% (24)
	middle school		22% (23)
	no one		1% (1)
Mother/step-mother's job:employee		101	68% (69)
	engineer		0% (0)
	manager		14% (14)
	other		0% (0)
	worker		18% (18)
Father/step-father's job: employee		103	29% (30)
	engineer		0% (0)
	manager		26% (27)
	other		0% (0)
	worker		44% (45)

Overall energy intake of children

The energy intake and glycemic load registered respectively a median value of 214.19 kcal and 11.67 g% GI, which corresponds to a median of 2 snacks per kid.

Effect of gadget per se and combined with TV viewing and advertising

Data on energy intake according to the specific study factors determined for each subgroup are presented in Table 2. No significant association between energy intake and gadget (Figure 2, left side) was found ($p=0.807$). Conversely, a significant association was found according to movie and advertising exposure (Figure 2, right side) ($p=0.006$).

The interdependence between Toys and TV was assessed, too. The highest score of caloric intake was revealed for the No TOY- Film High Spot group, meanwhile their interaction was not overall significant. The lowest value, instead, was recorded in the No TOY- Film Medium Spot group (Figure 3, left side). The

influence of the gadget principally emerged within the No Film No Spot group, where no significant difference among the two clusters, however, could be revealed (Figure 3, right side).

Once adjusted the confounding factors, when considering energy intake in the groups of children exposed to TV without gadget. All data are presented in Table 3.

High consumer

The third quartile of caloric intake showed an amount of 328.64 Kcal. Such measure constituted the cut-off points, in order to identify those children, presenting higher energy intake levels during the experimental session. In table 4 the main characteristics of such “high consumer” kids have been evidenced. In this cluster, made up of 34 children, a significant association was found in comparison with the TV exposure groups ($p=0.012$) and after evaluation of IBAI scores ($p=0.008$).

TABLE 2. Overall energy intake (Kcal) according to the study factors.

Study Factors	NoFilmNoSpot	FilmNoSpot	FilmLowSpot	FilmMediumSpot	FilmHighSpot	Total
NoTOY	12	12	12	12	12	60
Median	213.37	234.89	202.74	114.45	343.62	212.55
(I-III quartile)	(182.03-331.22)	(164.32-303.02)	(141.29-283.26)	(80.80- 222.08)	(175.90-486.82)	(104.78-322.91)
TOY (N)	12	12	12	12	12	60
Median	318.55	179.30	206.28	198.92	304.93	215.27
(I-III quartile)	(294.02- 344.58)	(113.09-202.19)	(164.73-292.80)	(130.25-215.27)	(210.23-360.24)	(159.00-330.54)
Total (N)	24	24	24	24	24	120
Median	301.66	189.39	202.74	176.03	323.18	214.18
(I-III quartile)	(212.55-335.58)	(118.12-287.76)	(146.74-292.80)	(100.69-216.36)	(209.55-386.27)	(127.39-328.63)

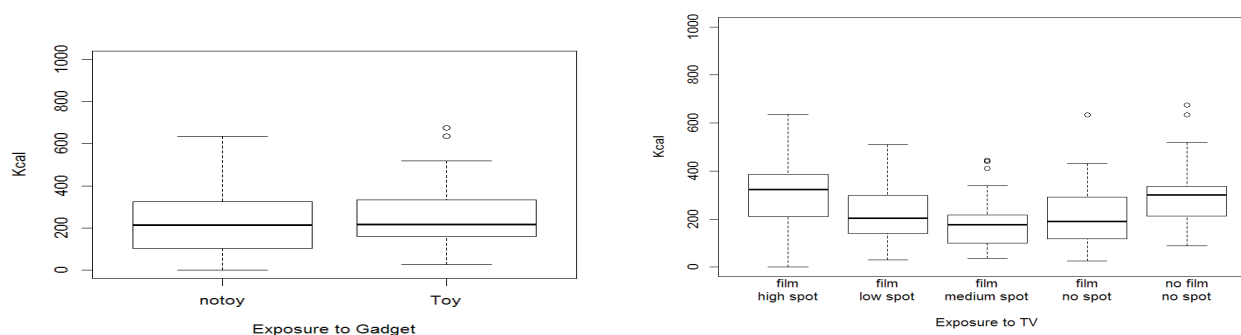


FIGURE 2. On the left side, energy intake related to gadget. On the right side, energy intake related to TV and advertising in a gadget's exposure status

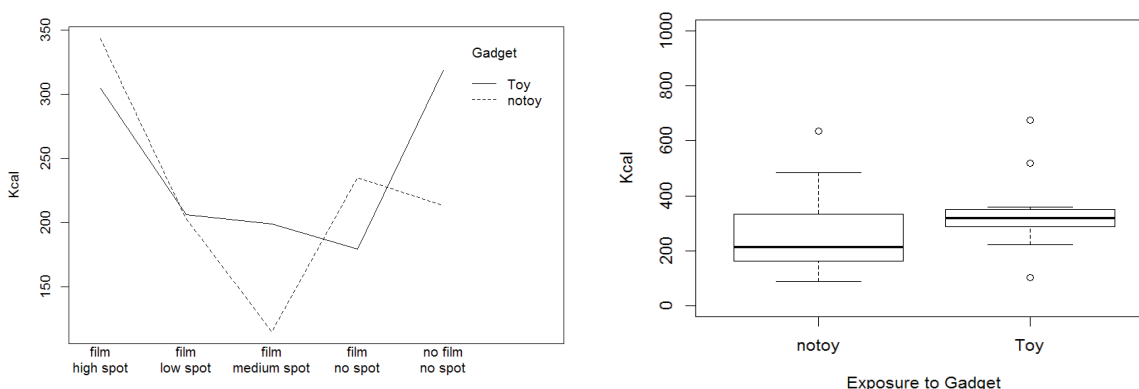


FIGURE 3. On the left side. Energy intake (kcal) trends related to TV and advertisement in a gadget TOY/no gadget NoTOY status. On the right side, energy intake related to gadget exposure in No Film Tv No Spot group

TABLE 3. Significance of the Gadget, TV, advertising and their interaction after adjustment for several potential confounding factors. Cells are p-values related to the variables indicated in the columns. p is considered as significant when $p < 0.05$

	TOY		FilmSpot					TOY:FilmSpot				
	bg	P-value	bTVNs	bTVLs	bTVMs	bTVHs	P-value	BTVNs:T	bTVLs:T	bTVMs:T	bTVHs:T	P-value
Base	72.17 (55.44)	0.793	-45.24 (55.44)	-41.24 (55.44)	-92.47 (55.44)	58.50 (55.44)	0.005	-88.29 (78.40)	-76.39 (78.40)	-51.50 (78.40)	-112.00 (78.40)	0.669
Base+M1	85.54 (64.11)	0.913	-25.88 (65.70)	-33.03 (60.51)	-82.16 (62.36)	67.55 (60.48)	0.008	-112.53 (91.52)	-84.36 (86.72)	-79.75 (87.64)	-130.26 (89.20)	0.665
Base+M1+M2	84.82 (63.79)	0.931	-6.83 (62.95)	-16.69 (59.06)	-65.03 (60.31)	70.01 (60.27)	0.008	-149.71 (89.44)	-93.20 (88.12)	-81.48 (85.62)	-103.80 (88.23)	0.574
Base+M1+M2+BA	74.75 (62.65)	0.930	-29.99 (62.62)	-20.85 (57.87)	-77.49 (59.36)	66.52 (59.04)	0.006	-115.85 (89.05)	-78.55 (86.57)	-66.19 (84.16)	-107.15 (86.41)	0.710
Base+M1+M2+BA+M3	58.95 (66.00)	0.973	-32.24 (66.00)	-30.77 (61.18)	-76.42 (63.02)	54.80 (61.95)	0.010	-102.86 (91.85)	-73.52 (89.47)	-53.08 (89.94)	-96.91 (89.62)	0.798
Base+M1+M2+BA+M3+M4	14.11 (68.56)	0.972	-26.17 (72.83)	2.18 (65.53)	-62.21 (66.97)	95.59 (66.56)	0.007	-104.25 (98.13)	-56.01 (91.99)	-19.59 (93.73)	-101.09 (99.59)	0.730

Base: Blocking + TOY + FilmSpot + TOY:FilmSpots. M1: BMI + Breast Feed + Hours/Week TV + Physical activity (hours/week)
M2: BMI Father+ BMI Mother+ number Brothers. BA: IBAI- Score. M3: Number of rooms in the house + number of TV in the house + Educational level mother. M4: breakfast in the morning + fruit portions/day + vegetables portions/day

TABLE 4. Characterization of the High Consumers according to the main study variables.
Summaries for categorical variables are expressed as percentage (absolute numbers in parenthesis)
and for continuous variables as median (I and III quartile).

	N	Low N= 86	High N= 34	Combined N= 120	p-value
Food&Toy: Toy	120	50% (43)	50% (17)	50% (60)	1
Gender: m	120	45% (39)	62% (21)	50% (60)	0.105
Age class: y3-6	120	55% (47)	38% (13)	50% (60)	0.105
Y7-10		45% (39)	62% (21)	50% (60)	
FilmSpot :NoFilmNoSpot	120	16% (14)	29% (10)	20% (24)	0.012
FilmNoSpot		24% (21)	9% (3)	20% (24)	
FilmLowSpot		22% (19)	15% (5)	20% (24)	
FilmMediumSpot		23% (20)	12% (4)	20% (24)	
FilmHighSpot		14% (12)	35% (12)	20% (24)	
BMI z-scores	120	14.795/ 16.245/ 17.802	15.365/ 17.220/ 19.557	14.880/ 16.395/ 18.790	0.094
BMI CDC z-scores: Normal	120	64% (55)	62% (21)	63% (76)	0.526
Obese		14% (12)	24% (8)	17% (20)	
Overweight		15% (13)	12% (4)	14% (17)	
Underweight		7% (6)	3% (1)	6% (7)	
Breastfeede: both	113	24% (19)	24% (8)	24% (27)	0.975
bottle-feeding		26% (21)	24% (8)	26% (29)	
breast-feeding		50% (40)	52% (17)	50% (57)	
Time spent watching TV hrs/w	120	9.000/ 11.000/ 12.000	9.000/ 11.000/ 13.775	9.000/ 11.000/ 13.000	0.377
Number of TVs in house: 0	120	2% (2)	0% (0)	2% (2)	0.749
1		19% (16)	18% (6)	18% (22)	
2		55% (47)	62% (21)	57% (68)	
3		15% (13)	15% (5)	15% (18)	
4		5% (4)	6% (2)	5% (6)	
5		5% (4)	0% (0)	3% (4)	
Breakfast in the morning					
(how often): 2-3 days a week	120	5% (4)	3% (1)	4% (5)	0.782
3-4 vdays a week		14% (12)	9% (3)	12% (15)	
every day		78% (67)	82% (28)	79% (95)	
never		3% (3)	6% (2)	4% (5)	
Eating Fruits portions/day: 1	120	41% (35)	47% (16)	42% (51)	0.692
2		49% (42)	44% (15)	48% (57)	
3		5% (4)	9% (3)	6% (7)	
4		2% (2)	0% (0)	2% (2)	
more than 4		1% (1)	0% (0)	1% (1)	
no one		2% (2)	0% (0)	2% (2)	
Eating Vegetables portions/day: 1	120	43% (37)	35% (12)	41% (49)	0.626
2		36% (31)	38% (13)	37% (44)	
3		17% (15)	21% (7)	18% (22)	
4		2% (2)	3% (1)	2% (3)	
more than 4		1% (1)	0% (0)	1% (1)	
no one		0% (0)	3% (1)	1% (1)	
Mother BMI	117	22.875/ 24.650/ 25.495	23.840/ 24.625/ 25.5825	23.320/ 24.650/ 25.540	0.267
Mother BMI CDC: Normal	117	40% (33)	35% (12)	38% (45)	0.304
Obese		4% (3)	12% (4)	6% (7)	
Overweight		54% (45)	53% (18)	54% (63)	
Underweight		2% (2)	0% (0)	2% (2)	
Father BMI	107	24.740/ 25.585/ 26.197	24.730/ 25.220/ 26.450	24.735/ 25.470/ 26.335	0.547
Father BMI CDC: Normal	107	31% (24)	34% (10)	32% (34)	0.714
Obese		0% (0)	0% (0)	0% (0)	
Overweight		69% (54)	66% (19)	68% (73)	
Underweight		0% (0)	0% (0)	0% (0)	
Brand Awareness (IBAI score)	120	8.00 15.00 23.00	13.25 22.00 26.00	8.75 16.50 24.00	0.008

DISCUSSION

The expansion of children's obesity is linked to several factors, influencing their behaviour. Genetic predisposition, environment and social factors may play a fundamental role when studying both the prevention and the development of obesity. The obesogenic environment, constituted by cultural and social factors, is of paramount importance for the research, given the role it plays for children's decision making. In the present *ad libitum* experiment the subjects' self-regulated intake according to personal choices and behavior was investigated (41). This methodology, particularly indicated for nutritional studies assessing behavioral characteristics linked to increased caloric intake (42), aimed at analyzing spontaneous behavior within an experimental setting, considering a set of potential confounding factors (42). This research represents therefore the first *ad libitum* study on snacking and related factors (like gadget and snack advertisement) focused on the potential variation of the energy gap associated to consumption of snacks in different environmental settings. Self-regulation has already been advocated as an efficient and preventive treatment for childhood obesity (43, 44). Among various co-causing variables responsible for increased caloric intake, no association emerged when adding gadgets to the snack, namely the overall quantity of snacks eaten by the child in this *ad libitum* study.

Interaction with TV and advertising

In this study, the effects of TV watching and advertising on children's consumption were investigated. The evaluation was carried out in order to compare children who were shown the short movie while eating, with those who were not selected to be shown any TV, so as to show different consumption behaviors within

various experimentally reproduced situations. Out of the results, both the presence and the absence of TV showed an increase of energy intake in children. This study, although located within an experimental setting, was intended to verify the maximum effect of a specific advertising spot promoting the snack eaten by the children. The main goal, therefore, consisted in establishing some kind of relation between the presence or the absence of commercial exposure. Within the research, differences in terms of energy intake among the HighSpot group and the NoFilmNoSpot group turned out to be not significant, while the children randomized in the MediumSpot group ate markedly less. Investigating the interaction between the presence of the gadget, as well as TV watching and exposure to advertisements, no significant association emerged, and even in the case of the only subgroup not selected for TV viewing (NoFilmNoSpot) -which represented the control group-, levels of consumption in terms of calories could not be related to the gadget.

Study Limitations

Although all results were confirmed also after adjustment, which shows a strong consistency within the study, several limitations can be mentioned. First of all, these results refer to an experimental setting, which needs to be validated in natural situated contexts. Nonetheless, the choice of an experimental setting allowed us to eliminate the wide variety of biases that could distort the depend variables. Second, the children may have possibly been aware of the artificial context created for the study as well as of the researcher's presence. All of these factors may have potentially distorted their behaviour. Still, for no *a priori* reason it could be supposed that such bias would have acted selectively on one group more than on the other. Thus, if a bias occurred, it would have most likely been spread on all groups equally. Third, there was no possibility for children to choose between different types of snack, given

the *a priori* decision to use a single product which was adequate to the research goals and experimental procedures. Children enrolled in the study might have been limited by the lack of choice in the *ad libitum* snacking setting. Further research involving a broader choice of products will offer a more representative analysis on children's consumption behavior.

CONCLUSIONS

Even if in the Film Spot group several differences among the five subgroups were identified, findings showed that food advertising does not encourage children to eat more. At this proposal, for a full understanding of the association between energy intake and food advertising, different investigative procedures have been performed. Furthermore, the study revealed that the presence of a toy commercialized along with a snack, does not alter the amount of the item consumed by children in a Mexican context. However, from a perspective of public health, effective and preventive interventions should be promoted in order to improve health and nutritional status and they need to be culture-specific and implemented at all levels: from single individuals to society at large.

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