Archivos Latinoamericanos de Nutrición

Official Publication of the Latin American Society of Nutrition

VOL 67 **JUNE 2017** **SUPPLEMENT 1**

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Archivos Latinoamericanos de Nutrición

Órgano Oficial de la Sociedad Latinoamericana de Nutrición

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Editorial

We are glad to present such special issue of the Archivos Latinoamericanos de Nutrición, developed in the context of the Executive Programmes of Scientific and Technological Cooperation between Italy-Argentina (2011-2013, extended until 2017) and Italy-Mexico (2011-2013), under joint support of the Italian Ministry of Foreign Affairs, the MINCYT (Ministerio de Ciencia, Tecnología e Innovación Productiva, Argentina) and the CONACYT (Consejo Nacional de Ciencia y Tecnología, Mexico).

Such bilateral research projects, focused on nutrition-related diseases' surveillance and prevention, were led by Prof. Dario Gregori (University of Padova, Italy) and Prof. Hugo Rodriguez (Garrahan Hospial, Buenos Aires, Argentina) (Italy-Argentina Cooperation), and by Prof. Francesco Giunta (University of Pisa, Italy) and Prof. Javier Dibildox (University San Luis Potosí, San Luis Potosí, Mexico) (Italy-Mexico Cooperation). These projects were aimed at analyzing epidemiological and preventive aspects of a multi-factorial phenomenon that represents a severe burden from the public health perspective: the relationship between nutrition and non-communicable diseases (referring particularly to obesity).

Obesity is well-known to be a concerning epidemic worldwide, both in developed and newly industrialized countries (NIC), and several efforts have been made to understand heterogeneous factors affecting its onset. In recent years, several researches have focused on the contribution of non-traditional factors to obesity. However, no definitive evidence is available in this field, in particular when moving apart from the North-American or Western-European experiences.

This special issue is aimed at serving as a collector for research experiences coming from outside of those regions. Investigations include researches on the role of both traditional (eating habits) and non-traditional factors (concentrating particularly on brand awareness, exposure to TV advertising, marketing of gadgets with toys) in affecting the adoption of unhealthy lifestyles, resulting in increased non-communicable diseases' risk in subjects from both developed and emerging economies. Together with the analysis of such predictors, which is essential to develop *ad hoc* public health interventions fighting obesity and other nutrition-related diseases, the impact of these public health policies, promoting healthy nutrition, has been investigated, analyzing if children's eating habits are compliant with current nutritional recommendations. Besides preventive aspects (and their efficacy), pure epidemiological investigations have been conducted, e.g.: analyzing the role of simple anthropometric measures in predicting body composition in children of different ethnicities. Finally, addictive behaviors connected to nutrition have been investigated, focusing on predictors of alcoholism in childhood.

As clearly seen from above, papers included in this special issue report from an intense bilateral cooperation between Italy and Latin America in an emerging field like nutrition and non-communicable diseases. In our view, this should contribute on promoting the development and the dissemination of researches in regions only partially covered by the general literature.

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Is branding food promoting obesity? An investigation on children in San Luis Potosí

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SUMMARY: This study aims at assessing children's awareness towards branded food products in central Mexico. One-hundred and twenty children, aged 3-10 years and balanced by gender, were recruited in San Luis Potosí. Kids' heights and weights were measured in order to calculate their BMI. A cross-sectional questionnaire was administered to children's parents in order to gain socio-demographic information. Children's brand awareness was assessed using the IBAI (International Brand Awareness Inventory). Basic exploratory analyses were performed for samples' general characteristics, and ANOVA was adopted for investigating differences between the IBAI tasks. Results demonstrated that 50% of kids correctly associated the logo to the respective brand in more than 70% of the cases. About half of the sample recalled the right name of the food type in 50% of the cases. 50% of kids recognized the brand name in less than 20% of cases. Older children (7-10 y) showed a higher brand awareness when compared to younger ones (3-6 y). Children demonstrated a consistent knowledge of famous fast-food and snack products. Prevention through informative campaigns should make parents more aware of the TV contents, their kids are exposed to.

Key words: Brand awareness, children, weight gain, Mexico.

RESUMEN. ¿Las marcas de los alimentos promueven la obesidad? Una investigación sobre los niños en San Luis Potosí. Este estudio tiene como objetivo evaluar la conciencia de los niños hacia los productos alimenticios de marca en México. Ciento veinte niños, de entre 3-10 años en grupos equitativos por sexos, fueron reclutados en San Luis Potosí. Se midieron la talla y los pesos de los niños con el fin de calcular sus IMC. A los padres de los niños se les entrego un cuestionario transversal a fines de obtener información socio-demográfica. El conocimiento de la marca de los niños se evaluó, mediante el uso del IBAI (Inventario Internacional de conocimiento de la marca). Se realizó un análisis exploratorio de base para obtener las características generales de la muestra y se adoptó un anova para investigar las diferencias entre las tareas IBAI. Los resultados demostraron que el 50% de los niños había asociado correctamente el logotipo de la marca respectiva en más del 70% de los casos. Aproximadamente la mitad de la muestra recordaba el nombre correcto de marca de alimentos en el 50% de los casos. 50% de los niños reconocía el nombre de la marca en menos del 20% de los casos. Los niños mayores (7-10 años) mostraron una conciencia de marca más alta si se compara con los más jóvenes (3-6 años). Los niños demostraron consistentemente tener conocimiento de los productos de comida rápida y bocadillos más conocidos. La prevención a través de campañas informativas debería conscientizar a los padres sobre los contenidos de televisión a los que que sus hijos están expuestos.

Palabras clave: Conocimiento de la marca, niños, aumento de peso, México.

INTRODUCTION

The growing epidemic of childhood overweight and obesity is a major public health concern. Multiple factors influence eating attitudes and food choices of children, like advertising (1, 2), branding (3), peers judgments (4, 5) and social context (6). Such factors need to be evaluated when considering behavioral influences, in order to assess proper public intervention to reduce the international

increase in childhood nutrition related diseases.

Genes and environment interact influencing phenotypes for intake and expenditure (7), thus indicating the need to provide information about behavioral aspects influencing obesity's rise (8). Although genetic factors play a fundamental role in obesity development (9), the rapid increase seen within the last 50 years cannot be attributable exclusively to etiologic causes (8). The "toxic environment" has been recognized as one of the leading risk factors in childhood obesity (6), a representing a scenario where kids are highly stimulated by food-related media messages and encouraged to consume high-fat, high-sugar foods (10, 11).

Food preferences appear just at an early age and are developed all along people's lifetime, becoming important determinants of food intake first in children, then in adolescents, and finally in adults (12). Many factors, as availability, accessibility, familiarity and parental modeling, influence the process (13).

Children, who exceed daily energy intake levels and present scarce frequency of regular physical activity, are considered being at a higher risk of increasing their body mass (7, 14). By means of an experimental assessment it would be possible to access the behavioral and motivational patterns, promoting compulsive consumption of highly energy-dense foods, which are commercialized on tv broadcasts and other advertisement sources (15, 16).

When considering emotions and choices behind food consumption, brand awareness and frequency of exposure to advertising have traditionally been indicated as conditioning children's tastes, diverting their preferences towards highly energetic food (1, 17).

It has been estimated, indeed, that children are exposed to 10000 advertisements for food per year, 95% of which are for fast foods, candy, sugared cereal and soft drinks (11). From a recent study developed in toddlers, daily caloric requirement exceeded in energy intake from 10 to 30%, mostly due to energy-dense food consumption (18).

Although present trends show an increasing pressure on food industry's advertising campaigns to divert children's preferences towards less processed food, the association between brand awareness, advertising and obesity has not yet been proved (19, 20). Moreover, little focus has been directed towards the relationship between children's food intake and energy expenditure (21).

The aim of this research was to develop an instrument to assess Mexican chidren brand awareness (the IBAI (International Brand Awareness Instrument)), based on a former research conducted by Forman et al. (3).

MATERIAL AND METHODS

Sample

Research population consisted of 120 children, recruited in San Luis Potosí, the sample of children was equally divided in females and males, and then split into two age groups (3-6, 7-10). The choice to divide the sample into two age-specific clusters emerged from findings of former studies carried out on this specific topic (22- 24). Results of these studies underlined, indeed, that the recalling and recognition performance of children differed according to their age.

Study Design

A selection of 12 different brand marks was performed for the mexican specific IBAI version. consistently to what was defined by Forman et al. (3), the IBAI has been adapted to the country-specific context of the present research with special attention reserved to the choice of several food brands, included for this study. Three alimentary lines were proposed as stimuli: sweet foods, savory ones, and carbonated beverages. The choice of these aliments emerged from a constant confrontation

among all stakeholders involved within the project (experts in public health, psychologists, educators as well as nutritionists). In order to propose a valid instrument for the context, two basic criteria had to be granted when choosing the single brands: 1.) all products must be available in most Mexican stores and markets on a local as well as on a national level; 2.) all of these trademarks must refer to foods usually consumed by children taking part in this research.

Independent variable

The stimuli consisted of 12 flashcards, containing just a part of a brand mark (e.g. the typical "M" in Mc Donald). In addition, sets of 12 four-image charts were correlated to each flash card. The images in the charts represent different alimentary alternatives (see table 1 for details). Out of these, only one corresponds to the brand partially shown in the flashcards. Figure 1 shows an example of a flashcard along with its multiple-choice image chart.

Procedure

Children were recruited after lunch in a quiet room inside the school they attend. The same meal was administered to all the kids and they followed the same physical activity patterns.

Afterwards, children were allocated individually in a classroom, and asked to sit on a chair next to a table, where the material was exposed. The kid was set in front of the researcher in order to interact with him and the observation tools (the 12 image charts). Once the researcher explained the procedure to the child, he showed her/him each single card representing a food brand, then the selection of 4 pictures containing alimentary products. First the child was asked to name the specific logo shown on each single card and afterwards she/he was invited to link it to one of the 4 images of aliments. The researcher then assigned 1 point if the child correctly named the product, 1 point if it has been matched to the respective food category and finally 1 point if the kid recognized the specific name of the product (e.g. "Mc Donald" is the brand, the correct image is a double roll containing two hamburgers with cheese, the products name is "Big Mac").

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) [15].

TABLE 1.International Brand Awareness Instrument (IBAI) – Mexico

Flash Card	Brand	Solution	Product 1	Product 2	Product 3	Product 4
1	Coca Cola®	A	Coca Cola	Milk	Orange	Chocolate
2	Mc Donald®	C	Pasta	Toast	Hamburger	Fish
3	Marinela®	D	Croissant	Pudding	Brioche with jam	Gansito
4	Pringles®	A	Pringles potatoes	Chips	Peanuts	Gummy candies
5	Holanda®	C	Creme caramel	Yogurt	Cornetto	Gummy candies
6	Ricolino®	D	Bread with jam	Brioche	Brioche with jam	Bubulubu
7	Danone	A	Danette	Cornetto	Chocolate bar	Smarties
8	Tang®	C	Cola	Milk	Fruit juice	Chocolate
9	Barcel®	B	Potato chips	Takis	Biscuit	Gummy candies
10	Gamesa®	C	Chocolate bar	Biscuit	Mamut cookies	Pudding
11	Kellogs®	D	Potato chips	Honey cereal	Wafer	Frosties
12	Sabritas®	C	Cheese	Potato chips	Cheetos poffs	Cornflakes

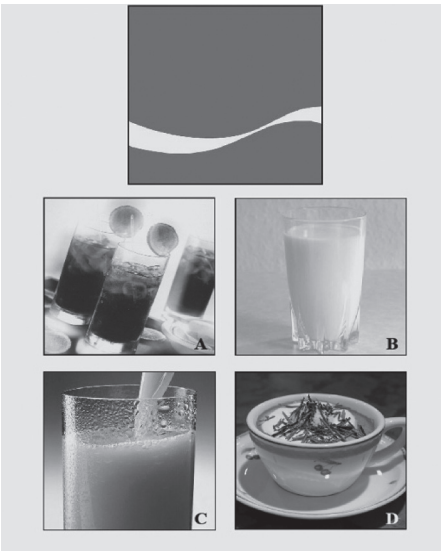

FIGURE 1. Example of flash cards used for the IBAI. The logo of Coca-Cola (co) has been associated to milk, orange juice, chocolate and a carbonated beverage (correct match: image A)

Ethical statements

Children who were diagnosed with cognitive disorders, metabolic diseases or allergies were excluded. Parent's informed consent was obtained for all children prior to each child's participation in the study, and they were explained the precise aims of the study and was guaranteed anonymity. Treatment of all data was performed in compliance with the guidelines and ethics standards issued by The American Psychological Association (25). Appropriate permission was obtained from the Institutional Review Boards.

Cross-sectional questionnaire

A questionnaire was administered either to children than to their parents. The questionnaire was structured into four parts. The first one aimed to assess socio-demographic characteristics of the whole family, asking about parental education, family members' BMI and composition of the household. A second section, in turn, looked into the general health-status of the family, especially eating habits, nursing, chronic diseases, etc. The following section assessed their eating habits in terms of both, quality and quantity of energy intake. The last part considered daily intensity and weekly frequency of physical activity performed by the children.

Anthropometrics

Children were weighed and measured in light clothing and without shoes on a balance scale and with a body meter measuring tape with wall stop. Weights and heights were utilized to calculate BMI. Children were considered to be overweight/obese with a BMI ≥85th and underweight with a BMI <5th, according to CDC growth standards (26, 27).

Statistical analysis

Basic exploratory data analysis was performed on the sample and was reported using median (I-III quartile) for continuous variables and percentages (absolute numbers) for categorical variables, whenever appropriate. Throughout a linear regression model the effect of age and gender on the total IBAI score was assessed. In order to analyze differences with regard to the three tasks of the IBAI (brand recognition, brand-product association, product recall), anova was adopted for repeated measures.

Distributions of correct recognition, recall and matching emerged from the IBAI test are shown through boxplots (Figure 2).

Analyses were performed using the R-software.

RESULTS

Children's IBAI scores arising from exact recognition of the brand mark, positive association between the logo and the respective product, as well as correct recall of the specific aliment are shown in Table 2.

Figure 2, instead, shows the different distribution of the single IBAI tasks, where overall 50% of the kids associated correctly the logo to the respective brand in more than 70% of the cases. Around half of the sample recalled the right name of the food type in 50% of the cases. 50% of kids recognized the brand name in less than 20% of cases. This comparison among the single boxplots, representing the main outcomes of the study with the twelve flashcards, shows that the brand-product association task, the brand recognition task and the product recall task show different levels of performance as demonstrated in Figure 2.

With regard to age, results showed that older children (7-10 y) performed better in the recognition task, instead in the recalling and association tasks, when compared to the younger ones (3-6 y). No significant gender related association could be revealed.

DISCUSSION

In the rapid spread of nutrition related pathologies among children, age-specific

TABLE 2. Item response distribution for the IBAI

	Brand name N	Brand name %	Brand-product association N	Brand-product association %	Product name N	Product name %
1	58	48,33	71	59,17	57	47,5
2	71	59,17	112	93,33	102	85
3	32	26,67	86	71,67	70	58,33
4	5	4,17	35	29,17	49	40,83
5	37	30,83	104	86,67	99	82,5
6	32	26,67	75	62,5	48	40
7	20	16,67	71	59,17	61	50,83
8	1	0,83	40	33,33	36	30
9	27	22,5	77	64,17	58	48,33
10	30	25	35	29,17	25	20,83
11	20	16,67	98	81,67	88	73,33
12	53	44,17	54	45	50	41,67

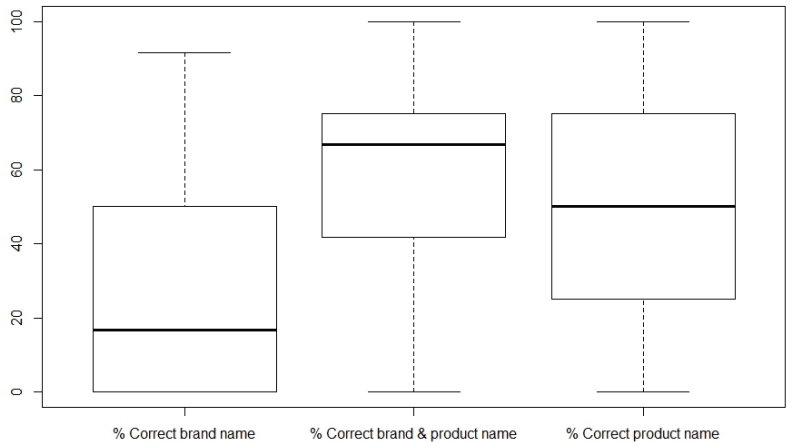

FIGURE 2. Percentage of correct responses for the 3 IBAI tasks.

advertising has been targeted as positively increasing the phenomenon. A systematic review of all the evidence made available by the Food Standards Agency (FSA) in 2003 (28), and a report by the Office of Communications (Ofcom) in 2004 (29) underlined the urgent need to expand knowledge about the influence of food commercials on children's eating habits. Both researches concluded that there is a link between the exposure to advertisement and obesity. In a further study, Ashton (30), underlined, instead, that both studies showed evident contradictions. In the first review, a statistically significant relation between a child's exposure to advertising and a rise of energy intake was found. However, whilst exposure to food commercials did reduce children's nutrient efficiency, it accounted for only 2% of the variance and had no direct effect on caloric intake, while parental behavior's influence was fifteen times greater (31). As indicated by Kopelman (32), indeed, both reports appeared to have major limitations, being strongly dominated by studies in North American setting and concentrating only on television advertising, ignoring all other inputs that might influence children's awareness. Kopelman's study, held on children from 9 to 11 years, did not demonstrate a close relationship between brand awareness and the children's reported eating behaviors, food knowledge and preferences, although the English sample showed a high brand logo recognition.

Buijzen et al. stated in a study published in 2008 (33) that television food advertising contributes to an unhealthy diet, influencing not only children's awareness towards brand-marks, but promoting even more a general rise in consuming energy-dense foods. Conclusions, however, were derived from correlational data, which do not isolate any specific causes. The same limitation regards also the linkage between branding and obesity.

Brand awareness is defined as the active and passive knowledge of a particular brand. Research on the brand awareness of young children has focused on two aspects of brand awareness: brand recognition and brand recall. The IBAI questionnaire, adapted to the Mexican context, considered both these aspects, by researching not only children's knowledge of brand recognition, but also of specific product naming.

Former studies, examining toddlers' and preschoolers' brand recognition (34, 35) and brand recall (36), showed that children's ability to recognize brands starts earlier in development than their ability to recall these brands, showing in preschoolers an excellent recognition memory, whereas their recall memory performance is considerably weaker. Moreover, older children have more content knowledge than younger children about almost everything. In general, new information is best learned and remembered when it can be related to existing knowledge in memory, a capacity that is more distinct in older children (37). In brand awareness building, along with normal developmental patterns, environmental factors result crucial determinants.

Brands are recognized by children in early life, but their effect on obesity development has not yet been clarified. By 2 years of age, brand awareness can be detected in children (38), progressively increasing selective attention and association abilities with certain products (39, 40), particularly if brands use salient features such as bright colors, pictures, and cartoon characters (34). Just in pre-school period, preferences towards specific foods start to arise, inducing a behavior defined as "consumption by influence" (41). Marketing strategies, therefore, take into account these phenomena (41), in order to encourage children to recognize and differentiate particular products and logos; for example advertisers place cereal boxes at children's eye level, because they know that toddlers can recognize brands of cereals, attracting their attention while there are seating in the grocery cart (6).

Previous experimental studies have shown a brand effect on children's preferences. Robinson

et al. (42) examined the effects of cumulative marketing and brand exposure on young children, by testing the influence of branding on taste preferences. Results showed that branding of foods and beverages influenced young children's taste perceptions, with a significant greater effect in those more highly exposed to TV. Roberto (43) explored the use of licensed characters as taste promoters in children from 3 to 6 years. Such results underlined a positive influence on taste and preferences towards so called junk food. A similar, recent work by Lapierre et al. (44) investigated whether food packaging with licensed media characters affected taste assessment of cereals, revealing consistently to Robinson and Roberto a positive effect of subjective judgments.

Unlike previous studies, focused on younger age groups, our research targeted children between 3 to 10 years old, in order to assess brand-awareness not only within specific groups, but also carrying out a comparison among them. Within our sample, age-related differences appeared.

O' Cass' and Clarke's study (45) showed that main differences between age and gender are evident in types of brands recognized or recalled rather than in the number. In our study, indeed, the older group demonstrated a better performance while carrying out the brand recognition tasks.

Despite age and gender, environmental factors like television advertising exposure, family characteristics, and peer influence determine young children's brand awareness. Correlational studies on children's brand recognition have demonstrated a significant relationship between television exposure and brand recognition (34, 46, 47). Some studies suggest that children from high income families show a better brand awareness, because they have greater exposure to the economic world than children of low socioeconomic status (37). Other studies, in contrast, have found that children belonging to low income families are better aware of brands, because they are exposed to the market-place earlier and more extensively than those grown in contexts with high socio-economic background (48).

STUDY LIMITATIONS

The study incorporated data from 120 kids, all children belonged to the same Mexican regional context, namely San Luis Potosì, and results could therefore only be intended as context-specific. Further research should extend the sample to a more cross-regional survey in order to understand if cultural differences in a country, presenting important variances from the north (close to the United States) to the south, where influences of South-American societies exercise a stronger impact, would produce different levels of awareness towards brand marks. Lifestyles and consumption habits are assumed to differ significantly, also due to the geopolitical pluralism of a central American country, which is going through a cultural transition. There was a second limitation, data could only be intended as an aproximate estimation of general trends across the overall population. Direct observation, also via ethnographic methodologies, could integrate the findings of this study with a perspective, naturally situated within real contexts

CONCLUSIONS

The study aims to assess, the awareness of 3-10 years old children towards brand marks of certain food products, usually commercialized in supermarkets and fast food franchising within a regional context of central Mexico. Results showed that children demonstrated a consistent knowledge about famous fast-food and snack products and that the awareness towards brands produces major effects in older children. Prevention through informative campaigns, making the parents more aware of the TV contents, their kids are watching, would improve the choice of kid-specific programs, monitoring also the food advertisement they are usually exposed to.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from ProChild ONLUS (Italy).

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Vol. 67 Suppl. 1, 2017

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 advertsements). 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 readly 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 ≥85th and underweight with a BMI <5th, 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

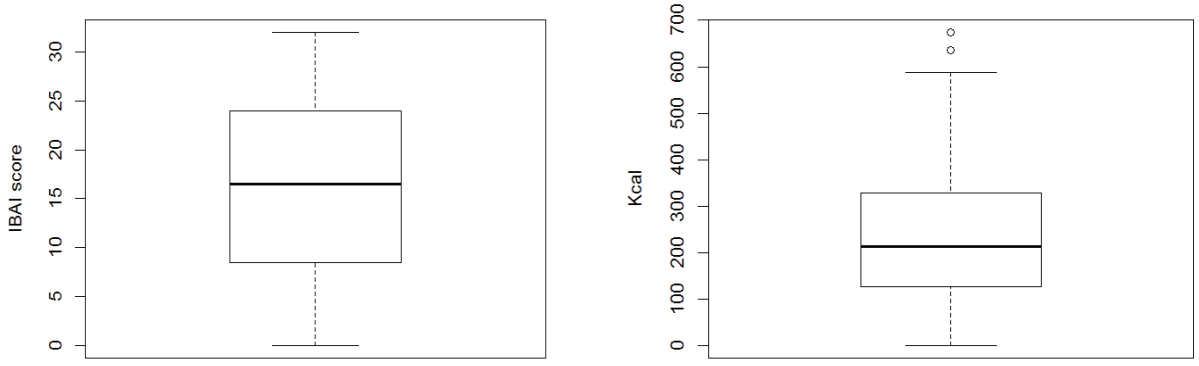

FIGURE 1. On the left side, country IBAI box plot. On the right side, country energy intake box plot.

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)
	Everyday		79% (95)
Daily fruit portions	1	120	42% (51)
	2		48% (57)
	3		6% (7)
	4		2% (2)
	None		2% (2)
	More than 4		1% (1)
Daily vegetable portions	1	120	41% (49)
	2		37% (44)
	3		18% (22)
	4		2% (3)
	None		1% (1)
	More than 4		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% Gl, 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 NoTOY- 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 (I-III quartile)	213.37 (182.03-331.22)	234.89 (164.32-303.02)	202.74 (141.29-283.26)	114.45 (80.80- 222.08)	343.62 (175.90-486.82)	212.55 (104.78-322.91)
TOY (N)	12	12	12	12	12	60
Median (I-III quartile)	318.55 (294.02- 344.58)	179.30 (113.09-202.19)	206.28 (164.73-292.80)	198.92 (130.25-215.27)	304.93 (210.23-360.24)	215.27 (159.00-330.54)
Total (N)	24	24	24	24	24	120
Median (I-III quartile)	301.66 (212.55-335.58)	189.39 (118.12-287.76)	202.74 (146.74-292.80)	176.03 (100.69-216.36)	323.18 (209.55-386.27)	214.18 (127.39-328.63)

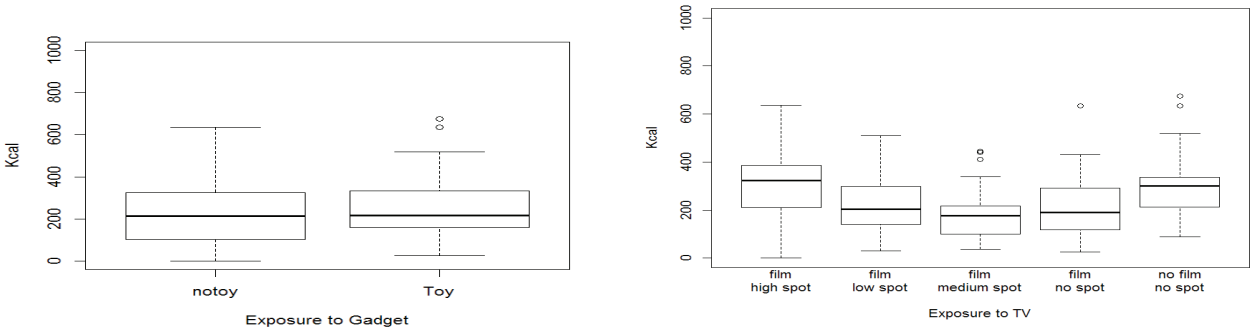

FIGURE 2. On the left side, energy intake related to gadget. On the right side, energy intake related to TV and advertising in a gadget's exposure status

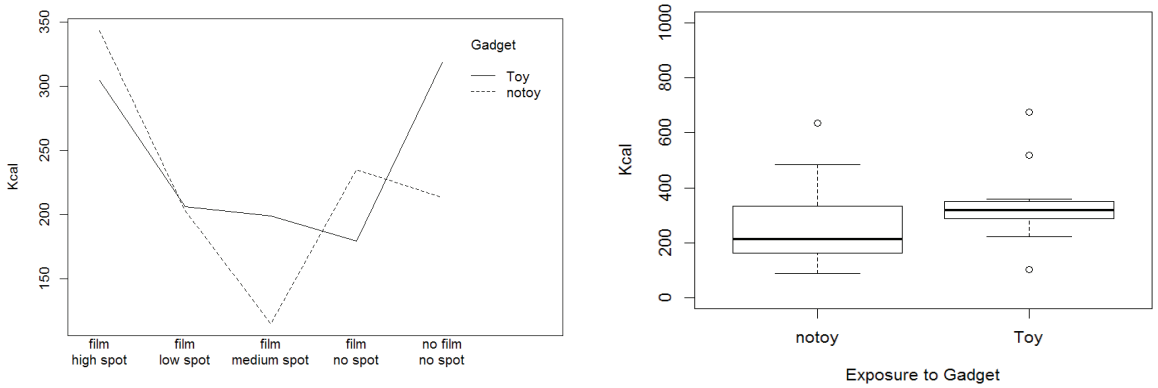

FIGURE 3. On the left side. Energy intake (kcal) trends related to TV and advertisement in a gadget TOY/no gadget NoTOY status. On the right side, energy intake related to gadget exposure in No Film Tv No Spot group

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)	
Breastfeeded: 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.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

ACKNOWLEDGMENTS

The study group gratefully acknowledges Ferrero Inc. for having provided all the experimental food and toys free to the experimenters. All authors declare to not have any conflict of interest.

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Does food advertising influence snacks consumption in Chilean children? Results from an experimental *ad libitum* study

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SUMMARY: The present study aimed at assessing the impact of food advertising on snack consumption in Chilean children using an experimental, *ad libitum,* design. Forty children were enrolled in urban, middle class, school setting. They underwent anthropometric assessment, brand awareness evaluation, and their lifestyle and habits were recorded through a validated questionnaire administered to their parents. A 5-arm design was adopted, consisting in the exposure to five different levels of TV spots and advertising. No significant differences were identified in caloric intake among children randomized to different levels of TV spots and commercials exposure. No significant effects on caloric intake, caloric intake per BMI, and or glycemic load were detected, even after adjustment for confounding factors. This study suggests the need for a better analysis of the contribution of non-traditional factors to obesity onset in children, which can provide high-quality evidence in order to develop effective public health strategies to face childhood obesity epidemic.

Key words: Children, food advertising, television, snack consumption, Chile.

RESUMEN. ¿Influye la publicidad de alimentos en el consumo de colaciones en los niños chilenos? Resultados de un estudio experimental *ad libitum*. El presente estudio tuvo como objetivo evaluar el impacto de la publicidad de alimentos en el consumo colaciones en los niños chilenos mediante la utilización de un diseño experimental basado en la voluntad de los participantes (*ad libitum*). Se realizó la inscripción de cuarenta niños en el contexto de una escuela urbana de clase media. Se les realizó una evaluación antropométrica, un examen de reconocimiento de marca y se procedió a registrar información sobre su estilo de vida y hábitos mediante un cuestionario validado que fue entregado a los padres y firmado por los mismos. Se adoptó un diseño de 5 grupos, que consistía en evaluar la exposición a cinco niveles diferentes de publicidad y clips televisivos. No se identificaron diferencias significativas en cuanto a la ingesta calórica entre los niños asignados aleatoriamente a diferentes niveles de exposición a clips televisivos y a anuncios publicitarios. No se detectaron efectos significativos en tanto a la ingesta calórica, ingesta calórica por IMC, o la carga glucémica, incluso después de realizar el ajuste por factores de confusión. El presente estudio sugiere la necesidad de un mayor análisis respecto de la incidencia de factores no tradicionales en la aparición de la obesidad en los niños, que proporcione evidencia de alta calidad con el fin de desarrollar estrategias eficaces en materia de salud pública ante la epidemia de obesidad infantil.

Palabras clave: Niños, publicidad de alimentos, televisión, consumo de colaciones, Chile.

INTRODUCTION

Obesity prevalence in childhood has been rising worldwide (1, 2), both in developed and in newly industrialized countries.

Childhood obesity represents a severe public health burden given its well-known association with metabolic and cardiovascular impairments. Understanding factors associated with obesity in children is crucial, in order to implement public health policies addressing obesity contributors,

reducing obesity (and its comorbidities) burden. Several predictors have been identified, and they are distinguished usually in modifiable and non-modifiable. Among non-modifiable ones, genetics play an important role in predicting obesity onset (3). Among modifiable predictors, different contributors have been identified, including: dietary patterns (4); behavioral factors (physical activity levels, sedentary behaviors (5), daily sleep hours (6)); perinatal characteristics (7) (mother's body mass index (BMI), birth weight, smoking during pregnancy, gestational diabetes); non-traditional risk factors (8) (food advertising, marketing of snacks with gadgets); and psychological ones (parents' perception of child body shape (9), stressful events, quality of family relationship).

Recently, researches on obesity predictors have concentrated especially on non-traditional factors. It has been suggested that TV viewing and exposure to unhealthy food and beverages advertising are associated with increased caloric intake, and, consequently, to increased obesity likelihood (10, 11). However, when looking at the association between marketing of snacks with gadgets (in order to capture children's attention) results are controversial. Experimental studies failed to identify a significant relationship between the exposure to food packaged with come-ons (e.g., toys) and increased caloric intake (12, 13), while observational ones seemed to suggest that the restriction in the use of gadgets for the promotion of energy-dense food results in healthier food choices (14).

Several governments worldwide have implemented interventions for obesity prevention by regulating advertisement aimed to children, and the marketing of food with come-ons, even if evidence from literature are controversial. Some examples of such regulations are represented by the Santa Clara County CA Ordinance (the first U.S. jurisdiction to prohibit the marketing of toys and other incentives with foods that do not meet nutritional recommendations), and the recent Chilean law on food labelling and advertising. The recent Chilean regulation has prohibited the advertisement of food and beverages (high in sodium, total sugar, satured fat, and energy) and the use of come-ons, such as toys, stickers etc., in the promotion of such products to children under the age of 14. The adoption of such measures is motivated by the concerning high prevalence of childhood obesity, especially in Chile, where a recent report of the Chilean Health Ministry has shown that about 30% of preschoolers are overweight/obese (15).

Considering such framework, characterized by the urgent need to deal with childhood obesity epidemic, but the lack of evidence available on non-traditional obesity predictors, the aim of this study is to assess the impact of food advertising on snack consumption in Chilean children using an experimental, *ad libitum*, design.

METHODS

The present experimental study was a spin-off of the OBEY-AD (OBEsogeneicitY of gADgets marketed with snacks) study, aimed at assessing the contribution of non-traditional factors on obesity development in children.

Children aged 6-12 years were recruited from an urban, middle-class, school setting in the city of Santiago (Chile). Children suffering of allergies, cognitive disorders or metabolic diseases were excluded. Parents' informed consent was obtained prior to children participation to the study. Subjects' treatment was consistent with the guidelines of the American Psychological Association (APA) (16). Appropriate permissions were obtained by the Institutional Review Board. A detailed description of the study is given elsewhere (12).

Experimental design and procedure

The experimental study was 5-arm ad libitum eating design (study procedure is reported in Figure 1). Children were exposed to ten different

snacks (Table 1) that could be eaten ad libitum during the experimental session. The experimental factor was represented by the exposure to TV and advertising, organized in five levels: "no exposure to TV" (NoFilmNoSpot), "exposure to TV without advertising" (FilmNoSpot), "exposure to TV and one advertisement" (FilmLowSpot), "exposure to TV and two advertisements" (FilmMediumSpot), and "exposure to TV and three advertisements" (FilmHighSpot).

The film was a non-spoken cartoon lasting 22 minutes. It consisted of a set of episodes with Disney Pluto© as main character.

The experimental session took place in a quiet room of the school facility during the afternoon break. Children participating to the study received the same meal and had consistent physical activity patterns. They were sitting at a table in front of a monitor (except to those randomized to the NoFilmNoSpot level), while the investigator was in a back-screen position to not interfere with children performance, but to be easily reachable from their requests. The session was videotaped using two hidden HD cameras. Parents were asked to not attend the experimental session; if they refused, they were asked to sit at the back of the room without being seen by the child.

Once enrolled in the study, children underwent anthropometric assessment and lifestyle habits recording (through a validated questionnaire). After baseline assessment, kids were randomized. Randomization was blocked by age and gender, and was performed using an ad hoc software integrated with data collection and study conduction system. Subsequently, the investigator administered the International Brand Awareness Inventory (IBAI) (17) to children, and explained the next study's steps.

Ten different snacks were presented to children (Table 1), and at the same time it was started the cartoon movie (when applicable, according to participants' allocation). The snacks were placed on a tray, with their branded packages directed upwards. All children were asked to choose the

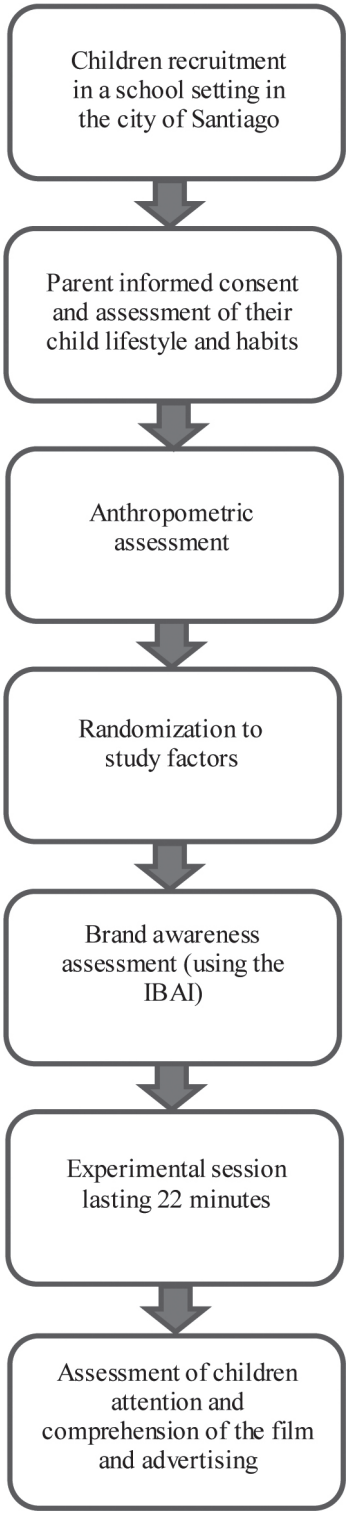

FIGURE 1. Flow-chart of the study procedure.

TABLE 1. Nutritional facts of snacks presented to children in the experimental session.

Product Name	Packaging Weight	Carbohydrates g available	sugars	Proteins g	Fats g total	saturated	trans	M	P	Cholesterol mg	Sodium mg	Kcal
Twix©	50,7g	33	/	2	12	9	0	2,2	0,7	5	100	250
Rollo©	25g	15	11	1,4	2,8	2,2	0	0,3	0,2	15	72	92
Mini Oreo©	50g	32	19	3	12	6	0,3	4	1	5,3	212	244
Snickers©	58,7g	35	/	4	14	5	0	5,5	2,4	5	140	280
Rayita©	40g	24	18	1,7	5,4	2,6	0	1,7	0,4	10	99	152
Alfajor	20g	13,4	/	1,5	2,9	1,2	0	1,4	0,3	0,2	18	83
M&M'S©	47,9g	34	/	2	9	6	0	2,6	0,3	34	35	230
Mini kuky©	40g	26,5	/	2,3	9,8	5,8	0,19	2,4	0,68	1	136	203
Museo©	40g	30,9	/	2,3	5,6	2,9	0,11	1,6	0,64	1	132	183
Kinder Joy©	20g	11	10,6	1,6	6,6	2,8					0,017	110

M=monounsaturated; P= polyunsaturates

snacks they preferred and to eat *ad libitum.*

In order to calculate the amount of snacks eaten by each child, the residuals were weighed at the end of the experimental session and data were entered in the study software (each snack was identified with a code reported in the study's system program together with its weight, assessed at the beginning of the study).

Anthropometric measurements

Children's were weighed and measured barefoot and wearing light clothes. Weight and height were assessed using a balance scale and a body meter with a wall stop. BMI was calculated as weight divided by height squared. Children were considered to be overweight/obese with a BMI ≥85th and underweight with a BMI <5th, according to CDC growth standards (18).

Study questionnaire

A cultural-specific questionnaire was administered to children's parents in order to assess their son/daughter habits and lifestyles.

The tool was made of different parts. The first one aimed at assessing family characteristics (number of siblings, age/weight/height/physical activity levels of parents and siblings, with whom the child lived); socio-economic status (parents' working status and educational level, number of rooms in the house); time spent watching TV/videogames (hours the child spent each day watching TV and playing with videogames, number of TVs in the house, presence of the TV in the child room). The second section assessed child's eating habits (food frequency, if the child usually had breakfast/snacks/lunch/dinner) and feeding practices in early childhood (if the child was breastfed and how long). The third part consisted on a projective test investigating mother's perception of child's body size, and the last one assessed child's physical activity levels.

Brand awareness

Children's brand awareness was evaluated by administering the IBAI questionnaire. It is a validated instrument, consisting on 12 images of food products (both international and country-specific). Children were asked to: recognize the brand, match the brand with the corresponding food product and name the product. Details of the instrument are given elsewhere (17, 19).

Power calculation

Basic assumptions for powering the study were a consumption in the baseline groups

(NoFilmNoSpot) of 200 Kcal, roughly corresponding to the consumption of a snack during the experimental session. Standard deviation of the regression errors has been set to 100 Kcal based on previous pilot observations. If the true slope of the line obtained by regressing Kcal consumption against experimental arm levels is 5.5 (trend analysis), 32 subjects were needed to be able to reject the null hypothesis that this slope equals zero with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05. Sample size has been increased to 8 for accounting for non-experimental variations in the study subjects. Sample size has been estimated using PS (20).

Statistical analysis

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

Further exploratory data analysis has been conducted to highlight the differences in the co-primary endpoints (Kcal and Kcal/BMI and Glycemic Load) across the study regimes, reporting the median and the interquartile range for both, stratified by NoFilmNoSpot, FilmNoSpot, FilmLowSpot, FilmMediumSpot and FilmHighSpot. These results can be further visualized graphically in the corresponding boxplot. (see Figure 2, Figure 3 and Figure 4).

Main analysis has been based on a linear model where blocking factors (sex and age) and FilmSpot have been inserted in the model. This is the base model used in the analysis, where specific investigations on single factor-level effects have been conducted using appropriate linear contrasts.

To further check for additional confounding factors, adjusted model has been developed, using the AIC criterion in the backward fashion. For each model, significance of the main experimental factor (exposure to TV or spot) has been assessed.

Children were classified as "high consumers" if their energetic intake during the sessions exceeded the III quartile of the distribution. Basic descriptive data analysis has been performed on the stratified sample and reported using median (I-III quartile) for continuous variables and percentages (absolute numbers) for categorical variables, were reported. Also, accordingly association tests were conducted between the probability to be a high-end consumer and selected variables (Fisher exact test for the categorical variables and t test for the continuous). Analyses has been conducted using the R System (21).

RESULTS

Forty children, balanced by gender, were enrolled. Children's age ranged from 6 to 12 years (median age 9.5 years). More than an half of them was found to be overweight/obese according to the CDC growth charts (18), and to never do physical activity (22%) or to do it rarely (45% of children did physical activity only half an hour or an hour per week). Despite the fact that most of children were found to be physically inactive, most of them were reported to do not play with videogames (42.5%) or to play with videogames no more than an hour per week (50%), even if they spent a median time of 18 hours per week watching TV (roughly at least 2 hours per day). Median IBAI score was found to be 19 (15, 22 I-III quartile), corresponding to a medium-low/medium-high brand awareness. Sample characteristics are summarized in Table 2.

During the experimental session, children were found to eat a median of 453.7 kcal, corresponding to a median glycemic load of 24.725. Table 3 shows caloric intake (rough and per BMI) and glycemic load according

TABLE 2. Sample characteristics. Numbers are I quartile/median/III quartile for continuous variables and percentages for categorical variables.

Sample characteristics	N	Descriptive statistics
% Female	40	50
Age (years)	40	8/9.5/11
Race	40	
% Mapuche	40	0.128
% Mestizo	40	0.128
% White	40	0.743
Weight	40	34.48 / 42.10 / 48.58
Height	40	130/141/14.4
Child BMI	40	19.43/21.08/22.75
% Normal	40	0.2
% Obese	40	0.375
% Overweight	40	0.4
% Underweight	40	0.025
Weekly physical activity	40	
% none	40	0.225
% Half an hour	40	0.125
% An hour	40	0.325
% 2-3 hours	40	0.250
% 4-6 hours	40	0.075
Weekly video games	39	
% none	40	0.425
% Half an hour	40	0.175
% An hour	40	0.325
% 2-3 hours	40	0.025
% 4-6 hours	40	0.05
% Children eating at least two portions of fruit	40	0.59
% Children eating at least two portions of vegetables	40	0.542
Months breastfeeding	40	6 / 8 / 13.5
% having a TV in own room	40	0.676
Father is working	40	0.892
Father education	40	
% Complete secondary or higher	40	0.459
% Complete technical	40	0.351
% Primary school	40	0.162
% None	40	0.027
Mother education	40	
% Complete secondary or higher	40	0.35
% Complete technical	40	0.450
% Primary school	40	0.175
% None	40	0.025
Weekly hours of TV	40	14/18/25
IBAI score	40	15/19/22

to exposure to TV and advertising, and the differences in the intake of children randomized to different levels of TV/advertising exposure compared to those randomized to the NoFilmNoSpot level. Despite the fact that children allocated in the FilmMediumSpot and in the FilmHighSpot levels were reported to have higher caloric intake (rough and per BMI), and glycemic load compared to the other children (as it is depicted in Figure 2, 3, and 4), no significant differences were identified. No significant effects on caloric intake, caloric intake per BMI, and glycemic load were detected, even after adjustment for potential confounding factors using both single comparisons to the reference level NoFilmNoSpot (Table 4) and multiple comparisons between different treatment regimens (Table 5).

Looking at the

characteristics of children classified as "low consumers" and "high consumers" (according to the III quartile of the distribution of the energy intake), higher consumers were found to be more likely to be obese compared to the "low consumers". However, referring to the study factors, no significant differences were identified according to treatment allocation.

TABLE 3. Overall energy intake according to the study factors.

Outcome	NoFilm NoSpot	Film NoSpot	Film LowSpot	Film MediumSpot	Film HighSpot	Total
N	8	8	8	8	8	40
Kcal eaten						
Median	369.8	217.7	322.6	590.5	517.8	453.7
(I-III quartile)	(238, 506)	(130.5, 496.4)	(250, 451.7)	(468, 656.6)	(460.7, 569.8)	(272.2, 613.9)
Difference with NoFilmNoSpot (p-value*)		-99.67 (0.91)	-36.92 (0.99)	154.44 (0.67)	105.8 (0.89)	
Kcal/BMI						
Median	20.05	11.4	14.65	26.54	26.82	21.22
(I-III quartile)	(14.22, 28.14)	(5.398, 25.1)	(11.89, 21.75)	(17.9, 32.99)	(21.8, 29.89)	(12.84, 29.11)
Difference with NoFilmNoSpot (p-value*)		-5.80 (0.823)	-4.45 (0.92)	5.025 (0.89)	3.94 (0.95)	
Glycemic Load						
Median	20.15	11.87	17.580	32.18	28.22	24.72
(I-III quartile)	(12.97, 27.58)	(7.11, 27.05)	(13.62, 24.61)	(25.5, 35.77)	(25.10, 31.05)	(14.83, 33.55)
Difference with NoFilmNoSpot (p-value*)		-5.43 (0.91)	-2.01 (0.997)	8.416 (0.67)	5.76 (0.88)	

p-values refer to the significance of difference in means in multiple comparison of each level of exposure to TV with or without advertising (Film NoSpot, Film LowSpot, Film MediumSpot, Film HighSpot) to the reference level (NoFilm-NoSpot)

FIGURE 2. Energy intake (Kcal) according to TV/advertising exposure.

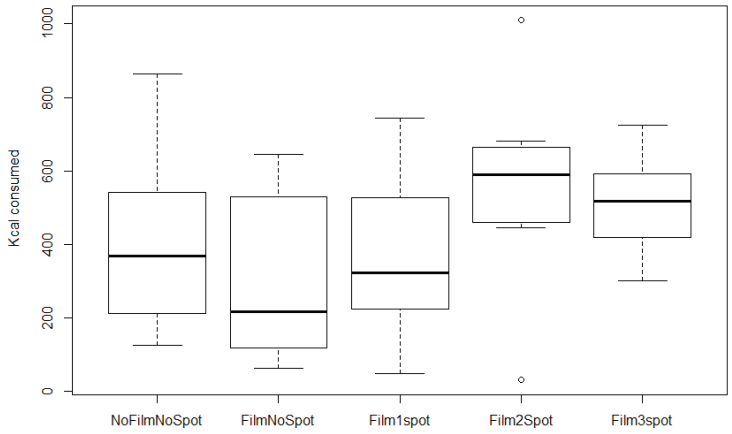

FIGURE 3. Energy intake (Kcal/BMI) according to TV/advertising exposure.

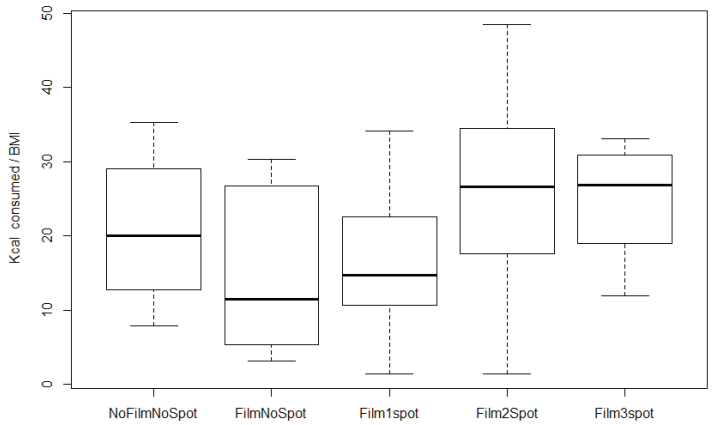

FIGURE 4. Glycemic load according to TV/advertising exposure.

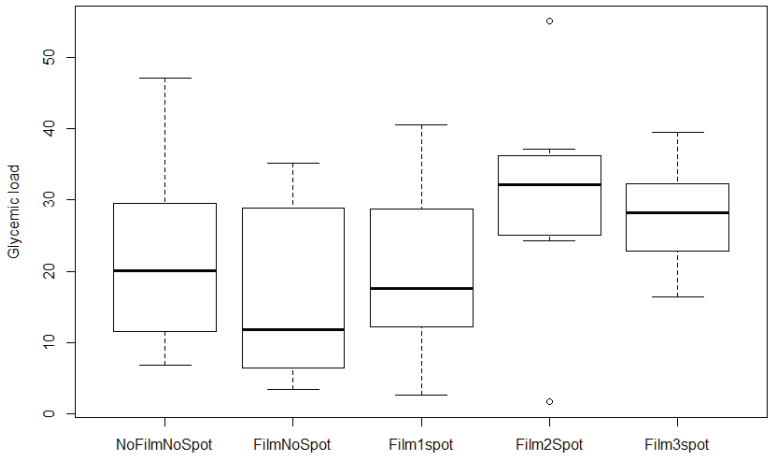

TABLE 4. Significance of the TV and spot regimes in comparison to the reference level (NoFilmNoSpot) after adjustment for several potential confounding factors.

	FilmNoSpot Vs NoFilmNoSpot	FilmLowSpot Vs NoFilmNoSpot	FilmMediumSpot Vs NoFilmNoSpot	FilmHighSpot Vs NoFilmNoSpot	p-value (F-statistic)
Kcal eaten					
Base model	-99.67	-36.92	154.44	105.80	0.103
	(110.43)	(110.43)	(110.43)	(110.43)	
Adjusted model	-69.253	-12.025	239.52	129.176	0.152
	(110.67)	(123.08)	(126.86)	(125.52)	
Kcal/BMI					
Base model	-5.803	-4.451	5.025	3.940	0.170
	(5.38)	(5.38)	(5.38)	(5.38)	
Adjusted model	-3.704	-5.43	5.46	3.46	0.291
	(5.21)	(5.47)	(5.46)	(5.77)	
Glycemic Load					
Base model	-5.431	-2.012	8.416	5.766	0.103
	(6.02)	(6.02)	(6.02)	(6.02)	
Adjusted model	-4.083	-3.195	9.891	5.352	0.217
	(6.06)	(6.35)	(6.36)	(6.71)	

In the first four columns: linear contrasts of each treatment regime with respect to the reference level, with standard errors in parenthesis. Last column represents joint significance of the treatment regime, using F-statistics. P-value is considered as significant when p <0.05/3 = 0.0167 (Bonferroni correction for co-primary endpoints). Base model: Sex + Age + FilmSpot Adjusted model: Base + BMI + Hours/Week TV + Physical activity (hours/week) + IBAI + number of TV in the house

TABLE 5. Multiple comparison of different treatment regimes. Last column reports the results of the comparison between Treatment (pooled exposure to TV with or without advertising (FilmNoSpot + FilmLowSpot + FilmMediumSpot + FilmHighSpot)) vs No treatment (no TV exposure (NoFilmNoSpot))

	FilmMediumSpot vs FilmNoSpot	FilmHighSpot vs FilmNoSpot	FilmMediumSpot vs FilmLowSpot	FilmHighSpot vs FilmLowSpot	Treatment vs No treatment
Kcal eaten					
Base model	254.11	205.5	191.4	142.7	123.6
	(110.43)	(110.43)	(110.43)	(110.43)	349.2
Adjusted model	308.8	198.4	251.6	141.2	287.4
	(126.7)	(122.0)	(114.0)	(112.6)	(393.6)
Kcal/BMI					
Base model	10.828	9.743	9.476	8.391	-1.289
	(5.383)	(5.383)	(5.383)	(5.383)	(17.02)
Adjusted model	9.17	7.168	10.90	(8.90)	-0.21
	(5.56)	(5.66)	(5.35)	(5.27)	(0.99)
Glycemic Load					
Base model	13.848	11.197	10.428	7.778	6.738
	(6.02)	(6.02)	(6.02)	(6.02)	(19.03)
Adjusted model	13.974	9.435	13.086	8.547	7.964
	(6.46)	(6.58)	(6.22)	(6.12)	(20.45)

Linear contrasts with standard errors in parenthesis. Treatment is the average of Film or spot regimes, while No treatment is considered as NofilmNoSpot. P-value is considered as significant when p <0.05/3 = 0.0167 (Bonferroni correction for co-primary endpoints). Base model: Sex + Age + FilmSpot. Adjusted model: Base + BMI + Hours/Week TV + Physical activity (hours/week) + IBAI + number of TV in the house. Signif. codes: 0 '***' 0.001 '**' 0.0167 '*'

TABLE 6. Characterization of the High Consumers according to the main study variables. Numbers are I quartile/median/III quartile for continuous variables and percentages for categorical variables.

	N	Low	High	Combined	p-value
% Female	40	50	50	50	
Age	40	8/9/10	9.5/11/11	8/9.5/11	0.038**
Race	40				0.58
% Mapuche		17.24	0	0.128	
% Mestizo		13.79	10	0.128	
% White		68.97	90	0.743	
Weight	40	31.78/36.45/44.45	50.18/55.15/67.30	34.48/42.10/48.58	0.0001***
Height	40	129.0/137.0/144.8	143.2/145.0/154.5	130/141/154.4	0.0054***
Child BMI	40	18.06/20.24/21.54	23.52/26.08/28.03	19.43/21.08/22.75	0.0001***
Classes of BMI	40				0.0006***
% Normal		27	0	20	
% Obese		20	90	37.5	
% Overweight		50	10	40	
% Underweight		3	0	2.5	
Weekly physical activity					0.77
% none	40	23	20	22.5	
% Half an hour		10	20	12.5	
% An hour		36	20	32.5	
% 2-3 hours		23	30	25.0	
% 4-6 hours		6.7	10	7.5	
Weekly video games	39				0.82
% none		60	33.33	42.5	
% Half an hour		20	16.67	17.5	
% An hour		20	36.67	32.5	
% 2-3 hours		0	6.66	2.5	
% 4-6 hours		0	6.67	5.	
% Children eating at least two portions of fruit	40	65.52		59.0	0.11
% Children eating at least two portions of vegetables	40	40		0.542	0.73
Months breastfeeding	34	3.00/8.00/16.50	7.5/8.0/9.0	6/8/13.5	0.164
% having a TV in own room	40	67.7	70	67.6	1
Father is working	40	93	78	89.2	0.244
Father education	40				0.95
% Complete secondary or higher		46.42	44.44	45.9	
% Complete technical		35.71	33.33	35.1	
% Primary school		14.29	22.23	16.2	
% None		3.57	0	02.7	
Mother education	40				1
% Complete secondary or higher		33.7	40	35.	
% Complete technical		43.3	50	45.0	
% Primary school		19.7	10	17.5	
% None		3.3	0	2.5	
Weekly hours of TV	40	14/18/23	12.75/21.50/36	14/18/25	0.561
IBAI score	40	15/19/23	19/19.5/21	15/19/22	0.778
Treatment regime	40				0.549
NoFilmNoSpot		23.33	10	20	
FilmNoSpot		23.33	10	20	
FilmLowSpot		20	20	20	
FilmMediumSpot		13.33	40	20	
FilmHighSpot		20	20	20	

p-values are result of Fisher exact test for the association between the two categorical variables (high end and the row variable), while they refer to t-test for difference in means across the two groups (high-end and low-end consumers) for the continuous variables.

DISCUSSION

The aim of the present study was to assess if an association existed between TV advertising and snack consumption in Chilean children. Understanding factors associated to obesity onset is relevant among kids living in Chile, given the concerning high prevalence of childhood obesity. In recent years, this country goes through a rapid economic improvement. Along with such economic improvement, a social and cultural transition has taken place, resulting in substantial changes in living conditions (e.g., adoption of better hygiene practices and food habits, but also of sedentary lifestyles and of energy-dense food consumption, instead of fruits, vegetables, and whole grains) (22). Referring specifically to nutrition transition, these changes contribute to a progressive reduction of undernutrition, but result in a dramatic growth of obesity (and its comorbidities) prevalence, especially among children and adolescents (15). Reflecting this concerning scenario, more than a half of children enrolled in the study were found to be overweight or obese, and to be scarcely physically active, which is consistent with previous research in the field (23).

The hypothesis of the existence of an association between commercials and snack consumption has been motivated by previous research suggesting that food advertising might influence food behaviors regardless subjects' awareness (24). The analysis of data from the experimental session showed no significant association between TV/food advertising exposure and energy intake. These findings differed from those reported in previous studies, which generally have demonstrated that exposure to food advertising results in higher energy intake (25, 26). However, it has been suggested the existence of an inter-regional variability influencing the association between food advertising and snack consumption (12, 13). Moreover, a recent review on clinical trials analyzing the relationship between TV/advertising exposure and caloric intake has shown that first-quality evidence in this field are lacking. This is because generally studies have focused on children's choice and preferences and not on their actual intake of food, even if it could not be directly translated children's preferences to their actual consumption (27).

Results of this study show that the association between advertising and caloric intake is not obvious and possibly depending from the actual context where it is evaluated. Recent regulatory activities might be important steps in limiting consumption of specific food items. In this sense, it is essential to strictly monitor both the short and long-term effects of such regulation, carefully evaluating any changes in food choices and in overweight/obesity (and their comorbidities) prevalence among Chilean population, in order to evaluate the actual effectiveness of such public health strategies against childhood obesity epidemic.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Is brand visibility on snacks packages affecting their consumption in children? Results from an experimental *ad-libitum* study

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SUMMARY: The aims of the study were to assess the effects of the brand when snacking in children 6-11 years old and to evaluate the effect of different levels of brand awareness on children's intake. A 3x2 factorial design was adopted, and 96 children were randomized based on their brand awareness scores, assessed using the IBAI instrument and the study was conducted over two experimental sessions. First, 11 snacks were presented to the half of children laying on their own branded packages, whilst to the other half unbranded. In a second afternoon break, on a different day, the condition of branded/unbranded was crossed-over. Children were randomized in three groups based on combinations of concomitant TV and advertising exposure. Caloric intake (Kcal) of snacks eaten during sessions was taken as the main study outcome. No significant differences in energy intake were recorded according to brand visibility, both in children with high and low brand awareness. Exposure to TV and advertising showed no significant association with energy intake in the different groups and with the likelihood of being a high consumer. The present study suggested that brand visibility did not promote a higher caloric intake in 6-11 years old children during a snacking occasion.

Key words: Food brand, snacking, advertising, *ad libitum,* brand awareness, caloric intake.

RESUMEN. ¿La visibilidad de la marca en el empaque afecta el consumo en los niños? Resultados de un estudio experimental *ad libitum*. Los objetivos del estudio fueron el evaluar los efectos de las marcas comerciales durante una merienda en niños de entre 6 y 11 años de edad, así como analizar el efecto de diferentes niveles de conciencia de marca en el consumo de los niños. Se utilizó un diseño factorial 3x2, y se asignó al azar a 96 niños según sus puntuaciones de conciencia de marca, que fueron evaluados mediante el instrumento IBAI. El estudio se realizó en dos sesiones experimentales. En primer lugar, se presentaron 11 bocadillos (alimentos), a la mitad de los niños colocando en sus propios paquetes de marca, mientras que a la otra mitad sin marca. En un segundo recreo de la tarde, otro día, se realizó un cruce en la condición de bocadillos de marca y sin marca. Los niños fueron asignados al azar en tres grupos, según combinaciones concomitantes de exposición a la televisión y a pautas publicitarias. La ingesta calórica (Kcal) de bocadillos consumidos durante las sesiones se adoptó como principal resultado del estudio. No se registraron diferencias significativas en el consumo de energía dependiendo de la visibilidad de la marca, ni en los niños con un alto o bajo reconocimiento de marcas. La exposición a la televisión y a la publicidad no mostró una asociación significativa con el consumo de energía en los diferentes grupos y ni con la probabilidad de ser un gran consumidor. El presente estudio sugiere que la visibilidad de las marcas no promueve una mayor ingesta calórica en niños de entre 6 y 11 años de edad en el contexto de una merienda.

Palabras clave: Marca de alimentos, refrigerio- colación, publicidad, a gusto, conocimiento de la marca, ingesta calórica.

INTRODUCTION

The growing prevalence of overweight and obesity in children has gathered an extensive interest from the scientific community (1), shifting from an initial analysis dedicated to assess the present situation and its outcomes toward a broader research targeting potential risk factors involved in its development and

maintenance. The increase in childhood and adolescent obesity is leading to adverse health outcomes in the short and in the long term (2, 3), since it is deleterious to individual health, and it also results in a rising cost for the public sector.

The multifactorial network characterizing obesity determinants has frequently been mentioned, in order to broaden research towards a complex scenario taking into account mutual influences and relationships (4, 5). Each node of this net is characterized by different factors, that are modified, switched, and triggered by several macro structures, like genetics, behavior, built and social environment.

Among various factors identified as possible causes for the increase of children's obesity, television viewing and advertising aimed at children are among the most important factors that have been linked to a reduction in physical activity and an overconsumption of food high in fat and sugar (6, 7).

The mechanism is etiologically grounded on the lower caloric expenditure associated with TV viewing and the increased caloric intake due to TV-generated distraction and snack advertisements. In addition, recent studies have pointed out that, especially in overweight and obese children, preference for high carbohydrate and high fat foods is enhanced in children who are exposed to the greatest amounts of televisual media (8). Experimental studies in adults suggest that focusing attention on watching TV or listening to music while eating may disrupt the ability to regulate energy intake and promote overeating (9, 10). Similar associations were found in children, showing a positive association between TV viewing and childhood obesity (11, 12), but they failed to describe the mechanisms underlying these results. Costa showed the inverse association between screen time and daily consumption of fruits, concluding that the number of television in a household is positively related to BMI in children and adolescents (13).

Literature provides such heterogeneous results referring to the impact of food advertising on children's food consumption (14). The effect of advertising and its interaction with brand visibility during afternoon snack time has not been yet jointly investigated. Indeed, afternoon snacking has not been very much studied, and its effects, both in terms of nutrient composition and caloric intake, on dinner eating habits or its impact on after-school physical activity are still not entirely known (15).

The primary aim of the present study was to assess the effect of having brands displayed in food packaging on children's eating behavior during an afternoon snack time. The secondary objective is to evaluate the effect of different levels of brand awareness on children's intake. By design, TV viewing and brand advertising (displayed both on food package and on TV commercials) were taken into account as potentially intervening factors and balanced during randomization.

MATERIALS AND METHODS

Design

The present study was a randomized, 3x2 factorial experimental study. For logistic purposes, the study was organized in three steps: assessment of brand awareness (Step 0), evaluation of brand visibility on children's caloric intake (Step 1), repetition of Step 1 by crossing over the condition of branded/ unbranded visibility (Step 2).

In Step 0 children were selected by means of the score reported from a modified version of the original IBAI questionnaire (16), assessing brand awareness. The total sample was then divided into two groups, one included high brand awareness (characterized by a total scoring ≥40 points) subjects, and the other, a low brand awareness (< 40 points) ones. Furthermore, each group was further assigned to one of three

different conditions of TV exposure (No TV, TV, TV + advertising), resulting in 6 factorial combinations. In each category, the resulting 12 children were stratified for brand awareness, age, and gender (Table 1) and finally randomized to brand visibility. In summary, the experimental study developed in Step 1 had a 2x3 (Brand Visibility x TV and advertising exposure) full factorial design, blocked by age (two groups 6-8 and 9-11 years old), by gender (male and female) and by brand awareness. Specifically, the first factor was TV exposure, organized in 3 different levels: no TV exposure, exposure to cartoons, and exposure to cartoons and advertisements. The second factor was the presence of the brand on the snacks given to children, and was organized in two levels: presence of the brand (branded), absence of the brand (unbranded).

Step 2 was carried out equally to Step 1, but inverting the brand level in the two groups (branded snack were given to the subsample that had received an unbranded snack in Step 1, and vice versa).

Participants

Ninety-six children between 6 and 11 years of age were selected to have high and low level of brand awareness. Children were recruited as equally distributed by gender and age: forty-eight 6-8-year-olds (24 female) and forty-eight 9-11-year-olds (24 female). Children with cognitive disorders or metabolic diseases or allergies to the products offered during the experimental session were excluded. Parent informed consent was obtained for all children prior to each child's participation in the study. Children's participation followed the guidelines and ethics issued by APA (17). Parents were asked not to provide snacks to children in the hours before the experimental sessions.

TABLE 1. Sample stratification according to age, gender and brand awareness. Mean Brand Awareness scores, with SD in brackets.

Gender	Age	n	Brand awareness score High	n	Brand awareness score Low
Male	6-8 ys	12	46.67 (2.81)	12	28.17 (5.25)
	9-11 ys	12	47.00 (3.10)	12	29.33 (5.42)
Female	6-8 ys	12	46.17 (3.16)	12	26.58 (8.74)
	9-11 ys	12	45.83 (3.59)	12	27.33 (6.34)

Sample size

The sample size of 96 children was computed with reference to an alpha equal to 0.05 and a power of 0.90, which aimed at detecting at least a difference of 20 Kcal of caloric intake (assuming an equal standard deviation in the two groups of approximately 30 Kcal) between the two groups of Brand Visibility in each of the 8 randomization cells (Age x Gender x Brand Awareness).

Experimental procedure

The preliminary phase of this study (Step 0) involved sample recruitment and stratification. The sample consisted of children between 6-11 years (children attending primary school).

Children were selected on the basis of their level of brand awareness assessed by means of the IBAI (Italian Brand Awareness Instrument (16); a logo-matching exercise, consisting of 30 pictures representative of food brand logos) and they were equally divided into high and low brand awareness groups.

The experiment was characterized by two experimental sessions separated by a 2-week period (Step 1 and Step 2), in which parents were asked to bring their children to the laboratory during two afternoon breaks. The project flow is presented in Figure 1.

In Step 1, 11 snacks were placed on a tray, laying on their own branded packages, for half of the sample, whilst the other half of the children received a neutral tray (unbranded).

After 2 weeks period, Step 2 was performed and the condition of branded/unbranded was

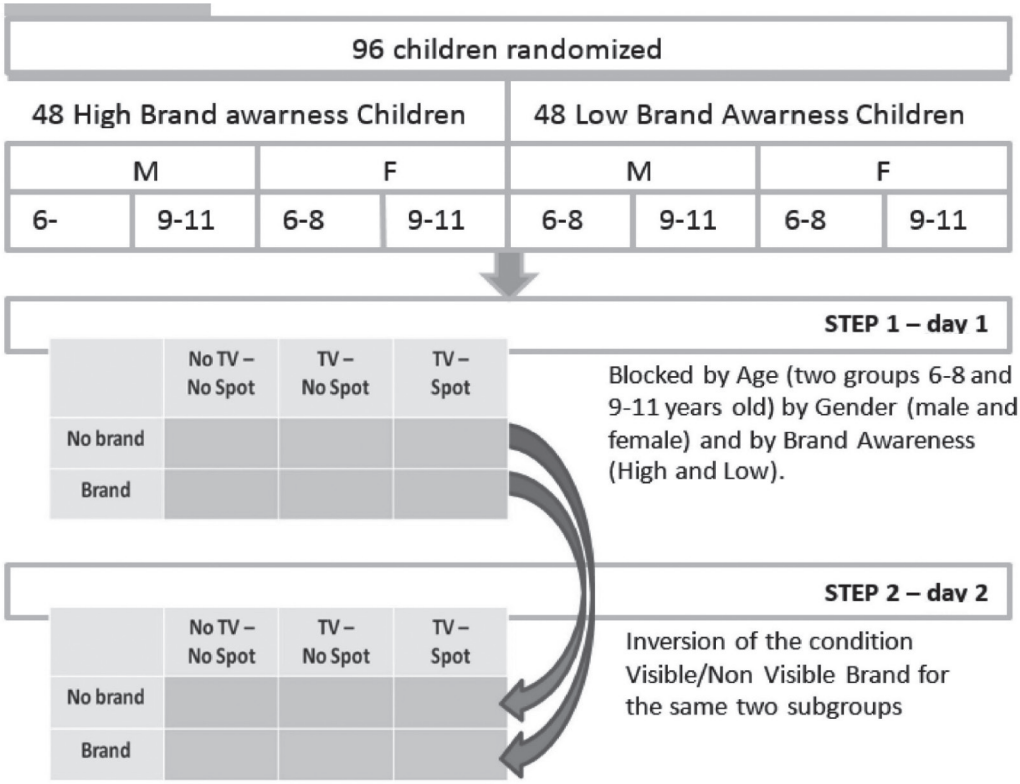

FIGURE 1. Project flow.

inverted for the same two subgroups of the sample. The snacks utilized in the experiment were Kinder Frutti©, Ferrero Brioss Albicocca©, Kinder Brioss Latte©, Kinder Delice©, Mulino Bianco Flauti Latte©, Mulino Bianco Flauti Albicocca©, Mulino Bianco Pan Goccioli©, Mulino Bianco Saccottino Albicocca©, Mulino Bianco Pan di Stelle©, Kinder Yogo Brioss©, Mulino Bianco Plum Cake©. Snacks included: cocoa biscuits (Mulino Bianco Pan di Stelle©); individually packaged soft pastries with apricot jam (Kinder Frutti©, Ferrero Brioss Albicocca©, Mulino Bianco Flauti Albicocca©, Mulino Bianco Saccottino Albicocca©, Kinder Yogo Brioss©), milk cream (Kinder Brioss Latte©, Mulino Bianco Flauti Latte©) and chocolate chips (Mulino Bianco Pan Goccioli©); individually packaged soft sponge with cocoa cream topping and filled with milk cream (Kinder Delice©); individually packaged mini-plum cakes made with yogurt (Mulino Bianco Plum Cake©). Children's preferences towards these snacks were not investigated.

The two groups of children characterized by different brand awareness (high and low brand awareness) were randomized into 3 groups based on TV and advertising exposure: No TV, TV, TV and advertising. Within the "TV" subgroup, younger children watched a 16 min. episode of Disney© Lion King, while the older ones watched a 16 min. episode of Marvel© Spiderman. The advertising utilized in the third subgroup was embedded within the movies and consisted in 7 spots lasting for 3 minutes, referred to the products that children had on the tray they were facing.

All children were asked to eat *ad libitum* and to choose the snacks they preferred, being given 16 minutes from their first bite.

All the snacks were weighed with a high-precision balance before and after each session,

in order to quantify the amount of snack not eaten, therefore estimating energy intake of each child.

Measures

Socio-Demographic variables

Before the starting of the experimental session, parents were interviewed by the investigators in order to assess demographic parameters, children's health status, behaviors, frequency of food consumption, food habits, physical activity, daily lifestyle (sleep, TV viewing, after- school care, etc.).

IBAI questionnaire

Food images represented in the 30 flash-cards of the IBAI were shown to the children (16), interviewing them on food images' brand and product names and subsequently on the correct matching of each logo with the right food, between four choices of foods.

At the end, the interviewer asked the child on the specific name of the product. Brand Awareness Scores (IBAI-score) could range from a minimum of 0 to a maximum of 90, with a cut-off set at 40 points which was used to define the two groups: low brand awareness children (<40) and high brand awareness (≥ 40) (16).

Snacks weighing

At the beginning of the study, every snack was assigned with a specific code and was weighed in order to record these data in the software used for the study. At the end of every session, each snack the child had had was weighed once again in order to calculate the difference in terms of eaten products. All weights were collected by means of an Acculab© precision weighing scale with the capacity of 510g of and 0.1g readability.

Statistical analysis

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

The main analysis has been based on a linear model for caloric intake where the blocking factors (i.e., Gender, Age in two classes according to the randomization procedure, and Brand Awareness) have been forced to stay in the models. Repeated measurements were taken into account using the sandwich estimator of Huber-White (18, 19). Specific investigations on single factor-level effects have been conducted using appropriate linear contrasts.

To check for additional confounding factors, a further model, in addition to the base one has been developed, performing a selection among the candidate variables using the AIC criterion in the backward fashion, still forcing the inclusion of the design variables in the model.

In addition, children were identified as "high consumers" if their caloric intake during the experimental session exceeded the top quartile of the observed distribution. The variables related to the probability of being a high consumer were modelled using a logistic regression model, again using the Huber-White estimator for accounting for repeated measurements, and selected via the AIC criterion in a backward fashion.

The analyses have been performed using the R System (20).

RESULTS

Ninety-six children were assessed using the IBAI questionnaire and were selected to participate to the following phases, equally divided by age (6-8 and 9-11 years), gender, (male and females) and brand awareness score. They were unselected for overweight or obesity. The highest median brand awareness score was retrieved in older males (47.00), while the lowest was measured in the younger female group (26.58).

Sample characteristics (assessed by children questionnaire), in accordance to brand visibility and also to TV exposure (no TV, only TV, TV+advertising) are summarized in Table 1 along with their main characteristics in Table 2.

Comparing the caloric intake of the three groups of children (no TV exposure, only TV

TABLE 2. Description of the sample. Summaries for categorical variables are expressed as percentage (absolute numbers in parenthesis) and for continuous variables as I quartile / median / III quartile.

			Brand visibility		TV			
		N	No	Yes	No TV	TV	TV+spot	Combined
			(N=48)	(N=48)	(N=32)	(N=32)	(N=32)	(N=96)
Child BMI		88	15.26/16.55/17.59	15.30/17.16/19.88	14.96/16.99/18.75	15.30/16.60/18.94	15.27/16.88/18.38	15.28/16.88/18.75
Mother BMI		85	20.31/22.49/26.97	19.79/20.62/22.43	19.83/21.48/24.93	19.95/20.62/22.53	20.28/21.61/24.61	20.07/21.45/24.61
Father BMI		80	23.25/24.78/26.22	22.91/24.69/26.54	23.31/25.03/27.16	23.18/24.49/26.17	22.58/24.07/26.22	23.18/24.77/26.36
N° products eaten in Step 1		96	2.00/3.00/4.00	2.00/3.00/4.00	2.00/3.00/4.00	1.75/3.00/4.00	1.75/2.00/3.00	2.00/3.00/4.00
N° products eaten in Step 2		96	2.00/3.00/4.00	2.00/3.00/4.00	2.00/3.00/4.25	2.00/3.00/3.25	2.00/3.00/3.25	2.00/3.00/4.00
Mean calories per session (kcal)		96	148.07/238.11/291.37	101.34/181.10/319.51	134.49/254.25/330.74	120.77/215.53/313.72	112.72/200.19/259.09	120.77/229.45/308.30
Quantity per session (gr)		96	38.80/60.90/73.68	25.00/44.20/80.70	36.00/65.40/84.90	29.55/54.05/79.85	29.95/51.35/68.45	30.80/57.60/79.30
N° of people living with the child		95	2/3/3	2/3/3	2/3/4	2/2/3	3/3/3	2/3/3
Mother unemployed		91	16% (7)	15% (7)	23% (7)	14% (4)	9% (3)	15% (14)
Father unemployed		84	100% (41)	100% (43)	100% (27)	100% (26)	100% (31)	100% (84)
N° of rooms in the house		91	2/3/3	2/3/3	2.0/3.0/3.0	2.0/2.5/3.0	2.0/3.0/3.0	2.0/3.0/3.0
N° of cars/van owned	2 or more	96	58% (28)	48% (23)	53% (17)	47% (15)	59% (19)	53% (51)
	none		2% (1)	2% (1)	0% (0)	6% (2)	0% (0)	2% (2)
	one car		2% (1)	6% (3)	3% (1)	3% (1)	6% (2)	4% (4)
	one van		38% (18)	44% (21)	44% (14)	44% (14)	34% (11)	41% (39)
Health status	good	94	19% (9)	36% (17)	25% (8)	35% (11)	23% (7)	28% (26)
	discrete		2% (1)	0% (0)	0% (0)	0% (0)	3% (1)	1% (1)
	excellent		79% (37)	64% (30)	75% (24)	65% (20)	74% (23)	71% (67)
Chronic diseases		96	2% (1)	10% (5)	6% (2)	3% (1)	9% (3)	6% (6)
Presence of headache in the child	once a week	95	4% (2)	0% (0)	3% (1)	3% (1)	0% (0)	2% (2)
	once a month		10% (5)	17% (8)	12% (4)	19% (6)	10% (3)	14% (13)
	never/rarely		85% (41)	83% (39)	84% (27)	78% (25)	90% (28)	84% (80)
Presence of stomachache in the child	once a week	94	4% (2)	0% (0)	3% (1)	0% (0)	3% (1)	2% (2)
	once a month		9% (4)	17% (8)	12% (4)	16% (5)	10% (3)	13% (12)
	never/rarely		87% (41)	83% (39)	84% (27)	84% (27)	87% (26)	85% (80)
Frequency of breakfast	3-4 days per week	96	4% (2)	4% (2)	9% (3)	3% (1)	0% (0)	4% (4)
	never		2% (1)	8% (4)	3% (1)	9% (3)	3% (1)	5% (5)
	every day		94% (45)	88% (42)	88% (28)	88% (28)	97% (31)	91% (87)

TABLE 2. Description of the sample. Summaries for categorical variables are expressed as percentage (absolute numbers in parenthesis) and for continuous variables as I quartile / median / III quartile. (cont.)

			Brand visibility		TV			
		N	No	Yes	No TV	TV	TV+spot	Combined
Portions of fruit/day		96	1.00/1.00/2.00	0.75/1.00/1.00	1.00/1.00/2.00	1.00/1.00/2.00	1.00/1.00/1.25	1.00/1.00/2.00
Portions of vegetables/day	0	96	15% (7)	19% (9)	19% (6)	19% (6)	12% (4)	17% (16)
	1		42% (20)	46% (22)	38% (12)	50% (16)	44% (14)	44% (42)
	2		40% (19)	33% (16)	38% (12)	28% (9)	44% (14)	36% (35)
	3		4% (2)	2% (1)	6% (2)	3% (1)	0% (0)	3% (3)
Fruit and vegetable consumption		96	6% (3)	6% (3)	9% (3)	9% (3)	0% (0)	6% (6)
	no fruit, no veg		8% (4)	12% (6)	9% (3)	9% (3)	12% (4)	10% (10)
	fruit and vegetable		83% (40)	69% (33)	69% (22)	75% (24)	84% (27)	76% (73)
	vegetable		2% (1)	12% (6)	12% (4)	6% (2)	3% (1)	7% (7)
Chips or snacks	once a week	96	27% (13)	38% (18)	28% (9)	31% (10)	38% (12)	32% (31)
	never		6% (3)	2% (1)	6% (2)	0% (0)	6% (2)	4% (4)
	rarely		65% (31)	54% (26)	62% (20)	62% (20)	53% (17)	59% (57)
	once a day		2% (1)	6% (3)	3% (1)	6% (2)	3% (1)	4% (4)
Sweets or chocolate	once a week	96	40% (19)	42% (20)	44% (14)	41% (13)	38% (12)	41% (39)
	more than once a day		4% (2)	2% (1)	0% (0)	6% (2)	3% (1)	3% (3)
	rarely		40% (19)	38% (18)	25% (8)	38% (12)	53% (17)	39% (37)
	once a day		17% (8)	19% (9)	31% (10)	16% (5)	6% (2)	18% (17)
Biscuits	once a week	96	23% (11)	25% (12)	22% (7)	16% (5)	34% (11)	24% (23)
	never		0% (0)	2% (1)	0% (0)	0% (0)	3% (1)	1% (1)
	more than once a day		6% (3)	4% (2)	9% (3)	3% (1)	3% (1)	5% (5)
	rarely		15% (7)	10% (5)	12% (4)	12% (4)	12% (4)	12% (12)
	once a day		56% (27)	58% (28)	56% (18)	69% (22)	47% (15)	57% (55)
Sweet snacks	once a week	96	50% (24)	35% (17)	66% (21)	34% (11)	28% (9)	43% (41)
	never		12% (6)	0% (0)	6% (2)	3% (1)	9% (3)	6% (6)
	more than once a day		0% (0)	4% (2)	3% (1)	0% (0)	3% (1)	2% (2)
	rarely		25% (12)	38% (18)	16% (5)	41% (13)	38% (12)	31% (30)
	once a day		12% (6)	23% (11)	9% (3)	22% (7)	22% (7)	18% (17)
Snack (cakes, pastry, etc)	once a week	96	48% (23)	31% (15)	56% (18)	31% (10)	31% (10)	40% (38)
	never		15% (7)	2% (1)	9% (3)	3% (1)	12% (4)	8% (8)
	more than once a day		0% (0)	15% (7)	6% (2)	9% (3)	6% (2)	7% (7)
	rarely		29% (14)	27% (13)	22% (7)	31% (10)	31% (10)	28% (27)
	once a day		8% (4)	25% (12)	6% (2)	25% (8)	19% (6)	17% (16)
Fried food, French fries	once a week	96	33% (16)	40% (19)	25% (8)	47% (15)	38% (12)	36% (35)
	never		4% (2)	8% (4)	9% (3)	3% (1)	6% (2)	6% (6)
	rarely		62% (30)	52% (25)	66% (21)	50% (16)	56% (18)	57% (55)
Soda	once a week	96	27% (13)	29% (14)	31% (10)	31% (10)	22% (7)	28% (27)
	never		19% (9)	17% (8)	16% (5)	16% (5)	22% (7)	18% (17)
	more than once a day		8% (4)	2% (1)	3% (1)	6% (2)	6% (2)	5% (5)
	rarely		42% (20)	31% (15)	41% (13)	25% (8)	44% (14)	36% (35)
	once a day		4% (2)	21% (10)	9% (3)	22% (7)	6% (2)	12% (12)

exposure, TV+advertising exposure) when both snacks were branded and unbranded, no significant differences were recorded (Table 3), neither in Step 1 and Step 2. Despite no significant differences, we found out that, in the group of non-visible brand (Step 1), children not exposed to TV presented an intake of 100 kcal higher than those exposed to TV+spot.

Referring to the multivariable model, even after adjustment for potential confounders, we showed no significant association between increased caloric intake and Brand visibility (Table 4).

Figure 2 and Figure 3 report the trends among the two brand awareness groups of total grams

TABLE 3. Energy intake in the experimental grid, expressed as mean Kcaloric intake. SD is given in brackets. No significant differences observed.

Brand Visibility	No TV	TV	TV+spot	Total
Non Visible (N)	16	16	16	48
STEP 1	287.36 (128.36)	233.33 (106.54)	185.06 (100.25)	235.25 (117.77)
STEP 2	290.46 (245.22)	233.83 (106.52)	293.51 (183.07)	272.60 (185.14)
Visible (N)	16	16	16	48
STEP 1	220.59 (174.58)	190.01 (138.99)	227.89 (173.88)	212.83 (160.67)
STEP 2	270.52 (140.23)	237.62 (128.62)	231.67 (123.77)	246.60 (129.39)
Total (N)	32	32	32	96
STEP 1	253.98 (154.50)	211.67 (123.79)	206.47 (141.30)	224.04 (140.58)
STEP 2	280.49 (196.76)	235.73 (116.19)	262.59 (156.90)	259.60 (159.41)

TABLE 4. Multivariable model to assess the association between caloric intake and other parameters recorded with children questionnaires.

	Estimate Std	Error	p-value
(Intercept)	209.93	61.50	<0.001
Age range			
9-11 years old	41.11	25.04	0.104
Male	63.26	24.26	0.010
Brand Awareness (no brand vs brand)	-22.58	27.23	0.409
Brand Visibility (visible vs. non visible)	-24.21	14.47	0.097
N° of cars/van owned - None	-139.87	89.31	0.120
N° of cars/van owned – One car	-158.11	86.74	0.072
N° of cars/vanowned – One van	-31.13	25.36	0.222
Fruit portions	49.82	16.24	0.002
Sweets and chocolate			
More than once a day	-173.73	76.13	0.025
Sweets and chocolate			
Rarely	-14.13	28.24	0.618
Sweets and chocolate			
Once a day	-39.64	35.77	0.270

intake in children, exposed or not exposed to TV viewing. Children reporting high brand awareness and not exposed to TV showed lower snacks intake when brand was not visible (Figure 2), while children exposed to TV+advertising showed the same snacks intake when both the snacks were branded and unbranded, this probably because of children's prior preferences towards the snacks, even if we did not investigate them. Additionally, among children with low brand awareness (Figure 3) exposed to TV and TV+advertising, the snack intake was lower when the brand of the snack was visible, this could be related to the fact that TV and TV+ advertising exposure was distracting.

High consumer

The top quartile of energy intake corresponded to 319 Kcal. This value has been chosen as the cut-off to identify the subgroup of 21 children with higher energy intakes during the experimental session in order to investigate factors associated to higher energy intake in this snacking occasion. Table 5 shows the main characteristics of these "high consumer" children. At the multivariable analysis, no significant association was found for the experimental factor TV (p-value 0.251), Brand Visibility (p-value 0.328) or their interaction (p-value 0.177) with the "high consumer" status. The only variable associated with this status turned out to be the age group of the child. Taking the 6-8 year-old age group as reference, the Odds Ratio (OR) of being a "high consumer" was 0.45 (95% C.I. 0.23-0.89) for older children in the age group 9-11 years.

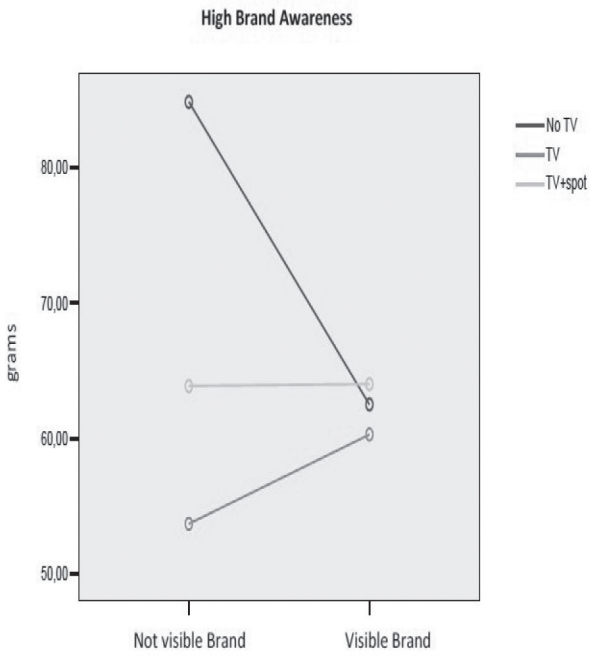

FIGURE 2. Trends of energy intake among children of the high brand awareness group, exposed or not exposed to TV viewing and package's brand.

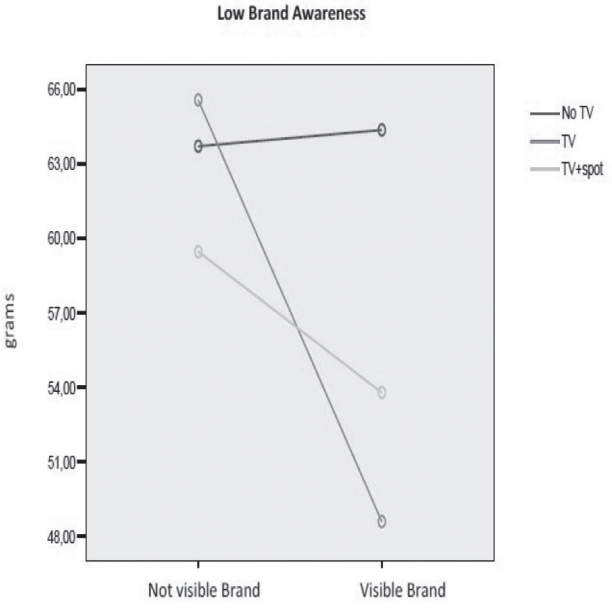

FIGURE 3. Trends of energy intake among children of the low brand awareness group, exposed or not exposed to TV viewing and package's brand.

TABLE 5. Characterization of the High Consumers according to the main study variables. Values for the categorical variables are expressed as a percentage (absolute numbers in parenthesis) and those for the continuous variables as the median (I quartile / median / III quartile).

Variable	Levels	N	High	Low	p-value
			(N=21)	(N=75)	
Gender	Male	96	57% (12)	48% (36)	0.459
Age	9-11 years	96	8/10/10	7/ 8/10	0.031
Brand Awareness	Low	96	48% (10)	51% (38)	0.805
TV : No TV		96	43% (9)	31% (23)	0.481
TV			33% (7)	33% (25)	
TV+spot			24% (5)	36% (27)	
Brand Visibility	Visible	96	57% (12)	48% (36)	0.459
Child BMI		88	15.43934/16.99524/18.79983	15.27619/16.76608/18.43674	0.84
Mother BMI		85	20.29787/22.16496/25.52073	20.06920/21.25850/23.43750	0.44
Father BMI		80	24.47132/26.04167/27.73661	22.77319/24.15167/26.21882	0.062
N° products eaten in Step 1		96	4/5/6	1/2/3	-
N° products eaten in Step 2		96	3/5/5	2/2/3	-
Mean calories per session (kcal)		96	356.320/395.439/465.698	99.836/165.045/246.694	-
Quantity per session (gr)		96	90.90/ 98.00/127.50	25.70/ 42.70/ 63.05	-
N° of people living with the child		95	2/3/4	2/3/3	0.152
Unemployed mother		91	26% (5)	12% (9)	0.138
Unemployed father		84	100% (18)	100% (66)	
N° of rooms in the house		91	2/3/3	2/3/3	0.239
N° of cars/van owned	2 or more	96	57% (12)	52% (39)	0.616
	none		0% (0)	3% (2)	
	one car		0% (0)	5% (4)	
	one van		43% (9)	40% (30)	
Health staus	good	94	29% (6)	27% (20)	0.862
	discrete		0% (0)	1% (1)	
	excellent		71% (15)	71% (52)	
Chronic diseases		96	5% (1)	7% (5)	0.75
Presence of headache in the child	once a week	95	5% (1)	1% (1)	0.273
	once a month		5% (1)	16% (12)	
	never/rarely		90% (19)	82% (61)	

TABLE 5. Characterization of the High Consumers according to the main study variables. Values for the categorical variables are expressed as a percentage (absolute numbers in parenthesis) and those for the continuous variables as the median (I quartile / median / III quartile). (Cont.)

Variable	Levels	N	High (N=21)	Low (N=75)	p-value
Presence of stomach ache in the child	once a week	94	0% (0)	3% (2)	0.182
	once a month		24% (5)	10% (7)	
	never/rarely		76% (16)	88% (64)	
Presence of back pain in the child (never/rarely)		94	100% (21)	99% (72)	0.59
Presence of malaise in the child (never/rarely)		94	95% (20)	96% (70)	0.896
Presence of fatigue in the child	once a week	94	5% (1)	3% (2)	0.632
	once a month		10% (2)	4% (3)	
	never/rarely		86% (18)	90% (66)	
	more than once a week		0% (0)	3% (2)	
Frequency of breakfast	3-4 days per week	96	5% (1)	4% (3)	0.984
	never		5% (1)	5% (4)	
	every day		90% (19)	91% (68)	
Portions of fruit/day		96	1/1/2	1/1/2	0.162
Portions of vegetables/day	0	96	10% (2)	19% (14)	0.212
	1		48% (10)	43% (32)	
	2		33% (7)	37% (28)	
	3		10% (2)	1% (1)	
Fruit and vegetable consumption		96	5% (1)	7% (5)	0.756
	no fruit, no veg		5% (1)	12% (9)	
	fruit and vegetable		81% (17)	75% (56)	
	vegetable		10% (2)	7% (5)	
Chips or snacks	once a week	96	38% (8)	31% (23)	0.466
	never		0% (0)	5% (4)	
	rarely		62% (13)	59% (44)	
	once a day		0% (0)	5% (4)	
Sweets or chocolate	once a week	96	43% (9)	40% (30)	0.758
	more than once a day		0% (0)	4% (3)	
	rarely		43% (9)	37% (28)	
	once a day		14% (3)	19% (14)	
Biscuits	once a week	96	19% (4)	25% (19)	0.052
	never		5% (1)	0% (0)	
	more than once a day		14% (3)	3% (2)	
	rarely		5% (1)	15% (11)	
	once a day		57% (12)	57% (43)	
Sweet snacks	once a week	96	48% (10)	41% (31)	0.167
	never		0% (0)	8% (6)	
	more than once a day		5% (1)	1% (1)	
	rarely		43% (9)	28% (21)	
	once a day		5% (1)	21% (16)	
Snack (cakes, pastry, etc)	once a week	96	48% (10)	37% (28)	0.911
	never		10% (2)	8% (6)	
	more than once a day		5% (1)	8% (6)	
	rarely		24% (5)	29% (22)	
	once a day		14% (3)	17% (13)	
Fried food, French fries	once a week	96	33% (7)	37% (28)	0.875
	never		5% (1)	7% (5)	
	rarely		62% (13)	56% (42)	
Soda	once a week	96	29% (6)	28% (21)	0.824
	never		19% (4)	17% (13)	
	more than once a day		0% (0)	7% (5)	
	rarely		38% (8)	36% (27)	
	once a day		14% (3)	12% (9)	

DISCUSSION

This study was conducted among a sample of Italian children, where TV advertising it is demonstrated to be similar to those in other countries and in particularly in US. A study published in 2010 (21), comparing food advertising in children's TV channels of Europe, America, Australia and Asia, demonstrated that food is one of the most advertised products in all the countries involved in the study. However, regarding the type of food advertised, it found differences among Italian and US advertising, showing that fast food and chocolate/confectionary are the most common marketed products in US and Italy respectively. These results are consistent with a study (22) conducted on Italian food advertising for children which revealed that sweets were the products most frequently advertised.

The existence of an association between TV, advertising and risk of being overweight or obese has been evaluated in numerous studies(23-25), obtaining contrasting results. This study aimed at understanding the association between food consumption during snacking times, brand visibility and TV viewing.

With respect to the primary objective of the study, the assessment of the effect of TV viewing and brand advertising, the present study showed no significant effect on total energy intake. The secondary objective was to evaluate the effect of different levels of brand awareness on children's intake. Similarly to the previous results, no significant association of increased intake was recorded in any of the two brand awareness groups, showing similar trends also for brand and TV exposure.

The results of the present study disagreed with previous research studies, where a positive association was found between advertising and TV viewing and increased energy intake. Halford and colleagues showed that 9-11- year-old (26) and 5-7 year-old (27) children increased their intake of most food types after viewing food adverts, and that the ability to correctly recognize these food adverts was significantly associated with higher food intake following food advert exposure. Similar conclusions were found by Lobstein, that in 2004 stated that the overall findings justified the need for taking precautionary measures to reduce children's exposure to obesogenic marketing practices (11).

In our study, no significant association between brand visibility and increased caloric intake was found, neither in children with high brand-awareness nor in those with low brand-awareness. Children showed a somewhat homogeneous overall intake with a median of 3 snacks per child.

When considering solely the effect of a brand on children's snack intake, it resulted that if the packages were unbranded, children (in particular, males) tended to consume a higher number of grams of snacks, therefore increasing their caloric intake. These findings were consistent with those in Anschutz's research, which highlighted in boys an increased susceptibility to food cues in food commercials (28).

As suggested also from the research of Francis, TV viewing could either increase or decrease children's food intakes (25). Specifically, our study showed that in low awareness children, both TV groups experienced a decreased intake of snack when switching from unbranded towards branded packages. Additionally, children not exposed to TV showed an increased intake with branded snacks in comparison with unbranded snacks. Results were nonetheless not significant. Children seemed to be more prone to eat when they weren't distracted from any other factor, while TV viewing and brand presence didn't modify their eating behavior towards a larger request of snacks. These findings were not in line with previous ones, which associated increased snacking behavior with screen time (29).

A multivariable model was used to assess the association between increased caloric

intake and other parameters recorded with children questionnaires. In the present sample, confectionery's habitual consumption appeared to be a protective factor, showing a decreasing effect on overall caloric intake, while being a male and belonging to an older group showed a boosting effect on energy intake.

As a study limitation, it must be taken into consideration that this body of evidence emerges from an experimental study whose results can be extrapolated in the real life with caution. Nevertheless, all efforts were made to minimize biases. All the participating children attended the same school, attending the same meal supply chain and were brought in to the experimental area by their parents, not having eaten any other item before the study. In addition, the *ad libitum* method allowed us to focus our attention on the children's satiety point, giving them complete freedom while they were eating the chosen snacks, without any intervention of the interviewer in terms of neither limiting their choices nor highlighting the presence of the brand on the children's trays. Finally, we did not investigate children's preferences towards the snacks presented in the study and consequently we could not evaluate the effect of children's attitudes on energy intake.

Implications for Research and Practice

The present study failed to prove, in an afternoon snacking occasion, an effect of TV viewing and advertising in children, even when considering the high brand awareness subgroup. While breakfast habits and their effects have been largely investigated, the role of afternoon snacking has been less studied, both from nutritional and from behavioral point of view. However, it's crucial to widely study this snacking occasion in children, because afternoon snack presents unique characteristics that differentiate it from morning snack, especially in Italian context. While in the morning children have snack at school (which could also provide snacks, such as fruits or yogurt, as in some Italian school facilities implementing project for healthy nutrition), in the afternoon children have snacks usually outside school so they could be exposed to TV viewing (and consequently to TV spot).

Our results might indicate that children's attitudes to food during afternoon snacking is less modified by exposure to known and common factors like television and advertising. Further research is needed in order to guide health policies aimed at fighting childhood obesity epidemic.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

ACKNOWLEDGMENTS

The study group gratefully acknowledges Ferrero Inc. and Barilla S.p.A. for having provided all the experimental food. All authors declare to not have any conflict of interest.

CONFLICTS OF INTEREST

The authors have no competing interests

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Dietary patterns in Mexico and obesity in children

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SUMMARY: This cross-sectional study aims to investigate food habits, socio-economic status and blood lipids profile in schoolchildren (10-11 years of age) living in a low-income area of Mexico (the city of Montemorelos), characterizing lipid concentrations among children obese and evaluating the impact of socio-economic factors and dietary habits on blood lipids profile of these children. Complete data were available for 156 children (78 boys and 78 girls), food habits and socio economic status were assessed using a questionnaire developed from the one previously used from the enKid study conducted on Spanish children. Food reported in the questionnaire was classified in four food groups (animal source food/legumes, grains/tubers, fruits/vegetables, fats/sweets), beverages were classified separately. Blood samples were analyzed to determine concentrations of: total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, glucose. Children were found to eat fats and sweets more frequently than other food groups. The 59 children, found to be obese and overweight, presented significant higher blood lipid levels (except to glucose levels) than normal weight kids. Using random forests, we found out that food and beverage consumption plays a key role in influencing blood lipids profile in children overweight and obese. Given these observations, it's crucial to develop health care policies promoting healthy eating habits among schoolchildren taking into account the specific characteristics of this geographical area in Mexico.

Key words: Lipid profile, children, obesity, overweight, meal pattern.

RESUMEN. Los patrones dietéticos en México y la obesidad en los niños. Este estudio transversal tiene como objetivo investigar los hábitos alimentarios, el nivel socioeconómico y el perfil de lípidos sanguíneos en niños en edad escolar que viven en una zona de bajos recursos en México, caracterizando las concentraciones de lípidos en niños obesos/sobrepeso y evaluar el impacto de los factores socioeconómicos y hábitos dietéticos en el perfil de lípidos de estos niños. Mediante un cuestionario utilizado previamente en el estudio enKid realizado con niños españoles lo realizaron en forma completa 156 niños (78 niños y 78 niñas), se evaluó los hábitos alimentarios y el estado socioeconómico. Los alimentos reportados en el cuestionario se clasifica en cuatro grupos de alimentos (alimentos fuente animal / legumbres, granos / tubérculos, frutas / verduras, grasas / dulces), las bebidas fueron clasificadas por separado. Se analizaron muestras de sangre para determinar las concentraciones de: colesterol total, LDL-colesterol, HDL-colesterol, triglicéridos, glucosa. Los 59 niños, obesos/sobrepeso, presentaron niveles de lípidos en sangre significativamente más altos que los niños de peso normal. Usando Selvas Aleatorias nos enteramos de que los alimentos y el consumo de bebidas juegan un rol clave para influir en el perfil de lípidos en la sangre en niños obesos/sobrepeso. Teniendo en cuenta estas observaciones, es crucial desarrollar políticas de salud que promueven hábitos alimenticios saludables entre los escolares, teniendo en cuenta las características específicas de esta área geográfica en México.

Palabras clave: Perfil lipídico, niños, obesidad, sobrepeso, modelo de comidas.

INTRODUCTION

Investigating factors that influence blood lipid concentrations is of great interest, referring especially to the impact of food habits on biochemical profile. Meal frequency appears to be associated to lipid concentrations: both adults (1, 2) and children (3) who have daily higher meal frequency seem to present better biochemical profile (low levels of total cholesterol and LDL). Breakfast particularly seems to play a key role in influencing blood lipids: adults (4) and children (5) who

report to eat breakfast regularly show better biochemical profiles than those who skip breakfast. Referring, more specifically, to the effect of food consumption on lipid profile, junk food consumption among adults is related to higher lipids concentrations (6). In addition, it is demonstrated (7, 8) that children who eat processed food and food containing saturated fat present higher blood lipids concentrations. Understanding the impact of food habits on blood lipids profile is important, especially in the context of childhood obesity, because several studies (9-12), investigating blood lipid profile among school children, find out higher lipid concentrations among overweight and obese children compared to normal weight ones. Biochemical impairments in children (especially in those overweight/obese) could lead to the early onset of atherosclerotic process and metabolic alterations (impaired glucose tolerance, high concentrations of inflammatory biomarkers) resulting in higher risk of developing cardiovascular and endocrine diseases in early adulthood. Given the increased risk of cardiovascular and metabolic diseases, biochemical alterations in obese children represent a concerning public health burden, worsened by the high prevalence of overweight and obesity in both industrialized and emerging countries: the NHANES investigation (13), conducted between 2011 and 2012 among US population, shows that 34.2% of children (6-11 years of age) were overweight or obese in accordance to CDC growth standards (14) . Similar rates are reported from the ENSANUT survey (15) (conducted among Mexican population in 2012), showing a prevalence of overweight and obesity among Mexican school children (5-11 years of age) of 34.4%.

Therefore it's crucial to characterize blood lipid profiles among overweight/obese children (especially among Latino ones who seem to be more prone to metabolic impairments compared to other ethnic groups (16)), investigating factors that play a key role in determining lipid concentrations in order to orientate health care policies.

This study aims to investigate socio-economic characteristics, food habits and blood lipid profile among school children in the city of Montemorelos (a low income living area located in Mexico), characterizing lipid concentrations among overweight/obese children and evaluating the impact of socio-economic features and food habits in influencing lipid profile among these children.

MATERIALS AND METHODS

This cross sectional study is based on data from a survey conducted in school children of 19 school facilities in the city of Montemorelos (Nuovo Leon, Mexico). The aim of the study was to investigate socio-economic characteristics, eating habits, anthropometric data and blood's lipid profile of the enrolled children. Children were eligible for the study if they attended the fifth school grade (10-11 years of age). Their parents were asked to complete an informed consent document before the enrollment. Complete data were available for 156 children (78 boys and 78 girls). The instrument used for data collection was adapted from the one previously used in the enKid study (17) on Spanish children. Mothers were asked to fill the questionnaire.

Socio-economic characteristics

Socio-economic characteristics regarded parents' working status (worker and housewife for mothers, intellectual and manual worker for fathers), educational level (considered as low, referring to primary education, and medium-high, referring to secondary and post-secondary education) and living conditions (house of property, house for rent or council house)

Eating habits

Eating habits are represented by weekly food consumption, meal frequency, breakfast consumption and mealtime characteristics (distractions at mealtime, with whom children

have meals, where children have meals outside home). Food consumption was classified using the three food groups (grains and tubers, fruits and vegetables, animal source food and legumes) indicated from "el Plato del Bien Comer" (established from the official Mexican norm NOM 043-SSA2-2005 (18)). In order to classify all the food types reported in the questionnaire, we considered a further food group including fats and sweets. The classification is based on the nutritional values of the food included in every food group: fruits and vegetables are a source of vitamins and minerals, diary and animal food source content proteins, grains and tubers bring carbohydrates and vitamins. Beverages were classified separately from food, including milk, soft drinks, fruit juices, coffee and tea and licuados (a traditional Latin American beverage made of milk and fruit, sometimes added with sugar, honey, oat or ice).

Anthropometric measurements and blood lipid profile

Anthropometric measurements were performed by trained researchers in a room provided by every school facility involved in the study. Height and weight were measured while children were barefoot and wearing light clothes. BMI (Kg/m^2) was calculated as weight (kg) divided by height (m) squared. Children were classified to be overweight/obese with a BMI $\geq$85 percentiles, as recommended by CDC growth standards (14).

Venous blood samples were collected after an overnight fast. The collection of blood samples was performed by three trained laboratory technicians from 7:00 a.m. to 8:00 a.m. in a dedicated room of the same school facilities attended from children enrolled in the study. Blood samples were stored in special containers to maintain proper conditions until the analysis and transported to the laboratory of the "La Carlota" hospital where the biochemical analyses were performed. Glucose, total cholesterol, HDL cholesterol and TAG concentrations were determined using the Reagent Set, Pointe Scientific, Inc. Michigan, U.S.A.

Statistical analyses

Descriptive statistics report continuous data as median [I and III quartiles] and categorical data as percentages (absolute number).

The role played by each factor potential influencing the concentration of total cholesterol, HDL, LDL, triglycerides and glucose was estimated using Random Forest, consisting in 500 bootstrap replication of the classification and regression tree. Statistical analyses were performed using R system (19) and random forest library (20).

RESULTS

Sample characteristics are summarized in Table 1. Children attend the fifth school grade (10-11 years of age). Most of children watch television more than 3 hours every day. Regarding eating habits, the number of fats and sweets' servings per week is higher than the number of servings of animal source food and legumes, grains and tubers, fruits and vegetables. Additionally, children drink the same number of weekly servings of milk and soft drinks. Referring to meal frequency, despite the fact that the majority of children have breakfast every day, most of them are reported to have only 2 meals per day. This could be related to the fact that enrolled children do not have lunch or dinner, but we could also hypothesize that this result depends on a misunderstood meal definition (indicating as an occasion of food consumption) conducting mothers to do not consider breakfast as a meal occasion and counting only lunch and dinner. However, we do not investigate specifically if children have lunch and dinner every day.

In accordance to the CDC growth standards

TABLE 1. Sample characteristics. Continuous data are median [I and III quartiles], categorical data are percentages (absolute number).

	Female (n=78)	Male (n=78)
Biochemical profile		
Total cholesterol	147.00 [122.75; 171.50]	140.00 [117.00; 167.00]
HDL	41.50 [33.0; 45.75]	40.00 [35.00; 46.00]
LDL	73.50 [88.00; 101.75]	68.00 [85.00; 100.00]
Triglycerides	76.50 [55.00; 100.75]	78.00 [55.00; 132.50]
Glucose	79.50 [74.00; 84.00]	78.50 [73.25; 82.00]
Socio economical characteristics		
Father's job		
Manual	55 (43)	63 (49)
Intellectual	8 (6)	9 (7)
Others	37 (29)	28 (22)
Mother's job		
Housewife	65 (51)	71 (56)
Worker	35 (27)	28 (22)
Father's level of education		
Low	19 (15)	21 (17)
Medium-High	81 (63)	78 (61)
Mother's level of education		
Low	14 (11)	14 (11)
Medium-High	86 (67)	86 (67)
Living conditions		
House of property	74 (58)	74 (58)
House for rent	23 (18)	19 (15)
Council house	3 (2)	6 (5)
n of TV hours per day		
<3	32 (25)	17 (14)
>3	68 (53)	82 (64)
Eating habits		
n of servings per week		
Animal source food/Legumes	32.00 [28.00; 35.00]	34.00 [32.00; 37.00]
Grains and tubers	20 [16; 23]	22 [20; 25]
Fruits and Vegetables	28.00 [25.00; 30.00]	29.00 [25.25; 32.00]
Fats and Sweets	36.00 [33.25; 40.00]	37.00 [33.25; 40.00]
Milk	5 [4; 6]	5 [4; 6]
Soft drinks	5.5 [5.0; 7.0]	5.0 [4.0; 6.0]
Juices	3.00 [2.00; 5.75]	4.00 [3.00; 6.00]
Coffee and tea	3.00 [2.00; 4.00]	2.00 [0.25; 4.00]
Breakfast consumption		
Yes	65 (51)	68 (53)
No	34 (27)	32 (25)
n of meals per day		
1	3 (2)	9 (7)
2	69 (54)	60 (47)
3	23 (18)	28 (22)
>3	5 (4)	3 (2)
Distractions at meals		
Watching TV	71 (55)	79 (62)
Others	29 (23)	20 (16)
Meals out of home		
School	96 (75)	100 (78)
Others	4 (3)	0 (0)
With whom		
Family members	97 (76)	99 (77)
Alone	3 (2)	1 (1)

(14), 37.8% of children are overweight or obese. Comparing normal weight and overweight/ obese children (Table 2), we find out significant higher concentrations of total cholesterol, HDL, LDL and triglycerides in children overweight/obese. However, glucose concentration was higher in normal weight children, this probably because blood sugar concentration could depend on other factors above body weight.

Figures from 1 to 5 show the role played from socio-economic factors and eating habits (sorted from the highest to the lowest score) in influencing concentrations of total cholesterol, HDL, LDL, triglycerides and glucose. Results demonstrate that eating habits, referring to food and beverage consumption particularly, influence blood's lipid profile the most.

TABLE 2. Blood lipid profile in accordance to normal weight and overweight/obese children. Data are median [I and III quartiles]

	Normal weight (n=97)	Overweight/Obese (n=59)	p-value
Total cholesterol	140.0 [111.0; 162.0]	159.0 [133.5; 176.0]	0.009
HDL	69.00 [53.00; 97.00]	87.00 [65.50; 143.00]	0.027
LDL	86.00 [65.00; 98.00]	88.00 [80.50; 102.50]	0.048
Triglycerides	69.00 [53.00; 97.00]	87.00 [65.50; 143.00]	0.003
Glucose	80.00 [74.00; 84.00]	77.00 [72.50; 82.00]	0.046

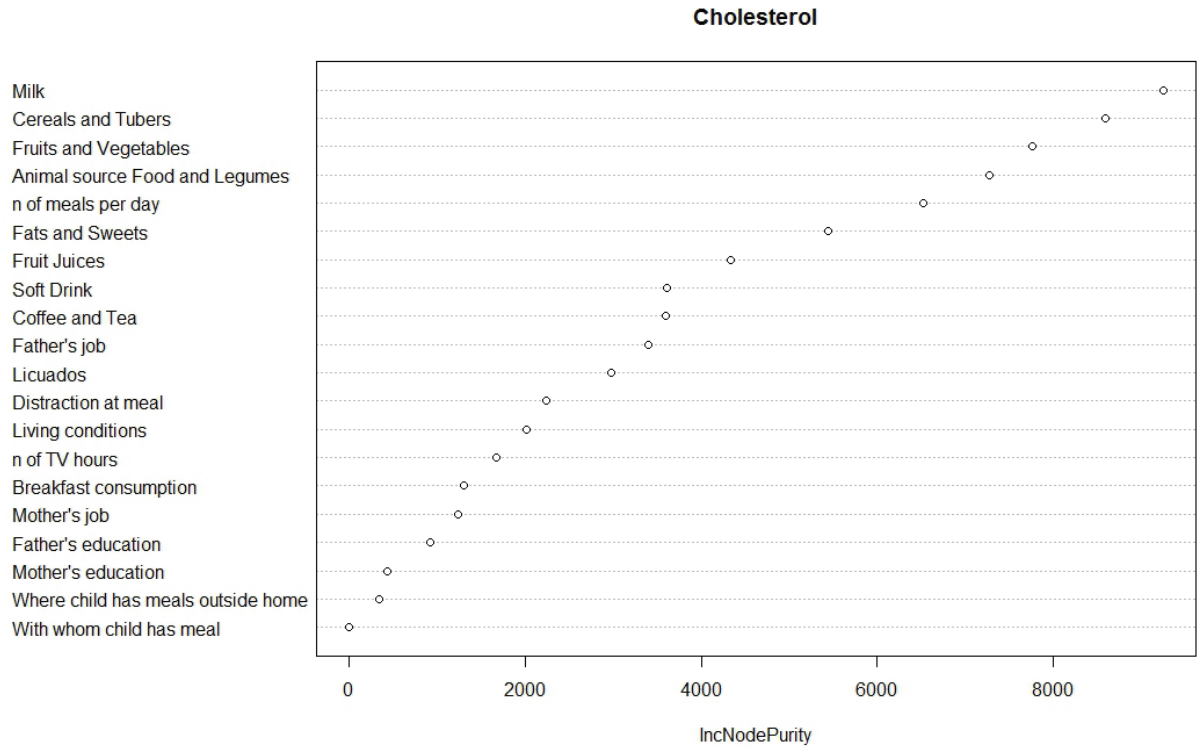

FIGURE 1. Distribution of factors associated with total cholesterol in overweight/obese children.

Figures show that the consumption of fruit and vegetables, animal source food and legumes, grains and tubers, fats and sweets and beverages, along with the number of meals per day, play a key role in influencing lipid concentrations. The weight of each type of food and beverage consumption differentiates little considering lipid concentrations one by one. Milk is reported to impact the most among total cholesterol, that's probably due to a high consumption of whole milk, despite guidelines for Mexican population recommend consumption of low fat milk for children over 2 years of age (21). Also HDL is influenced the most by beverage consumption, represented by soft drinks, along with daily meal frequency. Animal source food influences both glucose and triglycerides, while the latter is influenced also by fruits and vegetables consumption. The impact of breakfast consumption, meal characteristics and socio-economic factors is less important than food consumption among all the investigated lipid concentrations.

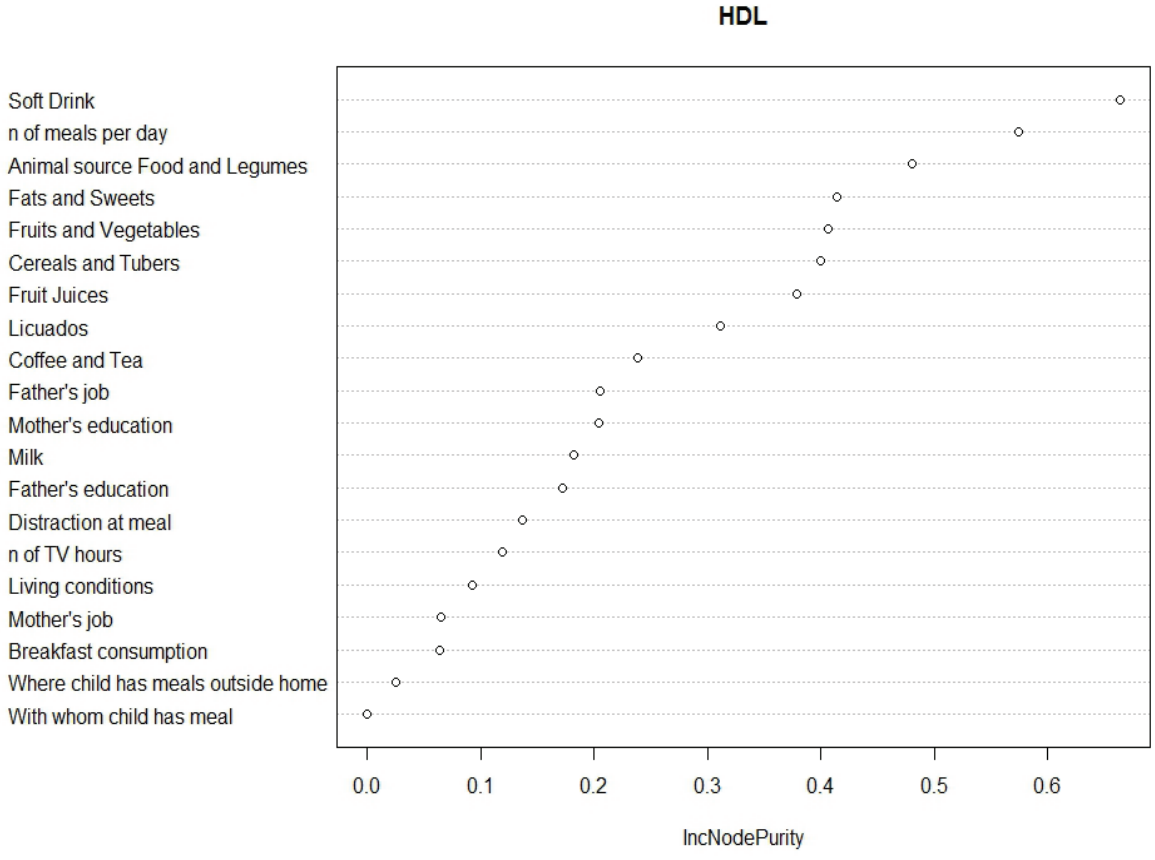

FIGURE 2. Distribution of factors associated with HDL in overweight/obese children.

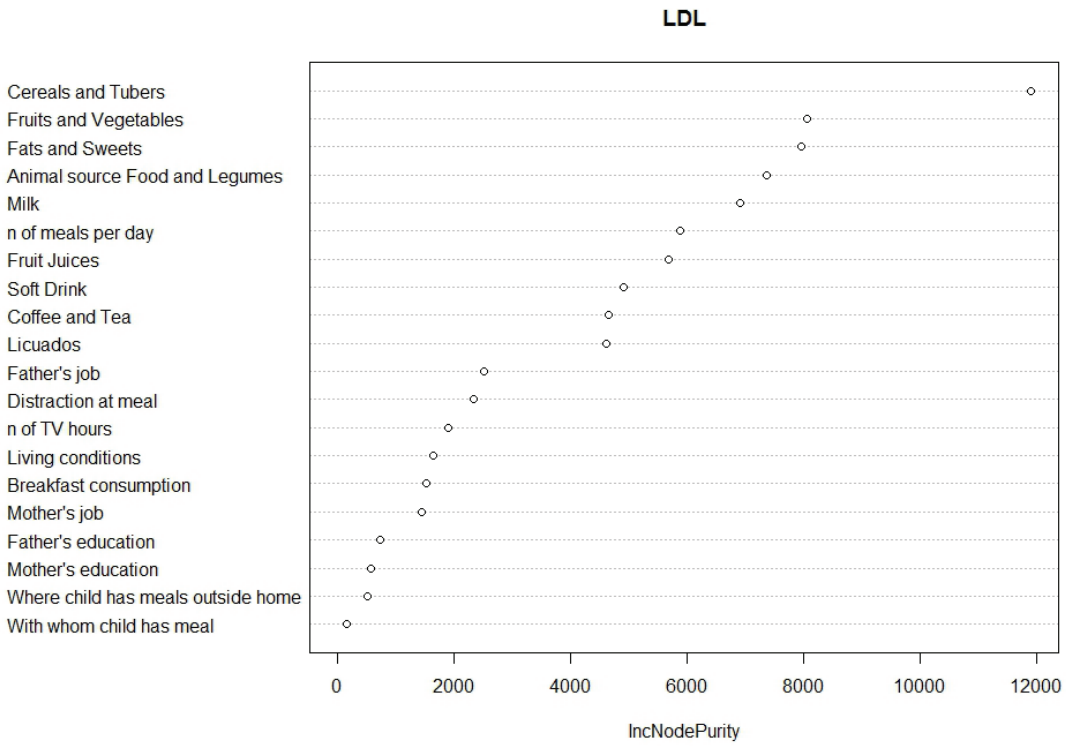

FIGURE 3. Distribution of factors associated with LDL in overweight/obese children.

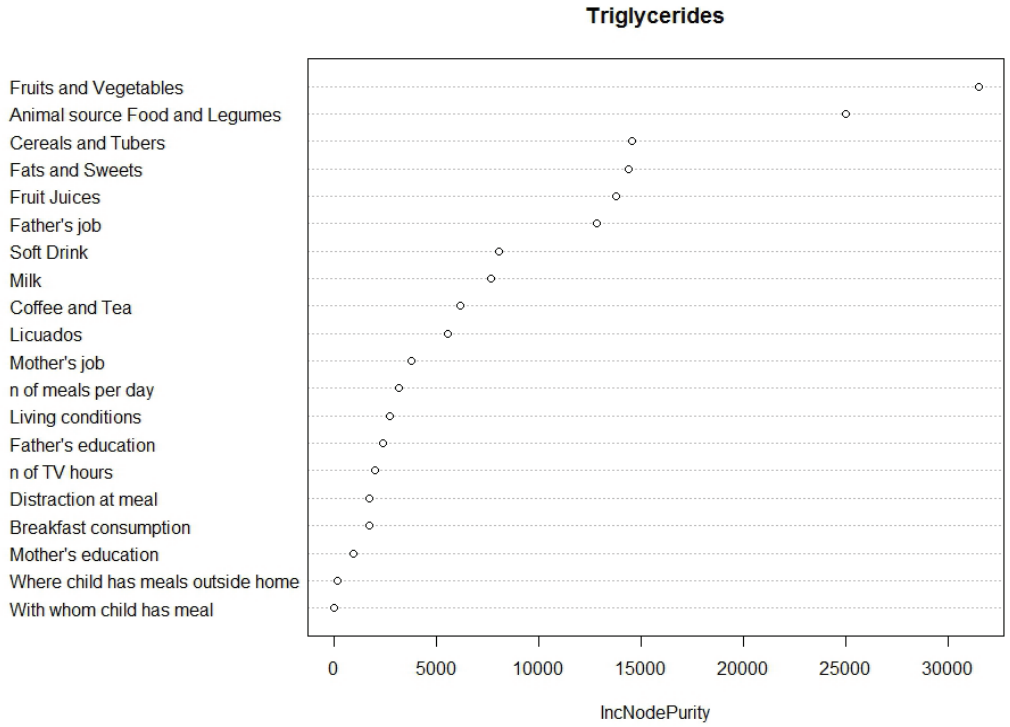

FIGURE 4. Distribution of factors associated with triglycerides in overweight/obese children.

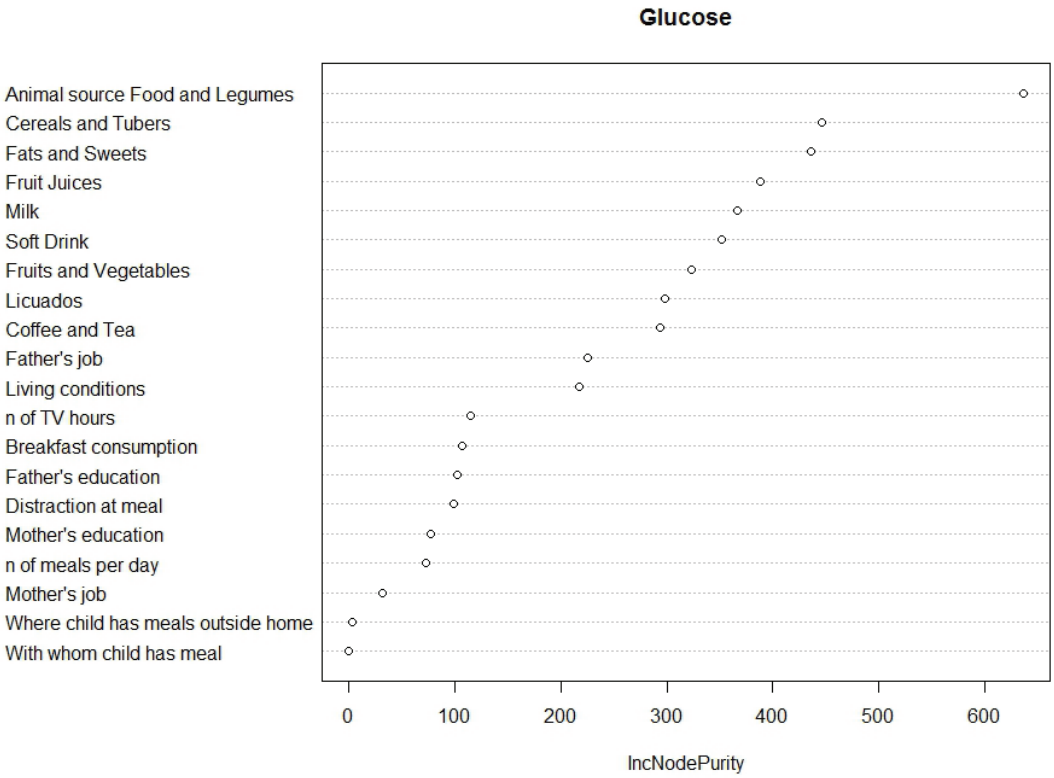

FIGURE 5. Distribution of factors associated with glucose in overweight/obese children.

DISCUSSION

This study is based on a survey conducted in schoolchildren of Montemorelos (a geographical area located in the north of Mexico). It aimed to investigate eating habits, socio-economic status and blood lipid profiles of children living in the city of Montemorelos, characterizing lipid concentrations among normal weight and overweight/obese children and assessing the impact of socio-economic factors and food habits in influencing blood lipid concentrations (total cholesterol, HDL, LDL, triglycerides, glucose) of overweight/obese kids.

Consistently with other studies conducted in US (22) and in Mexican population (23), we found out higher weekly consumption of fats and sweets compared to fruit/vegetables, animal source food/legumes, grains/tubers, despite the efforts of Mexican government to promote an healthy diet based on the consumption of the three food groups recommended from "el Plato del Bien Comer" (10). Additionally, in accordance to CDC growth standards (14), the prevalence of children overweight or obese is 37.8%, which is barely higher than the prevalence of overweight and obesity in Mexican schoolchildren (15) (34.4% among boys and girls from 5 to 11 years old). This higher prevalence of obesity and overweight is probably related to the fact that the living area of Montemorelos presents unique characteristics: the population living in this area is reported from the local health units to be at high risk of chronic and infectious diseases due to low socio-economic status, inadequate eating habits and

living conditions.

Referring to blood lipid concentrations, we found out higher lipid concentrations in children overweight or obese. These results were reported also from other studies (9-12) which demonstrated that obese children present higher lipid concentrations that could lead to early development of atherosclerotic process and of metabolic abnormalities with consequently higher risk of developing complications in early adulthood (cardiovascular and metabolic diseases particularly), highlighting the need of public policies preventing overweight and obesity in childhood.

Investigating the impact of eating habits and socio-economic factors on blood lipid concentrations, we demonstrated the key role of food and beverage consumption in influencing the lipid profile. Other studies (7, 8) showed the importance of food intake in determining high lipid concentrations, founding out especially a significant correlation of processed food and saturated fat consumption with lipoprotein concentrations. Additionally, we found out that also daily meal frequency play a key role in impacting lipoprotein concentrations, especially regarding HDL-cholesterol, in accordance to other studies demonstrating that higher meal frequency is related to better lipid profiles (1-3). However random forest does not specify the type of relationship (positive or negative) between the influencing factors (eating habits and socio-economic characteristics) and the outcomes (lipid concentrations), this approach shows only the weight of each factor in influencing the outcomes.

CONCLUSIONS

Our study demonstrated a higher prevalence of children overweight or obese compared to Mexican schoolchildren general population, additionally we reported higher blood lipid concentrations among these children, founding out that food and beverage consumption play a key role in influencing lipids profile. From these observations evolved the need of developing health care policies promoting healthy eating habits and physical activity among schoolchildren and their families taking into account the unique characteristics of the population living in this specific geographical area of Mexico.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs “Programmi di alta rilevanza scientifica e tecnologica” Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Long term interaction between dietary patterns and disease incidence: Evidence from Serbia

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SUMMARY: The objective of this study was to evaluate the relationship between dietary pattern and incidence of nutrition-related non-communicable diseases in Serbia, a country which has experienced a significant shift in nutrition and lifestyle habits, guided by its particular historical background and its rapid transition to liberal economy. Data was collected from annual reports published by the Statistical Office of the Republic of Serbia and the Institute of Public Health. It provides a focus on the timeframe of 1997-2014, in order to capture any changing pattern after the year 2000, in which the process of complete trade liberalization started.The results have shown a striking growing trend in both disease incidence on the one hand and processed food items such as processed meat, fruit juices, chocolate and biscuits and on the other hand. Granger causality test suggests that there exists causality that goes beyond spurious relationship between the disease of blood and blood-forming organs and immune system disorders and average *per capita* consumption of fruit and vegetables, poultry, processed meat, chocolates and biscuits and fruit juices. Also, we find evidence of long-term relationship between fish consumption and endocrine, metabolic and digestive diseases.

Key words: Food pattern, disease incidence, economy liberalization, processed food.

RESUMEN. La interacción a largo plazo entre los hábitos alimentarios y la incidencia de enfermedades: La evidencia de Serbia. El objetivo de este estudio fue evaluar la relación entre los patrones de dieta y la incidencia de las enfermedades no transmisibles relacionadas con la nutrición en Serbia, un país que ha experimentado un cambio significativo en los hábitos de nutrición y estilo de vida, guiado por sus antecedentes históricos particulares y su rápida transición hacia una economía liberal. Se recogieron datos de los informes anuales publicados por la Oficina de Estadística de la República de Serbia y el Instituto de Salud Pública. Se hizo foco en el período de 1997 a 2014, con el fin de poder detectar cualquier cambio en los patrones a partir del año 2000, cuando comenzó el proceso de liberalización total del comercio. Los resultados han mostrado llamativamente una tendencia creciente tanto en la incidencia de enfermedades como en la proliferación de alimentos procesados, tales como carne procesada, jugos de frutas, chocolate y galletas. La prueba de causalidad de Granger sugiere que existe una relación de causalidad que va más allá de la relación espuria entre las enfermedades hematológicas, las afecciones de los órganos hematopoyéticos y del sistema inmunológico y el consumo promedio per cápita de frutas y hortalizas, productos avícolas, carne procesada, chocolates, galletas y jugos de frutas. Parece evidente también la existencia de una relación a largo plazo entre la aparición de enfermedades endocrinas, metabólicas y digestivas y el consumo de pescado.

Palabras clave: Patrones alimentarios, incidencia de la enfermedad, liberalización de la economía, alimentos procesados.

INTRODUCTION

Nutritional pattern, commonly defined as a "Western diet", is typically characterized by high intake of refined carbohydrates, added sugars, fats and animal-source foods on the one hand and low intake of legumes and coarse grains, on the other (1). It strongly influenced many traditional food and cuisine (1), and become a feature of modern

dietary patterns in many low and middle-income countries (2). Food pattern modifications rose with new technology development and diffusion, income growth and retail globalization (1,3). Commercial interactions between nations affect food chain through leveraging the importance of import, allow a global spread of supermarkets (thanks to the Foreign Direct Investments) and contribute to evolution of preferences and cultural expectations of population via commercial promotion of food (4). New technologies, among other things, contributed to a worldwide increase in use of caloric sweeteners and vegetable oils such as soybean, sunflower, rapeseed, palm and groundnut oil (2–5). Individual intake of inexpensive vegetable oils increased threefold to six fold throughout the developing world (1). Furthermore, the increase in *per-capita* income, together with population growth and progressive urbanization is highly correlated with "livestock revolution", resulting in an unprecedented growth in demand for food of animal origin in developing countries (6) as well as consumption of a more processed food (1,7). Retailing globalization, with an enormous impact on the market structure in transition and developing countries (8,9), provides access to many new empty calorie foods and beverages and reduces the intake of fresh food, which represents an important source of nutrition.

Different studies have discussed potential adverse effect of the penetration of transnational food and drink companies on public health in developing and developed countries (10, 11). A displacement of traditional food systems has the potential to undermine public health more in low and middle income countries than in high-income countries, which already industrialized their dietary patterns (3). The dietary changes are very rapid and most probably will continue to evolve without suitable policy intervention (12–15).

"Nutrition transition" occurs concomitantly with two remarkable processes: demographic transition and epidemiological transition related to urban-industrial lifestyles. This results in an increased prevalence of obesity and contributes to the incidence of chronic and degenerative diseases (2). Now, nutrition-related non-communicable diseases (NCDs), most particularly cardiovascular disease (CVD) and some types of cancer, replaced previously dominant transmissible diseases in low and middle income countries. CVDs constitute the largest cause of mortality, representing 31% of all global deaths in 2012 (16). Over three quarters of CVD deaths take place in low and middle income countries affecting a nation's economic development through loss of income and the high cost of medical care (17)."Western diet" nutritional patterns,as well as frequent consumption of processed and ultra-processed food,promote obesity, metabolic syndrome, CVDs and, most probably, favor autoimmune diseases (18).

However, Serbia is a very particular case of middle-income country: it is one of the transition economies in Central and Southeastern Europe (CEEs), whose system rapidly switched from planned to market economy after the 1990's. In pre-transitional era only a limited range of food items were available, but due to low food prices and significant state agriculture subsidies, the typical diet found in these countries had features of high-income diets: a significant consumption of livestock products (19). Since the grain production was highly subsidized, bread was often used to feed livestock in small farms (20). Also, public health expenditures (as a percentage of GDP), was significantly higher in socialist countries than in most middle-income countries (20).

The biggest hyperinflation after World War II that has hit Serbia in the 1990s, gray economy, civil war, an influx of about one million refugees, international economic sanction – are all factors that contributed halving the size of the Serbian economy with respect to the early 1990s. (21).

Despite severe economic difficulties, Serbia has preserved its strong agricultural basis as it has historically been an important agricultural producer for both domestic and export market (19). Furthermore, there is a strong culinary tradition and efforts to preserve traditional food products and food cuisine (22).

Taking into account abrupt changes which occurred upon opening of the borders for competitive import, reduction of agricultural subsidies and shrinking of value added in agriculture, deterioration of social safety nets, (20) it is no wonder that important changes were experienced in terms of prevalent dietary patterns. It is interesting to notice that the evolution in food consumption did not concern the expansion of food quantity in a measure in which it concerned the diversification of available food items (20).

It is believed that Serbian population has been heavily affected by wars, disintegration and political crisis, resulting in an increased mortality from cancer and ischemic heart disease during the past two decades (23, 24). Since the 1990s, NCDs have represented a major cause of death, where cardiovascular diseases are the top ranked, followed by cancers (25). Dietary risk, along with tobacco smoking and high blood pressure, account for the most of the disease burden (26). Aging population and high burden of NCD mortality resulted in a continuously increasing crude death rate, which reached 13.97% in 2008. According to the national health survey in 2006, 54.5% of adult population were overweight and 18% children aged 7–18 were at least moderately obese. Only 23% of adult population reported undertaking physical activity on daily basis, with 67% of adults being physically inactive (27).

The aim of this paper is to provide consistent evidence about the long term relationship between dietary pattern and incidence of NCDs, in a very particular setting of Serbia which has undergone one of the most unstable transition experience in the CEEs.

Our literature review did not show many articles interested in the in analyses of long-term relationship between dietary pattern and disease incidents (28–30) To the best of our knowledge, this study is the first to document a significant shift in dietary pattern, and addresses the relationship between food consumption and incidence of broad categories of non-communicable diseases

MATERIALS AND METHODS

Data collection

Time series data about average per-capita food consumption is taken from the Statistical Office of the Republic of Serbia (31). Yearly data on diagnosed disease incidence was taken from the Institute of Public Health of Serbia "Dr Milan Jovanovic Batut" (32). Diseases, conditions and injuries in primary health service, provided by state-owned primary health centers are presented in uniform lists in accordance with the International Classification of Diseases – 10th Revisions (33). We have analyzed four groups of diseases: diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89), diseases of the circulatory system (I00-I99), endocrine, nutritional and metabolic diseases (E00-E90) and diseases of the digestive system (K00-K93) (Table 1).

We have selected relevant food categories that constitute a typical household diet, aggregating over certain food items. The categories are bread and paste products, fresh fruit and vegetables, milk products (fresh and fermented), red meat (beef, pork and goat), processed meat (dried bacon, dried meat boneless, dried meat with bones, salami and sausages all kinds, hot dogs, etc.), fish, poultry, fruit juices, processed snack food (sweets and biscuits) and total fat.

The data refers to the time frame of 1997-2014. We chose this period to evaluate the changes after the year 2000, the year of economy "opening", which can be considered as the year when the

TABLE 1. International Classification of Diseases – 10th Revisions

Endocrine, nutritional and metabolic diseases (E00-E90)	Disorders of thyroid gland (E00-E07) Diabetes mellitus (E10-E14) Other disorders of glucose regulation and pancreatic internal secretion (E15-E16) Disorders of other endocrine glands (E20-E35) Malnutrition (E40-E46) Other nutritional deficiencies (E50-E64) Obesity and other hyperalimentation (E65-E68) Metabolic disorders (E70-E90)
Diseases of the circulatory system (I00-I99)	Acute rheumatic fever (I00-I02) Chronic rheumatic heart diseases (I05-I09) Hypertensive diseases (I10-I15) Ischaemic heart diseases (I20-I25) Pulmonary heart disease and diseases of pulmonary circulation (I26-I28) Other forms of heart disease (I30-I52) Cerebrovascular diseases (I60-I69) Diseases of arteries, arterioles and capillaries (I70-I79) Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified (I80-I89) Other and unspecified disorders of the circulatory system (I95-I99)
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89)	Nutritional anaemias (D50-D53) Haemolytic anaemias (D55-D59) Aplastic and other anaemias (D60-D64) Coagulation defects, purpura and other haemorrhagic conditions (D65-D69) Other diseases of blood and blood-forming organs (D70-D77) Certain disorders involving the immune mechanism (D80-D89)
Diseases of the digestive system (K00-K93)	Diseases of oral cavity, salivary glands and jaws (K00-K14) Diseases of oesophagus, stomach and duodenum (K20-K31) Diseases of appendix (K35-K38) Hernia (K40-K46) Noninfective enteritis and colitis (K50-K52) Other diseases of intestines (K55-K63) Diseases of peritoneum (K65-K67) Diseases of liver (K70-K77) Disorders of gallbladder, biliary tract and pancreas (K80-K87) Other diseases of the digestive system (K90-K93)

Source: http://apps.who.int/classifications/apps/icd/icd10online2006/

process of complete trade liberalization started. The conclusion relates to the "opening" of the economy since 2000 relating to the completely closed economy until then. After parliamentary elections in December 2000, the EU lifts tariffs on import of goods from Federal Republic Yugoslavia (The Republics of Serbia and Montenegro together established a federation in 1992) and the prospect of a Stabilization and Association Process was settled, in accordance

with decisions of the EU Council (34). This has exposed agricultural producers to the increasing international trade competition. Besides this, Serbia has the signed Central European Free Trade Agreement (CEFTA)- agreements on free trade with the CEFTA countries, as well as free trade agreements with Russia, Turkey and Belarus. As a consequence, the aggregate supply of agricultural and food products has exceeded the demand in the period after the 2000 (35).

Statistical analysis

Multivariate time series analysis was conducted using as a reference standard cointegration approach. Pearson correlation coefficient and generalized regression modeling were used as a starting point, to underline problem of spurious relationship between the time series. Dickey- Fuller test was used to confirm level non- stationarity of the series, which can be visualized through graphical inspection (see Figure 1 and Figure 2). The order of the integration was determined using Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests, where the null hypothesis was that an observable time series is trend stationary against the alternative of a unit root (36). Since we have found that most series are of order 1, we have used a bivariate multivariate time series approach to establish

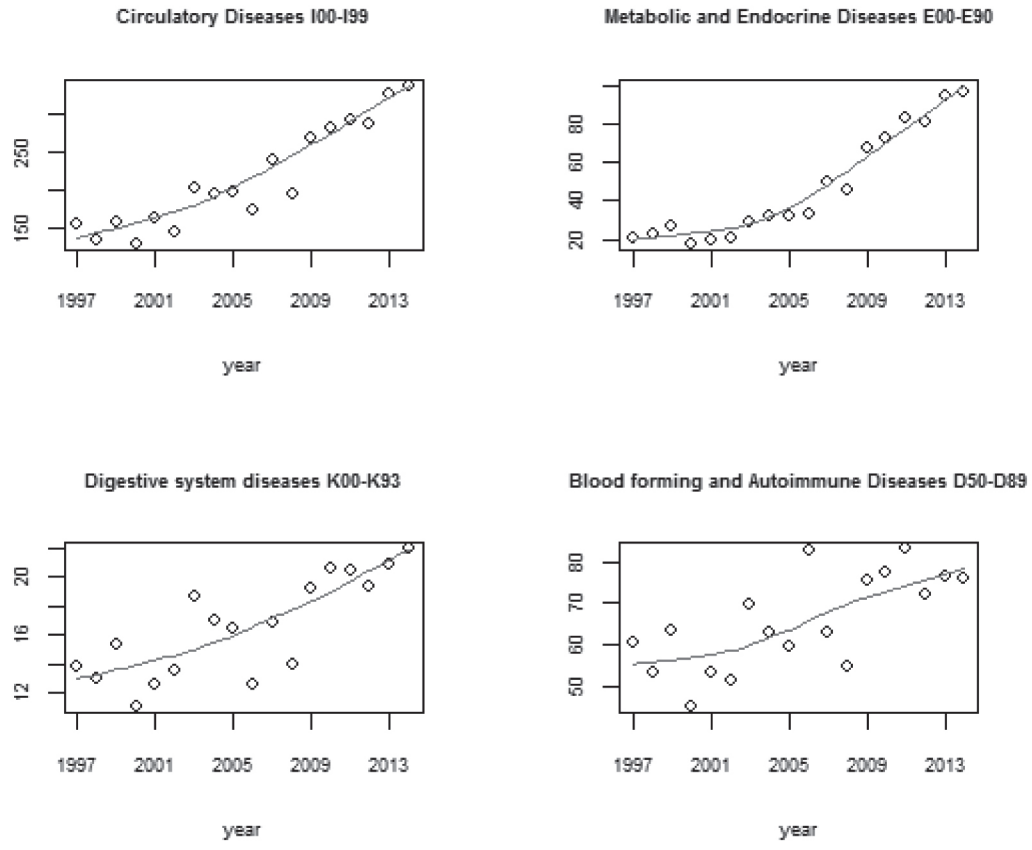

FIGURE 1. Serbian trends in non-communicable disease incidence (annual incidence rate per 1000 people on y axis).

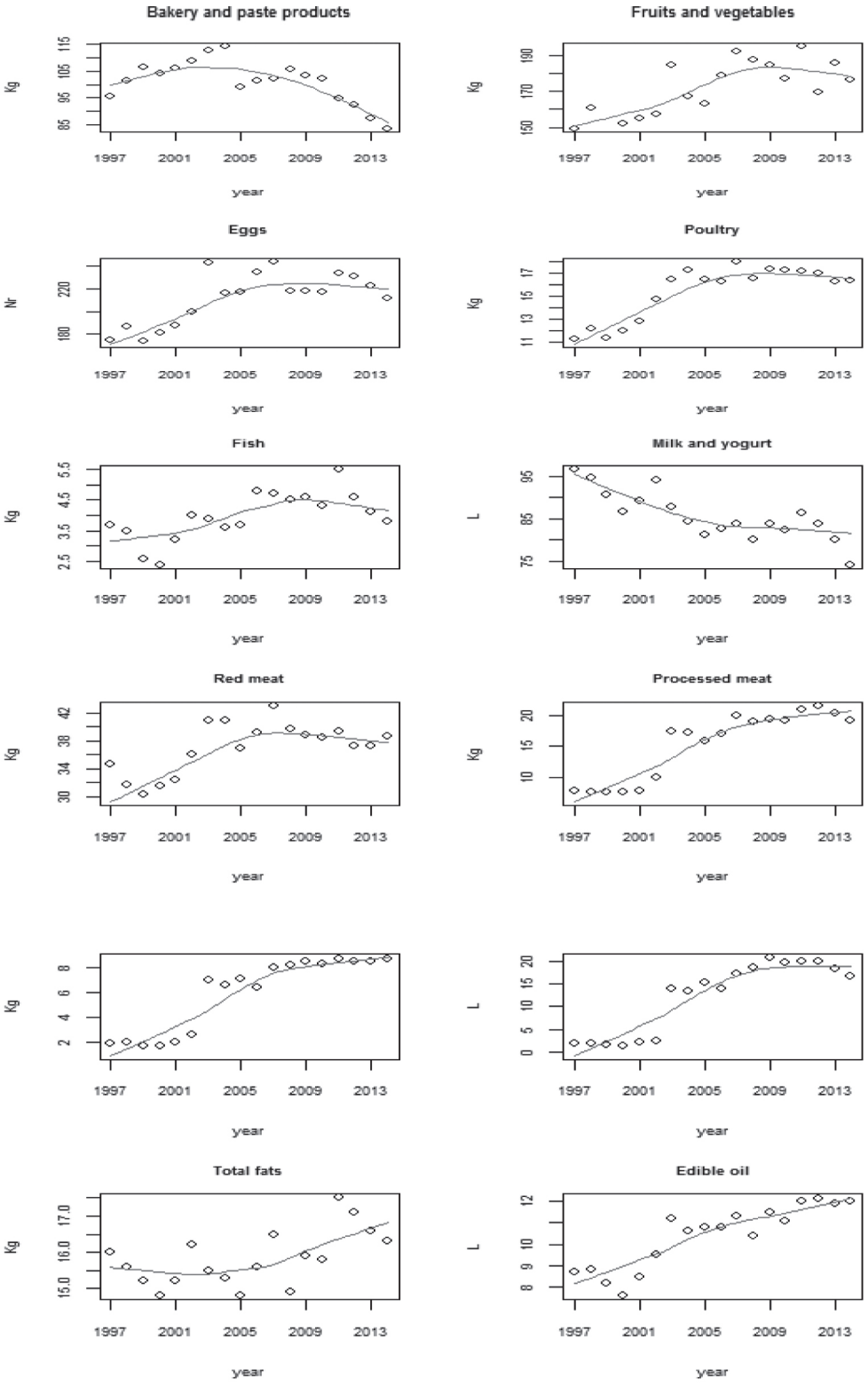

FIGURE 2.Serbian trends in dietary patterns
(average quantity consumed annually per household member on y axis)

long run relationship between the food pattern and disease. In particular, Granger causality test was used determine whether the lagged dietary pattern provide statistically significant information about the current values of outcomes (37).

RESULTS

There is an evident growing trend in both disease incidence and food items such as processed meat, fruit juices and chocolate and biscuits in the observed period (see Figure 1 and Figure 2). Most notably, endocrine, nutritional and metabolic diseases (E00-E90) incidence rates have almost quintupled from 0.02 in 1997 to more than 0.09 in 2014. Circulatory diseases (I00-I99) have doubled from 0.15 to more than 0.30. Prevalence of blood forming and autoimmune diseases (D50-D89) and diseases of the digestive system (K00-K93) has also increased for 58% and 26%, respectively. In relation to food consumption, the highest growth can be observed in the consumption of fruit juices, and chocolate and biscuits, 9.3 and 6.6 times, respectively. Processed meat consumption has increased almost 2.5 times. Regarding fresh meat, the largest increase in total consumption is recorded for chicken (about 45%). The consumption of individual edible oil, fresh fruits and vegetables and total fish had also increased for 38%, 18%, and 32%, respectively. In the same period of time, consumption of fresh milk and yogurt has decreased by 23%. Similar declining trend can be noticed in consumption of bakery and paste products.

Preliminary descriptive (graphically represented Pearson coefficient) suggest that there is strong interdependency between the dietary patterns and the annual incidence of non-communicable diseases (see Figure 3). Bread and paste products and milk products and fermented derivatives seem to have a risk-protective relationship with all the four disease groups. Fruit juices, processed snack good (defined as sweets and biscuits) and processed meat seems to be strongly positively correlated with the disease incidence.However, since unit root test confirms that the series are not stationary, the assumptions behind standard linear modeling can be violated, hence the correlations shown in Figure 3 might be misleading.

In order to investigate the nature of stationarity of the series, we have performed

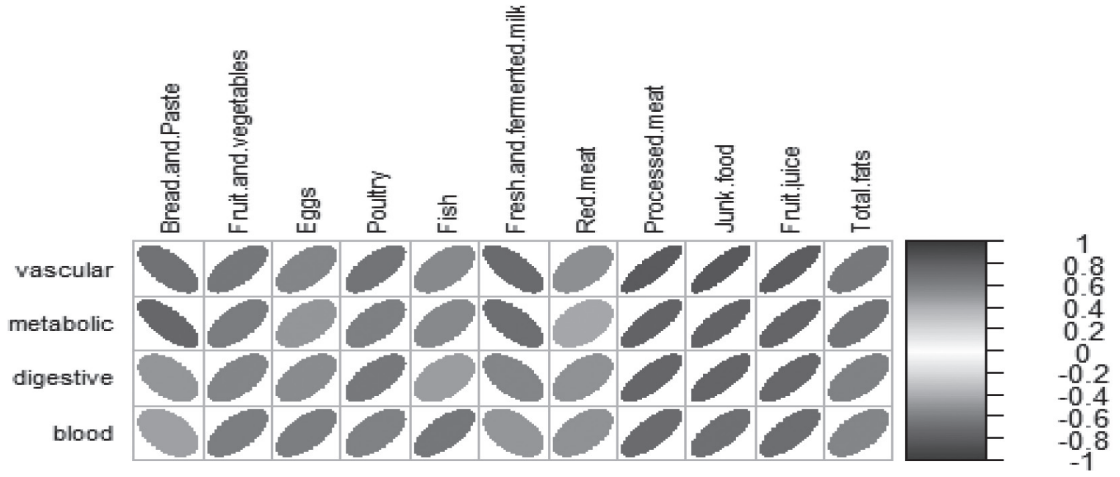

FIGURE 3. Pearson Correlation coefficient between the diseases and food pattern

KPSS tests on each series (see Table 2). Non-significant p-value (with p>0.05) means that the series is stationary around a deterministic (increasing or decreasing) trend. The lag order refers to the order of integration of the series.

What we find is that, among all, only several time series (bread and pastry products, fish and red meat) are trend stationary. This means that they remain stable around the deterministic trend and are hardly influenced by external shocks. All other series are "shock sensitive", meaning that any external shock (an event that has impact on the time series) permanently affects the series. In each case (trend stationary or integrated time series), standard assumptions for linear modeling fail, hence an alternative approach for testing the association between the dietary pattern and disease incidence is necessary.

Table 3 presents a more rigorous statistical testing using Granger causality test for long run relationship between the variables. Significant p-value means that the past values of the

TABLE 2. Unit root test for trend stationarity of the data.

	KPSS statistics	Significance level	Lag Order
Vascular diseases	0.6643	<0.05	1
Metabolic diseases	0.6464	<0.025	1
Digestive diseases	0.578	<0.025	1
Blood diseases	0.5668	<0.05	1
Bread and paste products	0.3902	>0.1	0
Fruit and vegetables	0.5522	<0.05	1
Eggs	0.4706	<0.05	1
Poultry	0.5257	<0.05	1
Fish	0.4494	<0.1	0
Fresh and fermented milk products	0.6272	<0.025	1
Red meat	0.3892	>0.1	0
Processed meat	0.6154	<0.025	1
Junk food	0.6188	<0.025	1
Fruit juices	0.6018	<0.025	1
Total fats	0.4053	<0.05	1

TABLE 3. Bivariate Granger causality (significant p-value and lag in the parenthesis)

	Vascular diseases	Metabolic diseases	Digestive diseases	Blood forming diseases
Bread and paste products	n.s.	n.s.	n.s.	
Fruit and vegetables	n.s.	0.089(2)	0.092 (1)	0.027 (3)
Eggs	n.s.	n.s.	n.s.	
Poultry	n.s.	n.s.	n.s.	0.023 (1)
Fish	n.s.	0.053 (2)	0.039 (1)	0.086 (1)
Fresh and fermented milk products	n.s.	0.096 (3)	n.s.	0.073 (1)
Red meat	n.s.	n.s.		0.09 (2)
Processed meat	n.s.	n.s.	0.077 (1)	0.02 (1)
Sweets and biscuits	n.s.	n.s.	n.s.	0.042 (2)
Fruit juices	n.s.	n.s.	n.s.	0.029 (2)
Total fats	n.s.	n.s.	n.s.	n.s.

n.s. – non significant. Significant p-value (p<0.05) indicate that past values of the series provide statistically significant information for predicting the outcome (predictive causality).

independent variable (diet) are significant in predicting dependent variable (disease) up to the lag indicated in the brackets. This test suggests that there exists causality between the disease of blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89) and average consumption of fruit and vegetables (p= 0.03), poultry (p=0.02), processed meat (p=0.02) sweets and biscuits (p=0.04) and fruit juices (p=0.03). The same test suggests causality between both endocrine, nutritional and metabolic diseases (E00-E90) and diseases of the digestive system (K00-K93) (p=0.05 and p=0.04, respectively) and fish consumption. We found no significant relation between diseases of the circulatory system (I00-I99) and specified food items.

DISCUSSION

Serbian background

Road border changes, wars, coexistence of different nations resulted in very heterogeneous cuisine. Traditional Serbian cuisine is based on Slavic traditions with strong Mediterranean (Byzantine/Greek), Oriental (Turkish) and Hungarian influences (38). Many food items such as relish from bell peppers or eggplant, jams, jellies, pickled food, sausages, clotted cream, yogurts, syrupy fruit conserve as well as fruit brandy are homemade. The Serbian diet is traditionally heavy on grilled meat, sausages, local cheeses and bread. There are a number of local dishes which highlight this, such as pljeskavica (mixture of lamb or pork and beef, grilled with onions and served hot on fresh bread) and rostilj (various unseasoned grilled meat and can include chicken wrapped in bacon and stuffed with cheese). In recent years, bakeries can be found everywhere in Serbia and cater to the food to go aspect of life (39).

After the Second World War, new Yugoslavian agricultural policy (development of social farms, new approach to cooperatives, stimulation of personal labor, price investments) has resulted in a very rapid growth of agricultural production. In the period 1957-1980 the group activities, directly dependent on the production of raw materials have recorded extremely rapid development. The food industry (meat, fruit and vegetables processing as well as milk preserving and drink production) overshadowed the food processing in households. Rapid supply growth was registered for bread grains, fats, fruits, sugar, ready to eat meals and drink (40). The share of the agricultural population, total and active, decreased in the period 1948 -1980 from 67 or 73% to only 29 or 38% (41). These very fast socio-economic changes in Yugoslavia had a significant impact on food patterns causing consumption growth of finished and semi-finished products(38).

After a period of economic and political uncertainty (1990-2000) Serbia started new era of “democratic changes”, the process of complete trade liberalization started, the growth of GDP began and urbanization brought changes in lifestyle. All these elements resulted in changes in food habits of the population. One theory states that a key constituent is penetration of modern supermarkets (42). After the privatization of the retail sector and the establishing of the first supermarket chains, this region faced an inflow of foreign supermarket chains: Belgian Delhaize Group, German Metro Group, French Intermarché, Slovenian Mercator and the Croatian Agrokor. Slovenian chain Mercator as well as Veropulus Super Market Group (Super Vero) opened its first hypermarket in Belgrade in 2002. Intermarché has been present in Serbia through local brand Interex since 2004 when it opened its first supermarket. Idea (Agrokor Group) and Metro Cash&Carry are retails chain with a constant market share growth since 2005, when the first store was opened in Belgrade.

Socio-economic conditions and population health are inextricably linked, and strongly

interdependent(32) and Serbia has been a rather good example to confirm this theory. In parallel with 'westernization' process of food habits (43) Serbia has experienced the general deterioration of public health (44). Adulthood obesity prevalence forecasts (2010–2030) predict that in 2020, 44% of men and 31% of women will be obese (45). Top three causes of death in the period 2000-2012 were CVDs: stroke, cardiomyopathy- myocarditis and ischaemic heart disease (31,46). One study has shown the markedly increasing trends in mortality rates from ischemic heart disease in man during 1991-2010 periods (30).

Public Health Nutrition Implications

Disease yearly incidence rate trend graphs (Figure 1) show some striking evidence about the increase in all the considered groups of diseases. While circulatory diseases incidence rates have doubled, metabolic and endocrine diseases have almost quintupled. Even digestive and blood forming and immune diseases show an upward trend, although less systematic and more disperse around the mean.

The evolution of cardiovascular disease trends in Serbia is in line with several eastern European countries, notably Russian federation, where CVDs mortality remains high (47). Trends regarding endocrine, metabolic and nutritional diseases are coherent with trends in many countries, especially if we consider overweight, obesity and diabetes which become a global health challenge (48).

Like in the developing world, where diets are shifting rapidly and going to high consumption of fat, sweets, animal source food and processed food (2,14), similar trend is observed in Serbia. The evolution of dietary patterns in general is also in accordance with Mediterranean countries, such as Greece where consumption of animal fats and high-calorie foods is increasing(49).

In the 18 period time frames it appears that the Serbian population has evolved its preferences (on average) towards certain food items: there is an important increase in consumption of poultry, processed meat, chocolate and biscuits, fruit juices and edible oils. This means that despite the efforts to preserve culinary heritage (majority of consumers eat at home and like cooking) and traditional food as a response to modernization processes (22,50) Serbia did not resist changes that are happening in the rest of the world. From 2002 to 2003 there has been a structural break, driven by opening new hypermarket stores (Mercator, Super Vero and Univerexport) in 2002 and huge increase in *per capita* gross national income (GNI) from USD 1.590 in 2002 to USD 2.130 in 2003 (51). This has fostered a significant shift in consumption of these goods, and can be observed in our data (see Figure 2). Upward trends are present, although less striking, in red meat, fish, eggs and fruit and vegetable consumption. On the contrary, downward trend brought milk products from 95 l *per capita* to 75 l *per capita*. Similar trend occurred in bakery and paste products consumption.

Since the dietary pattern and disease incidence rate move together in parallel, descriptive evidence does suggest that there is strong relationship between the consumption of certain food items and disease insurgence. However, claiming causality in these type of studies is overly ambitious tasks, especially for the fact that in the multivariate time series context, testing for linear relationship between the variables might lead to erroneous results due to spurious relationship problem. However, long-term causality test has confirmed causality between the certain diseases, especially blood forming diseases, and a range of food items (processed meat, junk food, fruit and vegetable, etc.). However, these results should be interpreted overall, as a descriptive evidence of a trend in dietary pattern which had both strong trend and structural break and lead to non-ignorable consequences in disease incidence.

Most probably, dietary modifications should form the ground for action for all four group diseases prevention. To find ways to push people to change their dietary habits into more a healthy diet is the challenge for coming years for national competent authorities (52). This going to be particularly difficult in Serbia since there is an insufficient involvement of the state regarding adoption of national dietary guidelines (53).

CONCLUSIONS

National statistical data provides striking evidence about the ”Nutrition transition”, in particular the shift in consumption of processed food items such as processed meat, fruit juices, chocolate and biscuits. Our results indicate that this dietary transition represents one strong potential driver of chronic conditions. The analysis shows strong evidence of correlation between consumption of certain food items and blood forming disease, although a more detailed data would probably allow for a clearer identification of causal patterns and long-run interactions.

Although this represents a rather descriptive study of a very complex phenomena, to the extent of our knowledge, it is the first study to address the issue of long-term associations between the shift in diet orientation and chronical conditions in Serbia. As described, Serbia represents a very unusual context where it would be particularly relevant to broaden the knowledge in the field of nutrition-related morbidity. Lack of consistant academic programs in nutrition and national dietary guidelines represent important obstacles to building an efficient food and health system, which would ensure strengthening the population resilience to nutritional risks.

Monitoring of the situation is extremely important, since it represents the stepping stone for evidence-based action, necessary to tackle the burden in terms of public health cost. Longitudinal country-level data allows for general monitoring of the evolution of dietary habits and disease epidemiology, however only individual level data would allow for further inspection of the mechanisms through which policy action and nutrition yields health effects.

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

What is breakfast for Mexican children?

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SUMMARY: In order to face with the concerning rising prevalence of overweight and obesity in childhood, Mexican government has implemented Nutritional Indications (NI) for preschool and schoolchildren. The aim of our study is to investigate what Mexican children have for breakfast and if they meet NI, which recommends that daily breakfast should include one food from each of the three recommended food groups (grains and tubers, animal source food and legumes, fruits and vegetables). We considered a sample of 120 male children aged 3-14 years, their mothers were asked to complete a questionnaire and to fill a breakfast diary for one week. Food was grouped in the three recommended food groups and a further group including fats and sweets was considered. Only 32 children met NI at least once a week (compliant children) and nobody followed NI throughout the week. The analysis on breakfast records showed a low intake of the fruits and vegetables food group. Children were more likely to follow NI when they had breakfast with family members. We show that children do not meet breakfast's NI, but further researches are needed to investigate the long-term impact of NI on Mexican children eating patterns.

Key words: Breakfast, children, Mexico, nutritional recommendations.

RESUMEN. ¿Qué es un desayuno para los niños mexicanos? Para hacer frente al aumento de la prevalencia de sobrepeso y obesidad en la infancia, el Gobierno Mexicano ha implementado las indicaciones nutricionales (IN) para niños en etapas preescolar y escolar. El objetivo de nuestro estudio es investigar los componentes del desayuno en la dieta de niños Mexicanos, además del cumplimiento con las IN, que recomiendan que el desayuno diario debe incluir un alimento de cada uno de los tres grupos alimenticios recomendados (granos y tubérculos, alimentos de origen animal, y legumbres, frutas y verduras). Se consideró una muestra de 120 niños (de género masculino) con edades entre 3 y 14 años. Se solicitó a sus madres completar un cuestionario y realizar un registro diario de los componentes del desayuno durante una semana. Los alimentos se agruparon según dictan las IN; además, un grupo que incluye grasas y dulces fue también considerado. Sólo 32 niños cumplieron con las IN al menos una vez a la semana (los niños que cumplen) y ninguno siguió las IN durante toda la semana. El análisis sobre los registros diarios mostró un bajo consumo del grupo de alimentos compuesto por frutas y verduras. El justo seguimiento de las IN ha sido más probable cuando el desayuno se ha realizado con miembros de la familia. Se demuestra que los niños no cumplen el IN del desayuno, pero se necesitan más investigaciones para investigar el impacto a largo plazo de IN sobre los hábitos alimenticios de los niños mexicanos

Palabras clave: Desayuno, niños, México, recomendaciones nutricionales.

INTRODUCTION

The rising prevalence of pediatric overweight and obesity, especially among Latino children and adolescents, represents a worryingly health care burden (1).

The Encuesta Nacional de Salud y Nutrición (2) (ENSANUT) shows that the prevalence of overweight and obesity in Mexican children under 5 years was increased from 8.8% in 1999 to 9.7% in 2012. Regarding children between 5 and 11 years the prevalence of overweight and obesity was increased from 26.9% in 1999 to

34.4% in 2012 and the prevalence of obesity is higher among boys than girls.

The risk of developing cardiovascular (coronary artery disease, hypertension) and metabolic (type 2 diabetes) diseases in early adulthood is higher among children and adolescents who are obese (3). Additionally, it has been demonstrated that Latino children are at higher risk (than non-Latino ones) of suffering from impaired glucose tolerance due to beta-cell dysfunction, which represents the preliminary stage of type 2 diabetes (4). Thus, the need for preventive policies promoting healthy lifestyle and nutrition.

In order to face with overweight and obesity epidemic and its consequences, especially among children and adolescents, Mexican government provides the "Estrategia contra el sobrepeso y la obesidad" (5) which promotes a specific action program that takes place in preschools, primary schools and secondary schools, starting from 2010-2011 academic year. It aims to promote physical activity and healthy eating habits (reduction of fat and sugar intake, increasing consumption of fruits, vegetables and cereals). To implement the project, Mexican government carries out an educational program that involves Mexican families in order to improve eating habits of children also outside school: it suggests what type of food children should take in different eating occasions (breakfast, lunch, dinner and snacks), taking into account that dietary habits play a key role in influencing the risk of childhood obesity. More specifically, it has been shown that breakfast patterns are related to weight gain and nutrient intake of children and adolescents: several studies (6-9) demonstrate that breakfast skipping is associated with increased risk of overweight and obesity among children (10). Additionally, subjects who skip breakfast are reported to present a lack of many nutrients (particularly of vitamins, minerals and dietary fiber) (11). Not only breakfast skipping, but also breakfast composition is important: having a balanced breakfast appears to be associated with children's better food habits and nutrient intake (12).

Given the importance of breakfast consumption and composition in children's weight gain, dietary patterns and nutrient intake, in this study we aim to investigate what Mexican children have for breakfast and if they follow the Nutritional Indications (NI) provided by the "Estrategia contra el sobrepeso y la obesidad".

MATERIALS AND METHODS

Study design

The present study was based on data from a market survey conducted in three Mexico's cities (Mexico D.F., Monterrey, Guadalajara) between 27th March and 21st June 2011. The aim of the market survey was to have a complete picture of what people had for breakfast. Participants (3-55 years of age) were selected using a stratified sampling technique.

A questionnaire was administered to the participants. It investigated socio-economic characteristics of the enrolled subjects, their breakfast habits (where they usually have breakfast, what they usually do while having breakfast), their attitudes towards breakfast and towards the types of food they choose for breakfast. They were also asked to fill a breakfast diary every day for one week in which they recorded what food they had for breakfast. Mothers filled the questionnaire and breakfast diaries for their children until 14 years of age.

We considered data from 120 male children (3-13 years of age). Socio-economic characteristics regarded child's age, household size, mother's age, working status and educational level. Mother's attitude towards children's breakfast was assessed using a 17 items questionnaire. Regarding breakfast diaries, we collected 437 breakfast records among 120 children. Every breakfast record reported what

children had for breakfast, what they did while they were having breakfast, with whom they had breakfast and how long did it take.

Nutritional indications (NI)

The aim of our study is to investigate if children follow the NI for breakfast recommended by the "Estrategia contra el sobrepeso y la obesidad" (13). The project, in order to face with obesity epidemic, provides an educational program towards Mexican families recommending what type of food children should take in different eating occasions (breakfast, lunch, dinner and snacks). The NI are based on "el Plato del Bien Comer": it shows the classification of food groups (fruits and vegetables, grains and tubers, legumes and animal source food) and in what proportion should take them, considering the specific features of Mexican population (it is established from the official Mexican norm NOM 043-SSA2-2005 (13)).

Regarding breakfast, the NI provided by the "Estrategia contra el sobrepeso y la obesidad" recommends that children should take one food from every food group (fruits and vegetables, grains and tubers, legumes and animal source food). In order to investigate if children follow these NI, we classify food reported in breakfast records into the three recommended food groups using the Sistema Mexicano de Alimentos Equivalentes (14). To classify all the food children have for breakfast, we consider a further food group (not suggested from the NI) including fats and sweets.

Beverages are classified separately from food. We classify beverages using the "Recomendaciones sobre el consumo de bebidas para la población mexicana" (15): the first level includes water, the second one is represented by skim or low fat (1%) milk and sugar free soy beverages, the third consists of coffee and tea which are not recommended for children due to caffeine. The fourth level includes non-caloric beverages containing artificial sweeteners, while beverages corresponding to the fifth level provide a high caloric intake but do not contribute to better health status (e.g. fruit juices, whole milk, alcoholic and sports drinks). Finally, the sixth level is represented by beverages that are high in sugar but provide low nutrient intake (soft drinks and other beverages high in sugar such as flavored waters, sweetened coffee and tea). The classification is inversely proportional to the suggested consumption: from the less recommended (Level 6, which should be drink rarely) to the most recommended (Level 1: water, which should be the first source of hydration).

Compliance with Nutritional Indications (NI)

The analysis of compliance with NI was conducted both on breakfast records and on individual basis. For the analysis on individual basis, we considered compliant children when they follow NI at least once a week. Following NI means that breakfast composition includes one food from each of the three recommended food groups (3/3 NI). Not following NI means that breakfast composition:

- includes food from only two or one of the recommended food groups (2/3 NI, 1/3 NI)
- includes food from only the fats and sweets group (which is not recommended from the NI) and not from the three recommended food groups
- in addition to the recommended food groups, includes food from also the fats and sweets group (3/3 NI + fats and sweets, 2/3 NI + fats and sweets, 1/3 NI + fats and sweets).

Statistical Analysis

Descriptive data analysis of the compliance with NI has been performed and reported using percentages (absolute numbers). The 95% confidence intervals (C.I.) were obtained by bootstrap method (1,000 sample replications).

Basic exploratory data analysis has been performed and reported using percentages (absolute numbers), and Chi-square is used to test variations across compliance with NI groups. Analyses were performed using the R System.

RESULTS

Table 1 shows that only 26.66% (26.56; 27.07 95% C.I.) of children followed NI (3/3 NI) at least once a week (compliant children), corresponding to 7.35% (7.30; 7.42 95% C.I.) of the breakfast records. Nobody followed NI throughout the week, and most of compliant children followed NI only once a week (Figure 1).

The majority of breakfast records didn't follow NI because breakfast composition included food from only two (2/3 NI) of the recommended food groups (44.41%, 44.40; 44.63 95% C.I.) or one (1/3 NI) of the recommended food groups (31.88%, 31.71; 31.92 95% C.I.). When only two food groups were included in breakfast composition, the less represented food

TABLE 1. Compliance with NI and beverages consumption analyzed both on breakfast records and on children.

	Breakfast records (n=734)			Children (n=120)		
3/3 NI	7.35	(7.30; 7.42)	54	26.66	(26.56; 27.07)	32
2/3 NI	44.41	(44.40; 44.63)	326	89.16	(89.01; 89.35)	107
GT + AL	41.96	(41.95; 42.17)	308	86.66	(86.50; 86.87)	104
GT + FV	1.36	(1.33; 1.38)	10	8.33	(8.30; 8.63)	10
AL + FV	1.08	(1.07; 1.12)	8	6.66	(6.45; 6.73)	8
1/3 NI	31.88	(31.71; 31.92)	234	75.00	(74.79; 75.29)	90
GT	24.93	(24.77; 24.97)	183	65.83	(65.81; 66.33)	79
AL	5.85	(5.82; 5.93)	43	24.16	(23.91; 24.38)	29
FV	1.08	(1.04; 1.09)	8	6.66	(6.51; 6.80)	8
3/3 NI + FS	3.26	(3.21; 3.29)	4	10.00	(9.79; 10.13)	12
2/3 NI + FS	9.94	(9.83; 9.97)	73	41.66	(41.41; 41.98)	50
GT + AL+ FS	9.53	(9.42; 9.56)	70	40.00	(39.61; 40.18)	48
GT + FV + FS	0.27	(0.25; 0.28)	2	1.66	(1.54; 1.69)	2
AL + FV + FS	0.13	(0.12; 0.14)	1	0.83	(0.76; 0.87)	1
1/3 NI + FS	2.45	(2.41; 2.48)	18	11.66	(11.58; 11.95)	14
GT + FS	2.17	(2.15; 2.21)	16	10.00	(9.94; 10.27)	12
AL + FS	0.27	(0.25; 0.27)	2	1.66	(1.58; 1.72)	2
FV + FS	0	(0.00; 0.00)	0	0	(0.00; 0.00)	0
Only FS	0.13	(0.12; 0.14)	1	0.83	(0.80; 0.90)	1
Beverages consumption, % (95% C.I.), n						
Level I	9.80	(9.72; 9.85)	72	30.00	(29.72; 30.25)	36
Level II	1.22	(1.19; 1.24)	9	2.50	(2.38; 2.55)	3
Level III	0.54	(0.54; 0.57)	4	1.66	(1.52; 1.66)	2
Level IV	0	(0.00; 0.00)	0	0	(0.00; 0.00)	0
Level V	58.44	(58.31; 58.53)	429	91.66	(91.54; 91.85)	110
Level VI	16.07	(15.99; 16.16)	118	60.00	(59.89; 60.45)	72

Data are percentages (95% Confidence Interval), absolute number. NI, Nutritional Indications; GT, Grains and Tubers; AL, Animal Source Food and Legumes; FV, Fruit and Vegetables; FS, Fats and Sweets.

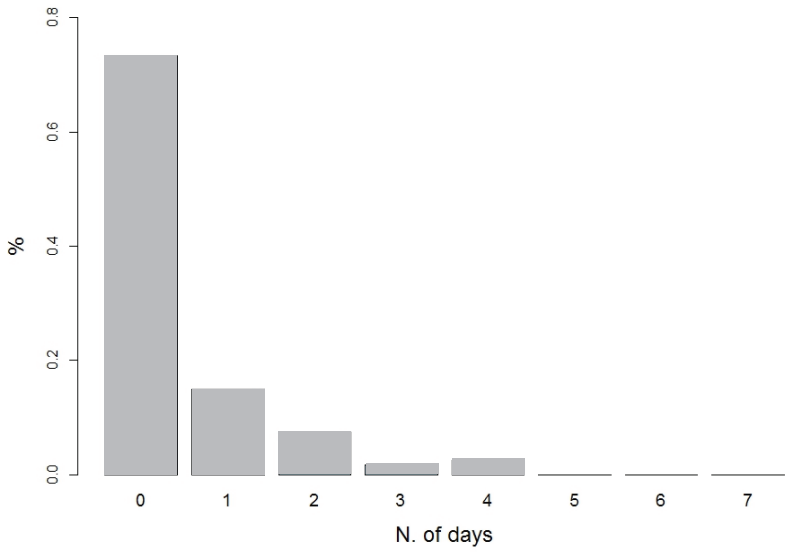

FIGURE 1. Number of days in which children follow NI

groups combination was legumes and animal source food + fruits and vegetables (1.08%, 1.07; 1.12 95% C.I.). When breakfast composition included only one of the recommended food groups, the less represented food group was fruits and vegetables (1.08%, 1.04; 1.09 95% C.I.).

Regarding the classification of beverages consumption, the most represented were: Level 5 (58.44%, 58.31; 58.53 95% C.I.), this is because children took whole milk more often than skim or low fat (1%) milk (Level 2), and Level 6 (16.07%, 15.99; 16.16 95% C.I.), because of the consumption of soft drinks and atole.

Table 2 and Table 3 show respectively socio-economic characteristics of children and their mother's attitude towards breakfast: there were no significant differences between compliant and noncompliant children.

Table 4 shows the characteristics of breakfast

TABLE 2. Socio-economical characteristics of children and their mothers according to children's compliance with NI. Data are percentages (absolute number).

	Compliant children (n=32)	Noncompliant children (n=88)	p-value
Children			
Age, % (n)			
3-6	44 (14)	31 (27)	0.546
7-9	19 (6)	27 (24)	
10-12	19 (6)	24 (21)	
13-14	19 (6)	18 (16)	
Mother			
Age, % (n)			
>35	59 (19)	51 (45)	0.424
<35	41 (13)	49 (43)	
Education level, % (n)			
medium-high	66 (21)	52 (46)	0.193
low	34 (11)	48 (42)	
Working status, % (n)			
worker	44 (14)	36 (32)	0.462
homemaker	56 (18)	64 (56)	
House old size, % (n)			
≤3	9 (3)	19 (17)	0.196
>3	91 (29)	81 (71)	

TABLE 3. Mother's attitude towards breakfast according to children's compliance with NI

		Compliant children (n=32)	Noncompliant children (n=88)	p-value
Breakfast is the most important meal of the day, especially for children, % (n)	Disagree Agree	28 (9) 72 (23)	22 (19) 78 (69)	0.454
In the morning, children usually don't want to have breakfast because they aren't hungry, % (n)	Disagree Agree	47 (15) 53 (17)	35 (31) 65 (57)	0.246
I would like to talk to my children during breakfast. I really want to see them happy at breakfast, % (n)	Disagree Agree	19 (6) 81 (32)	19 (17) 81 (71)	0.944
My children have hard time getting up in the morning: it's only after breakfast that they really wake up, % (n)	Disagree Agree	41 (13) 59 (19)	44 (39) 56 (49)	0.718
Weekday mornings are busy, so I'm looking for quick solutions for breakfast, % (n)	Disagree Agree	72 (23) 28 (9)	58 (51) 42 (37)	0.165
At breakfast I have trouble with my children: they want to decide what to have for breakfast and I want they have a balanced breakfast, % (n)	Disagree Agree	28 (9) 72 (23)	40 (35) 60 (53)	0.242
For breakfast, I look for food that helps my children to be ready for the day, % (n)	Disagree Agree	59 (19) 41 (13)	56 (49) 44 (39)	0.718
For breakfast, I look for food that is high in energy, % (n)	Disagree Agree	56 (18) 44 (14)	47 (41) 53 (47)	0.349
For breakfast I look for food that is delicious and make my children happy, % (n)	Disagree Agree	56 (18) 44 (14)	44 (39) 56 (49)	0.247
For breakfast I look for food that is both healthy and nutritious, % (n)	Disagree Agree	47 (15) 53 (17)	31 (27) 69 (61)	0.1
For breakfast I look for food that make me sure that my children will eat enough, % (n)	Disagree Agree	66 (21) 34 (11)	57 (50) 43 (38)	0.385
In the morning children need food that is high in energy in order to do all their physical activities: playing, jumping, playing sports, % (n)	Disagree Agree	62 (20) 38 (12)	51 (45) 49 (43)	0.269
In the morning children need food that is high in energy in order to do all their mental activities: learning, studying, % (n)	Disagree Agree	44 (14) 56 (18)	56 (49) 44 (39)	0.247
Breakfast would not be the same every day: I always look for new food types, % (n)	Disagree Agree	56 (18) 44 (14)	45 (40) 55 (48)	0.295
Breakfast affects the mood of the day: I want to be sure that my children leave home happy after a balanced breakfast, % (n)	Disagree Agree	53 (17) 47 (15)	43 (38) 57 (50)	0.334
Giving an healthy breakfast to my children helps to protect them against the flu, % (n)	Disagree Agree	53 (17) 47 (15)	43 (38) 57 (50)	0.334
Breakfast is important because, after spending hours without eating, children should eat enough to be ready for the day, % (n)	Disagree Agree	31 (10) 69 (22)	41 (36) 59 (52)	0.336

records which followed and didn't follow NI: children who had breakfast with family members are more likely to follow NI than children who had breakfast alone or with others (p-value 0.007).

TABLE 4. Characteristics of breakfast records according to compliance with NI

	Breakfast records followed NI (n=54)	Breakfast records didn't follow NI (n=680)	p-value
Where, % (n)			
at home	83 (45)	88 (600)	0.288
out of home	17 (9)	12 (80)	
With whom, % (n)			
alone	9 (5)	29 (196)	0.007
with family members	70 (38)	53 (363)	
with others	20 (11)	18 (121)	
Duration, % (n)			
<20 minutes	56 (30)	68 (464)	0.056
>20 minutes	44 (24)	32 (216)	
Distractions, % (n)			
no	30 (16)	30 (175)	0.53
yes	70 (38)	74 (505)	

DISCUSSION

This analysis of what children had for breakfast was conducted on a sample of 120 male Mexican children and aimed to investigate if children meet the NI for breakfast provided by the "Estrategia contra el sobrepeso en la obesidad". Only 32 children followed NI at least once a week. Similar results were obtained from other studies (16, 17) demonstrating that children and adolescents did not follow the nutritional indication for breakfast. In addition to breakfast, other studies (18, 19) evaluated if children meet daily recommended food groups intake (referring not only to breakfast consumption), showing a poor compliance. Despite the fact that we did not consider the nutrient intake but only the food group consumption and little differences in the recommendation used for the analysis of compliance, these studies, consistently with ours, reveal a low intake of fruits and vegetables compared to other food groups.

Another study (20) evaluates the impact of school action program of the "Estrategia contra el sobrepeso en la obesidad" (for the 2011-2012 academic year) on eating pattern of Mexican children, especially on school lunch. Consistently with our results, it demonstrated that the majority of lunch packages of primary schoolchildren do not follow national recommendation. Additionally, the amount of lunch packs not following guidelines further increase when the recommendations include water. Also in our study, the analysis of beverages consumption shows a low intake of water (Level 1). We found a high intake of whole milk (Level 5, which is recommended for children under 2 years of age or for children who live in geographical area with a high prevalence of malnutrition) and of beverages high in sugar and with low nutritional value, especially soft drinks (Level 6). Our findings are consistent with the results of other studies on Mexican children's beverages consumption (21, 22), showing a high intake of caloric beverages (especially whole milk and soft drinks) and on US children (23) (particularly referring to a higher consumption of whole milk compared to skim ones).

Differently from other studies that evaluate if children meet breakfast guidelines, we found out no significant association with socio-economic characteristics and mother's attitude towards

breakfast. Thus probably because most of compliant children meet NI only once a week and in any case nobody meet NI throughout the week, consequently there is no significant difference between compliant and noncompliant children by both socio-economic characteristics and mother's attitude towards breakfast. Particularly the assessment of beliefs on breakfast showed how mothers' attitude of compliant and noncompliant children were similar to each other and how they both not were fully aware on the importance of breakfast: despite they both thought that breakfast is the most important meal of the day, they did not express complete agreement regard the fact that children should have a balanced breakfast which helps to make them ready for the day and to do all their physical and mental activities.

Regarding breakfast records' characteristics, we showed that children are more likely to meet NI when they have breakfast with family members, consistently with other studies which demonstrated that children who have meals with parents present significant better dietary habits (24).

CONCLUSIONS

Our study investigated if children meet NI for breakfast provided by the "Estrategia contra el sobrepeso en la obesidad". We found out that only 32 children meet NI at least once a week and most of compliant children follow NI only once a week. Additionally, we showed a low intake of fruit and vegetables and water and a high intake of caloric beverages (whole milk and soft drinks). Further studies are needed to evaluate the long-term impact of the program on Mexican children's eating patterns.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Eating patterns in Mexico and obesity in children: Results from the NutriRun project

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SUMMARY: This study aims to compare obesity rates, physical activity levels and compliance with Nutritional Indications (NI), provided by the *Estrategia contra el sobrepeso y la obesidad*, between three consecutive years (2011, 2012, 2013) in children enrolled in the NutriRun project. Data were collected during the race *Carrera Kinder Generación en Movimiento* held in Mexico City in 2011, 2012 and 2013. A medical-dietetic questionnaire was administered to parents, investigating what kind of food their children usually had for breakfast, lunch and dinner, physical activity levels and family medical history. Children were weighed and measured and BMI was calculated. In order to evaluate compliance with NI, food reported in the medical-dietetic questionnaire for breakfast and dinner was classified in four main food groups and in other four main food categories for lunch, according to NI. The analysis of overweight/obesity in 2011, 2012 and 2013 revealed a significant reduction (p-value 0.001) of children overweight/obese and an increase of normal weight ones. However, in all the three considered years, they were found to not follow NI because of a poor consumption of fruits and vegetables and of salad. Therefore, further health care policies promoting fruits and vegetables consumption among Mexican families are needed.

Key words: Children, Mexico, meals, nutritional indications, NutriRun project.

RESUMEN. El modelo de alimentación en Mexico y la obesidad en los niños. Resultados del proyecto NutriRun. Este estudio tiene como objetivo comparar las tasas de obesidad, los niveles de actividad física y el cumplimiento de las Indicaciones Nutricionales (IN), proporcionada por la *Estrategia contra el sobrepeso y la obesidad*, entre los tres años consecutivos (2011, 2012, 2013) en los niños que participaron en el proyecto NutriRun. Los datos fueron recolectados durante la carrera *Kinder Generación en Movimiento*, celebrada en la Ciudad de México en 2011, 2012 y 2013. Un cuestionario médico-dietético se administró a los padres, investigando qué tipo de alimentos por lo general tenían sus hijos para el desayuno, el almuerzo y la cena, los niveles de actividad física y el historial médico de la familia. Los niños fueron pesados y medidos y se calculó el IMC. Con el fin de evaluar el cumplimiento de las NI, la comida reportada en el cuestionario médico-dietético se clasificó, para el desayuno y la cena, en cuatro grupos de alimentos principales y en otros cuatro principales categorías de alimentos para el almuerzo, de acuerdo con las NI. El análisis de las tendencias de sobrepeso/obesidad en 2011, 2012 y 2013 demostró una reducción significativa (p-valor de 0,001) de los niños obesos/sobrepeso y un aumento de peso normal. Sin embargo, en los tres años considerados, se encontró que los niños no siguen las IN, debido a un pobre consumo de frutas y verduras y de la ensalada. Por lo tanto se necesitan nuevas políticas de atención a la salud que promuevan el consumo de frutas y verduras entre las familias mexicanas.

Palabras clave: Niños, México, comidas, indicaciones nutricionales, proyecto NutriRun.

INTRODUCTION

In recent years, several health policies have been carried out, at both international and national levels, in order to face with obesity epidemic, especially among children. Obesity in children represents a severe health burden, this is because it could lead to early metabolic (increased insulin resistance) (1) and cardiovascular (increased of intima-media thickness and of blood pressure) (2) impairments, resulting in high risk of developing

cardiovascular (hypertension, coronary heart disease, stroke) (2) and metabolic (type 2 diabetes) (1) diseases in adulthood. Mexico is reported to be one of the world's countries with the highest obesity rate. Among children, the ENSANUT survey (3) shows that 37% of kids were overweight or obese in 2012. The dramatic high prevalence of obesity is mostly related to sedentary behaviours and unhealthy food habits. It has been demonstrated that Mexican schoolchildren report a low consumption of fruit and vegetables and a high consumption of soft drinks and food (snacks particularly) high in fat (4). Additionally, recent studies on Mexican children beverages consumption have shown great consumption of high caloric beverages (e.g. soft drinks and whole milk) (5), demonstrating that beverages intake among Mexicans constitutes the daily main caloric source (6). Regarding physical activity, a longitudinal study following a cohort of Mexican children from kindergarten to primary school has demonstrated an increase of sedentary behaviours corresponding to the start of the school (7). Low levels of physical activities and high consumption of food and beverages high in fats and sugars contribute to obesity epidemic among Mexican children. Given these concerning data, also Mexican government is working to implement public health policies promoting healthy lifestyles and nutrition in order to improve obesity burden. The Estrategia contra el sobrepeso y la obesidad (8) is a program (started on 2010-2011 academic year) that aims to promote physical activity and healthy nutrition among schoolchildren. In order to implement the project, educational interventions are carried out also towards families to promote healthy habits outside school. Vargas et al (9) have evaluated the impact of this strategy on children dietary patterns, demonstrating that schoolchildren lunch packs don't follow Nutritional Indications (NI) provided by the Estrategia contra el sobrepeso y la obesidad (8) and that the amount of inadequate lunch packs increases dramatically when water is included in the NI. However, to our knowledge, no studies evaluate the impact of the strategy on trends of physical activities and dietary habits (in terms of compliance with NI) in the years after the start of this program.

The aim of our study is to compare obesity rates, physical activity levels and compliance with NI (at breakfast, lunch and dinner) between three consecutive years (2011, 2012 and 2013) in children participating to a yearly sporting event held in Mexico City: the Carrera Kinder Generación en Movimiento.

MATERIALS AND METHODS

The NutriRun is an International study started on 2011 aimed to assess behaviours and eating habits of families in order to evaluate the impact of lifestyle choices on children's health status, particularly on the risk of developing nutrition-related diseases, such as obesity and diabetes. Data were collected during the race Carrera Kinder Generación en Movimiento. This race was held every April from 2011 to 2013 in Mexico City. This initiative intended to promote family integration and physical activity, as a healthy and fun activity, at early age among Mexican families. Children and one of their parents run together on one of the three proposed distances (1, 2 and 4 kilometers) depending on children's age. It was open to children over 5 years and, after the race, participants, as well as spectators (or non-participants), were invited to participate, voluntarily, to different laboratories promoting healthy lifestyles. One of these activities consisted on nutritional consultation: it took about 15-20 minutes and parents, with their children, were also asked to answer a medical-dietetic questionnaire. Finally, certified nutritionists took children's anthropometric measurements.

Medical-dietetic questionnaire

The medical-dietetic questionnaire consisted of three main parts. The first was represented by questions on children and family's medical history. It was evaluated if the child suffered from

chronic diseases and if the kid recently suffered from gastrointestinal diseases (e.g. nausea, vomiting, diarrhea). Additionally, it was assessed if family members suffered from chronic disease, especially from metabolic ones (e.g. diabetes and dyslpidemia). The second part regarded the assessment of children's eating habits. Parents were asked on their son/daughter number of meals per day, favourite and hated foods, food allergies. They were also asked to report what the child usually had for breakfast, lunch, dinner and snacks. Finally, children's physical activity was evaluated (parents were asked if their children did physical activity, what type, how often).

Anthropometric measurements

Anthropometric measurements (height and weight) were carried out by certified nutritionists. The scale used to weight the children was TANITA BC-533. The scale was placed on a flat, horizontal, solid surface. Children were placed in a central and symmetrical position on the scale platform with the palms of hands extended laterally. They were told to stay still for a moment to avoid oscillations in the weight reading. The stadiometer used to measure children's height was a floor based one, SECA model 213. It was placed on a flat, horizontal, solid surface, forming a 90º angle with the floor surface. It was checked that the midline of the child body matched the midline of the stadiometer. The arms were hanging freely and naturally throughout the body. The nutritionist being in front of children, placed both hands on the lower border of the mandible, exerting a minimum traction upward, as wanted to stretch the neck to guide the head to the Frankfort plane. Then the nutritionist lowered the squad of the stadiometer until it rested on the head of the children and performed the reading. Anthropometric measures were performed with children wearing light clothes and without shoes.

Body Mass Index (BMI) was calculated as weight (kg) divided by height (m) squared. Children were considered to be overweight/obese with a BMI ≥85th and underweight with a BMI <5th, according to CDC growth standards (10).

Compliance with Nutritional Indications (NI)

The aim of our study was to assess trends of Mexican children's food patterns (in terms of compliance with NI) at breakfast, lunch and dinner in three consecutive years (2011, 2012 and 2013). We considered the NI provided by the Estrategia contra el sobrepeso y la obesidad (8). This program was started on 2010-2011 academic year and aimed to promote healthy eating habits and lifestyles towards Mexican families in order to face with obesity epidemic among Mexican population. These NI are based on El Plato del Bien Comer (established from the official Mexican norm NOM 043-SSA2-2005 (11)). It provides a graphical representation of the three main food groups (grains and tubers, animal source food and legumes, fruits and vegetables) and recommends in what proportion should take them.

The Estrategia contra el sobrepeso y la obesidad (8) suggests that children, at breakfast and dinner, should take one food from every food group. Regarding lunch, the program suggests that children should take soup (made of vegetables or legumes or grains), salad and a main dish (consisting on a stew made of vegetables or grains or animal source food with beans or rice).

In order to evaluate compliance with NI (at breakfast and dinner) from 2011 to 2013, food reported in the questionnaires was classified in the three main food groups (grains and tubers, animal source food and legumes, fruit and vegetables). A further food group (represented by fats and sweets) was considered in order to classify all foods reported in the questionnaires. Children were considered compliant with NI if they had one food from every recommended food group, while they were considered not compliant if they had only two or one food from the recommended

food groups or if they combined food from the suggested food groups with fats and sweets (which were not recommended from the program).

Regarding lunch, food was classified in three main categories (corresponding to those recommended from the NI): soup, salad and main dish. Also for lunch, fats and sweets group was included to provide a complete classification of food reported in the questionnaires. Similarly to breakfast and dinner, children were considered compliant with NI if they had all the three food categories, while they were considered not compliant if they had only two or one food categories or if they ate food from the fats and sweets group.

Statistical analyses

Descriptive statistics was reported using percentages (absolute numbers) for categorical variables and median (I and III quartiles) for continuous ones.

Kruskal-Wallis test (a non-parametric test, similar to parametric One Way ANOVA test for independent samples) has been calculated for continuous variables. Pearson chi-square test was performed for categorical variables.

Statistical analyses were performed using R system (12) and hmisc package (13).

RESULTS

Children's characteristics, by year of participation to Carrera Kinder Generación en Movimiento, are provided in Table 1. The median age of children in the three years is 8 years old and they are equally distributed among boys and girls. Regarding BMI assessment, we found out significant differences (p-value <0.001) from

TABLE 1. Sample characteristics according to Nutrirun year. Data are percentages (absolute number) for categorical variables and median [I and III quartiles] for continuous variables.

	n	2011	2012	2013	p-value
Age	1081	8 [6; 10]	8 [5; 10]	8 [5; 10]	0.598
Gender, Male	1081	52 (154)	53 (194)	50 (209)	0.655
BMI	1074	16.9 [15.1; 19.4]	17 [15.4; 19.4]	16.8 [15.3; 19.5]	0.638
BMI assessment					
Underweight	1077	13 (39)	7 (26)	5 (20)	<0.001
Normal weight		58 (173)	72 (263)	74 (307)	
Overweight/Obese		28 (84)	21 (75)	22 (90)	
Phisical activity					
Children who did physical activity	1021	80 (239)	71 (259)	71 (297)	<0.001
1st physical activity frequency (n/week), ≤3	947	84 (250)	80 (291)	84 (239)	0.298
2nd physical activity frequency (n/week), ≤3	752	94 (280)	96 (348)	94 (84)	0.53
Eating habits					
N of meal per day, ≤3	930	27 (59)	25 (85)	27 (101)	0.878
Snacking	785	83 (125)	89 (238)	84 (310)	0.142

2011 to 2013: the amount of underweight and overweight/obese children decreased, while the number of normal weight children increased (58% in 2011, 72% in 2012 and 74% in 2013). No significant differences were reported concerning eating habits (for both number of meals per day and snacking). Referring to physical activity, despite the fact that most of children did it (that's probably related to the fact that data were collected during a sporting event and participants probably were more likely to be sporty), the amount of children who did physical activity significantly decreased (p-value <0.001) from 2011 to 2013 (80% in 2011, 71% in 2012 and 71% in 2013).

The analysis of compliance with NI at breakfast (Table 2) showed that only a few children were compliant and the poor compliance is related to a low consumption of fruit and vegetables. The majority of children had only two recommended foods (40% in 2011, 44% in 2012 and 46% in 2013 and most of them ate grains/tubers combined with animal source food) or one recommended food (21% in 2011, 22% in 2012, 20% in 2013 and most of them ate only animal source food). The high consumption of animal source food, especially combined with grains and tubers, was related to the fact that the majority of children drunk milk and ate cereal at breakfast but did not eat fruits and vegetables. Comparing the three years we found out no significant differences except to children who were compliant (p-value 0.048): the amount of children who were compliant was lower in 2012 compared to the other two years.

Regarding lunch, we found out that most of children ate food from two recommended food categories, followed by those who were compliant and finally by children who ate food from only a food category (the amount of children who combined the recommended food categories with fats and sweets was negligible). Analysing compliance with NI at lunch, we reported significant differences between the three years among compliant children (p-value 0.031) and among children who ate two foods from the suggested food categories (p-value 0.026). Particularly we showed that, from 2011 to 2013, the amount of compliant children decreased (25% in 2011, 20% in 2012 and 17% in 2013), while the number of children who ate only two foods from the recommended food categories increased (42% in 2011, 47% in 2012

TABLE 2. Breakfast consumption according to Nutrirun year. Data are percentages (absolute number).

	2011 (n=299)	2012 (n=364)	2013 (n=418)	p-value
3/3	15 (44)	9 (34)	15 (61)	0.048
2/3	40 (121)	44 (160)	46 (194)	0.287
AL+FV	8 (24)	6 (22)	8 (35)	0.429
GT+FV	3 (9)	3 (11)	1 (4)	0.082
GT+AL	29 (88)	35 (127)	37 (155)	0.098
1/3	21 (63)	22 (80)	20 (85)	0.854
AL	13 (39)	15 (53)	13 (55)	0.805
GT	6 (18)	5 (20)	6 (24)	0.959
FV	2 (6)	2 (7)	1 (6)	0.812
3/3+FS	3 (9)	1 (5)	1 (6)	0.126
2/3+FS	15 (46)	12 (44)	14 (59)	0.457
AL+FV+FS	8 (24)	6 (22)	8 (35)	0.429
GT+FV+FS	1 (2)	0 (1)	0 (1)	0.604
GT+AL+FS	7 (20)	6 (21)	6 (23)	0.793
1/3	5 (16)	4 (16)	4 (16)	0.62
AL+FS	4 (12)	3 (12)	3 (12)	0.586
GT+FS	1 (3)	1 (3)	1 (5)	0.875
FV+FS	0 (1)	0 (1)	0 (0)	0.523

GT= Grains & Tubers; AL= Animal source food & Legumes;
FV= Fruits & Vegetables; FS= Fats & Sweets

TABLE 3. Lunch consumption according to Nutrirun year. Data are percentages (absolute number)

	2011 (n=299)	2012 (n=364)	2013 (n=418)	p-value
3/3	25 (74)	20 (74)	17 (70)	0.031
2/3	42 (127)	47 (172)	53 (220)	0.026
Soup+Salad	2 (6)	1 (2)	2 (8)	0.195
Main Dish+Salad	11 (33)	13 (46)	9 (38)	0.279
Main Dish+Soup	29 (88)	34 (124)	42 (174)	0.003
1/3	16 (47)	14 (52)	15 (63)	0.874
Soup	7 (20)	2 (8)	3 (12)	0.005
Main Dish	8 (24)	11 (40)	3 (12)	0.005
Salad	1 (3)	1 (4)	1 (4)	0.98
3/3+FS	3 (8)	2 (8)	3 (11)	0.903
2/3+FS	8 (23)	7 (26)	10 (41)	0.363
Salad+Soup+FS	2 (6)	1 (2)	2 (8)	0.195
Main Dish+Salad+FS	0 (1)	1 (2)	1 (4)	0.568
Main Dish+Soup+FS	5 (16)	6 (22)	7 (29)	0.678
1/3	2 (5)	2 (9)	1 (6)	0.542
Soup+FS	1 (3)	1 (2)	0 (2)	0.661
Main Dish+FS	1 (2)	1 (2)	0 (2)	0.454
Salad+FS	0 (0)	0 (1)	0 (0)	0.373

FS= Fats and Sweets; Main Dish=stew (made of vegetables, meet or cereal) + rice or beans

TABLE 4. Dinner consumption according to Nutrirun year. Data are percentages (absolute number).

	2011 (n=299)	2012 (n=364)	2013 (n=418)	p-value
3/3	5 (15)	3 (12)	4 (15)	0.482
2/3	50 (149)	49 (180)	56 (234)	0.125
AL+FV	0 (0)	2 (8)	1 (4)	0.025
GT+FV	1 (4)	1 (3)	2 (7)	0.575
GT+AL	48 (145)	46 (169)	53 (223)	0.138
1/3	23 (69)	26 (95)	20 (82)	0.097
AL	10 (29)	14 (50)	13 (53)	0.268
GT	12 (36)	11 (39)	6 (27)	0.025
FV	1 (4)	2 (6)	0 (2)	0.27
3/3+FS	2 (5)	0 (1)	0 (1)	0.034
2/3+FS	11 (32)	11 (40)	9 (37)	0.561
AL+FV+FS	0 (0)	2 (8)	1 (4)	0.025
GT+FV+FS	0 (0)	0 (1)	0 (1)	0.677
GT+AL+FS	11 (32)	9 (31)	8 (32)	0.355
1/3	2 (6)	3 (11)	2 (10)	0.696
AL+FS	1 (4)	1 (4)	2 (9)	0.462
GT+FS	1 (2)	2 (6)	0 (1)	0.09
FV+FS	0 (0)	0 (1)	0 (0)	0.373

GT= Grains & Tubers; AL= Animal source food & Legumes;
FV= Fruits & Vegetables; FS= Fats & Sweets

and 53% in 2013). Among these children, most of them ate only the main dish and the soup, without the salad. Among children who had only one food from the three suggested food categories, they ate most often the main dish or the soup. Also for lunch most of children did not follow NI and, as for breakfast, this is related to a low consumption of vegetables (salad in this case).

Similarly to breakfast, also at dinner, only a few children were compliant with NI (5% in 2011, 3% in 2012 and 4% in 2013). About a half of children (50% in 2011, 49% in 2012 and 56% in 2013) had only two food from the three recommended food groups (and most of them ate animal source food/legumes combined with grains/tubers), followed by those (23% in 2011, 26% in 2012 and 20% in 2013) who ate food from only one food group, especially grains/tubers or animal source food/legumes. Consistently with the other two meal occasions, at dinner most of children were not compliant with NI due to a poor fruits and vegetables consumption.

DISCUSSION

The aim of our study was to compare, between three consecutive years (2011, 2012 and 2013), trends of overweight/obesity rates, physical activity and food habits (in terms of compliance with NI provided by Estrategia contra el sobrepeso y la obesidad (8)) among Mexican children.

Rates of overweight/obese children were lower in all the three years compared to those reported for Mexican children general population from the 2012 ENSANUT survey (3). Analysing physical activity levels, we found out that the amount of children who did physical activity was higher than those reported by the ENSANUT study (3). These observations could be related to the fact that the sample of children considered in this study was enrolled during a sporting event (Carrera Kinder Generación en Movimiento) and participants probably were more likely to lead an active life with resulting lower levels of overweight/obesity compared to general population. Additionally, probably participants, due to the nature of the event in which they were enrolled (a sporting one), were more likely to declare higher levels of physical activity compared to the amount of weekly physical activity they really did.

Regarding the analysis of overweight/obesity towards 2011, 2012 and 2013, we demonstrated a significant reduction of children overweight/obese and an increase of normal weight children. However, despite the fact that the enrolled children showed: a significant reduction of overweight/obesity rates among the three considered years, higher levels of physical activity and lower prevalence of overweight/obesity compared with Mexican children general population, they did not follow NI because of a low consumption of fruits and vegetables. Dramatically, these findings are similar to those reported from 1996-1997 survey on Mexican children dietary patterns, demonstrating a lower consumption of fruit and vegetables than those recommended (4). Our results are consistent also with those reported from Vargas and colleagues (9), evaluating the short term impact of the Estrategia contra el sobrepeso y la obesidad on lunch packs of Mexican schoolchildren, they found out that almost all lunch packs did not meet NI. The comparison of our findings with those of international studies showed similar results, despite difficulties related to a great heterogeneity of methods employed to assess dietary patterns (food consumption expressed as servings or weight, usage of different classification systems, depending on national guidelines). As in our study, the analyses of NHANES data (2007-2010) on U.S. children's food patterns, showed that 60% and 93% of children reported lower consumption of fruits and vegetables, respectively, than those recommended from the United States Department of Agriculture (USDA) (14). Additionally, specifically analysing fruit and vegetables consumption from 2003 to 2010 in children enrolled in NHANES survey, Kim and colleagues (15) showed an increase of whole fruit consumption but no changes in vegetables intake and reported that no children, except to those from 2 to 5 years old, were compliant with recommendations for fruits and vegetable of the Healthy People 2020 program.

The low consumption of fruits and vegetables is concerning because several studies (16-21) provided evidence of better health status thanks to fruits and vegetables intake (22). First of all, they are a source of many nutrients (especially vitamins, minerals and antioxidants). It has also been demonstrated that fruits and vegetables consumption is associated to a reduced risk of cancer (16, 20) and of cardiovascular diseases (17, 19). Additionally, given the high content of water and fibres promoting satiety, fruits and vegetables are demonstrated to be effective in determining weight loss and preventing obesity (18, 21). Therefore, it's crucial to implement new public health policies among Mexican families that promote especially fruits and vegetables

consumption in order to improve children's dietary patterns.

CONCLUSIONS

Despite the fact that enrolled children showed a reduction of overweight/obesity rates in the three consecutive years and higher levels of physical activity than those of Mexican children general population, they did not follow NI provided by the Estrategia contra el sobrepeso y la obesidad because of a poor consumption of fruit and vegetables. Further health care policies promoting food and vegetables intake are needed given the strictly association between the consumption of these food types and better health status.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Predictors of water intake among Mexican children and adolescents

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SUMMARY: Patterns of water consumption among children and adolescents are not widely analyzed. The aim of the study is to assess predictors (including dietary habits, anthropometric and physical activity frequency) of water consumption in Mexican children and adolescents. The NutriRun is an International study started in 2011. Subjects' anthropometrics, health status and behaviours were assessed during the race Carrera Kinder Generación en Movimiento, which has taken place in Mexico City every April between 2011 and 2013. The analysis of factors associated with water consumption showed that, age (p-value 0.025), male gender (p-vale 0.011), to be overweight/obese (p-value 0.013) and beverages consumption (p-value 0.014) were significant predictors of water intake. Particularly, age, male gender and weight status were found to be in a positive relationship with water intake, while a higher level of beverages consumption was a predictor of lower levels of water intake. These findings might be taken into account in the development of public health policies targeting on increasing water consumption (which has been demonstrated to have beneficial effects on health) among kids and their families.

Key words: Children, obesity, water consumption.

RESUMEN. Los predictores de la ingesta de agua entre los niños y adolescentes mexicanos. Los patrones de consumo de agua entre los niños y adolescentes no se han analizado ampliamente. El objetivo del estudio consiste en evaluar las tendencias y los factores predictivos (incluyendo hábitos dietéticos, antropométricos y frecuencia de la actividad física) de consumo de agua en niños y adolescentes mexicanos. El Nutri Run es un estudio internacional iniciado en 2011. La antropometría, el estado de salud y el comportamientos, fueron evaluados durante la Carrera Kinder Generación en Movimiento, que ha tenido lugar en la Ciudad de México cada mes de abril entre 2011 y 2013. El análisis de los factores asociados con el consumo de agua mostró que la edad (p-valor de 0,025), el sexo masculino (p-valor de 0,011), para estar en sobrepeso/obeso (p-valor de 0,013) y consumo de bebidas (p-valor de 0,014) fueron predictores significativos de la ingesta de agua. En particular, se encontró que la edad, el sexo masculino y el peso estaba en una relación positiva con la ingesta de agua, mientras que un mayor nivel de consumo de bebidas estaba un predictor de los niveles más bajos de consumo de agua. Estos resultados podrían ser tenidos en cuenta en el desarrollo de políticas de salud pública dirigidas a aumentar el consumo de agua (que se ha demostrado que tienen efectos beneficiosos sobre la salud) entre los niños y sus familias.

Palabras clave: Niños, obesidad, consumo de agua.

INTRODUCTION

Water has beneficial effects on health, since it plays a crucial role for the maintenance of a proper fluid balance and for the control of body temperature (1). Dehydration has detrimental effects on health status, resulting in impaired physical and cognitive functions (it has been demonstrated that increased water consumption is associated with better cognitive performance in children and adolescents (2-4), constipation, headache (5), skin dryness, impairment of kidney and hemodynamic functions (particularly in the case of severe dehydration) (1). Additionally, it has been shown that water consumption influences dietary patterns: higher water consumption seems to be associated with reduced caloric intake (6, 7).

Despite the fact that water consumption is demonstrated to have beneficial effects, several stu-

dies (8-10) have shown that water intake, in children and adolescents, is inadequate (according to national and international recommendations). The National Health and Nutrition Examination Survey (NHANES) (8), examining the trend of beverages consumption in children between 4 and 13 years, showed that levels of water consumption were below the recommendations provided by the Institute of Medicine (IOM) (11). Consistently with the results provided from the analyses conducted on U.S. kids, the Mexican National Health and Nutrition Survey (NHNS) (9) demonstrated that water consumption also among Mexican children and adolescents (1-18 years of age) was below the Dietary Reference Intake (DRI) provided by IOM (11). Additionally, an analysis of drinking habits among Mexican children demonstrated that the beverages most frequently consumed were whole milk, sodas and fruit juices (10).

Analyzing trends and predictors of water consumption is crucial in order to identify modifiable factors influencing patterns of beverages consumption and developing public health policies targeted on these modifiable predictors, implementing water consumption in pediatric age. However, this field is not widely analyzed and only few studies have assessed the association between environmental, psychological and behavioral factors with levels of water consumption in children. The NHANES survey showed that predictors of water intake in children and adolescents differed by age group (12). An analysis conducted on adolescents living in Florida reported that low water intake was influenced by soft drinks and snacks consumption during TV watching (13). According with these findings, a study conducted on U.S. adolescents demonstrated that low levels of water consumption were associated with inadequate eating habits(14).

The aim of the study is to analyze predictors (including dietary habits, anthropometric and physical activity frequency) of water consumption in Mexican children and adolescents participating to a yearly sporting event held in Mexico City: the Carrera Kinder Generación en Movimiento.

MATERIALS AND METHODS

The NutriRun is an International study started in 2011. The aim of the study was to assess dietary habits and behaviours of Mexican children/adolescents (1-18 years of age) and their families, evaluating the effect of lifestyle on kids' health outcomes, referring, particularly, to the risk of developing obesity in paediatric age.

Subjects' anthropometrics, health status and behaviours were assessed during the race Carrera Kinder Generación en Movimiento. The race has taken place in Mexico City every April between 2011 and 2013. Children/adolescents and one of their parents run together on one of the three proposed distances (1, 2 and 4 kilometers), according to the age of participants. The event aimed to strength the relationships among family's members and to promote physical activity, as a healthy and fun activity, at early age among Mexican families. It was open to children over 5 years and, after the race, participants, as well as spectators (or non-participants), were invited to participate, voluntarily, to different laboratories promoting healthy lifestyles. One of these laboratories was represented by a nutritional consultation, during which parents were asked to complete a medical-dietetic questionnaire, while children/adolescents were weighed and measured.

Medical-dietetic questionnaire

The medical-dietetic questionnaire was built on 3 main sections aimed at evaluating participants' health status, dietary habits and physical activity.

At first, child/adolescent and family's medical history was assessed, asking particularly if the child/adolescent and someone of the family members (e.g. parents, siblings or grandparents) suffered of any chronic disease and if the child/adolescent has suffered recently from a gastrointestinal illness (nausea, vomiting, diarrhoea, lack of appetite).

The second section aimed at evaluating children and adolescents' dietary patterns (number of meals per day, number of glass of water per day, food allergies, hated and favourite food and snacking habits). Additionally, parents were asked to report what their son/daughter usually ate at mealtimes (breakfast, lunch, snack time and dinner).

In the third part, parents were asked if the child/adolescent did physical activity, what type, how often and how long.

Anthropometric measurements

Children/adolescents were weighed and measured by certified nutritionists. TANITA BC-533 was used to weight the children and the stadiometer employed to measure the height was a floor based one, SECA model 213.Both the scale and the stadiometer were placed on a flat, horizontal solid surface and the stadiometer was placed in order to form a 90° angle with the floor surface.

The weight was measured by placing the child/adolescent in a central and symmetrical position on the scale platform with the palms of hands extended laterally and he/she was asked to stay still in order to avoid oscillations in the weight reading.

Height's measurement was taken checking that the midline of the child/adolescent body matched the midline of the stadiometer. The arms were hanging freely and naturally throughout the body. The nutritionist being in front of the subject, placed both hands on the lower border of the mandible, exerting a minimum traction upward, as wanted to stretch the neck to guide the head to the Frankfort plane. Then the nutritionist lowered the squad of the stadiometer until it rested on the head of the subject and performed the reading. Anthropometric measures were performed with participants wearing light clothes and barefoot.

Body Mass Index (BMI) was calculated as weight (kg) divided by height (m) squared. Children/Adolescents were considered to be overweight/obese with a BMI ≥85th and underweight with a BMI <5th, according to CDC growth standards (15).

Dietary habits

In order to understand if dietary habits significantly influence water consumption, foods that children/adolescents were reported to eat at mealtimes (breakfast, lunch, dinner and snacking occasions) were grouped in four main categories: Fruits & Vegetables, Grains & Tubers, Animal Source Food & Legumes, Fats &Sweets.

The food grouping procedure was performed using the Sistema Mexicano de Alimentos Equivalentes (16). The classification depends on the main nutrients carried out by the food included in every group: Fruits & Vegetables provide vitamins and minerals; Grains & Tubers carry out carbohydrates and vitamins; Animal Source Food & Legumes bring proteins.

Once food was classified, the number of servings per day for each food group (Fruits & Vegetables, Grains & Tubers, Animal Source Food & Legumes, Fats & Sweets) was calculated.

Beverages were considered separately from food by identifying a separate group including all types of beverages (the, coffee, soft drinks, aguafresca, -both homemade and industrial, beverage made of water, fruits, sugars and sometimes grains-, licuados-a typical Mexican beverage made of fruit and milk, sometimes added with sugar, honey, oat or ice-) that children/adolescents had through the day, except to water. We considered the amount of beverages drunk per day.

Water consumption was reported as glasses of water per day, a glass corresponded to 240 ml of water.

Statistical Analysis

Continuous variables were expressed as median (I° and III° quartiles) and categorical variables were reported as percentages (absolute number). Fisher exact test and Chi-squared test were performed as appropriate.

To assess the impact of anthropometric, dietary habits and physical activity on water consumption, a multi-level model was estimated, considering the year in which data were collected as grouping variable. In order to take into account the fact that participants were of different age (from 1 to 18 years of age), corresponding to different needs of water intake (11), in the multilevel model, the age, categorized in classes (1-3; 4-8; 9-13; 14-18), was included on the slope, accounting for age heterogeneity.

Analyses were performed using R system (17) and rms(18), lme4 (19) packages.

RESULTS

Subjects enrolled in the study were 1081 (299 in 2011, 364 in 2012 and 418 in 2013). Demographic characteristics (age and gender) of participants were similar in the three considered years: the median age was 8 years old each year and gender was balanced. However, the weight status resulted to be significant different (p-value <0.001) between 2011, 2012 and 2013: in 2011 more children/adolescents were overweight/obese (28%), compared to the subsequent years (21% in 2012 and 22% in 2013), in which the proportion of normal-weights was higher than 2011 (58% in 2011, 72% in 2012 and 74% in 2013). Referring to dietary habits, no significant differences were found except to the daily number of servings of Fats & Sweets (p-value 0.022), of Grains & Tubers (p-value 0.043) and the number of glasses of water per day (p-value <0.001). In 2012 participants enrolled in the study ate more often food items from the Fats & Sweets group and drank less glasses of water compared to 2011 and 2013 (Table 1).

TABLE 1. Subject's characteristics according to NutriRun year. Continuous variables are median [I° and III° quartiles], categorical variables are percentages (absolute numbers).

	N	2011	2012	2013	p-value
Gender: Male	1081	52% (154)	53% (194)	50% (209)	0.655
Age	1081	8 [6; 10]	8 [5; 10]	8 [5; 10]	0.598
Weight status					
Underweight	1077	13% (39)	7% (26)	5% (20)	<0.001
Normal-weights		58% (173)	72% (263)	74% (307)	
Overweight/Obese		28% (84)	21% (75)	22% (90)	
Dietary habits					
N° of servings of Animal Source Food & Legumes per day	1081	4 [3; 5]	4 [3; 5]	4 [3; 5]	0.083
N° of servings of Grains & Tubers per day	1081	4 [3; 6]	4 [2; 5]	4 [3; 5]	0.043
N° of servings of Fats & Sweets per day	1081	1 [0; 1]	1 [0; 2]	0 [0; 1]	0.022
N° of servings of Fruits & Vegetables per day	1081	2 [1; 3]	2 [1; 3]	2 [1; 3]	0.515
N° of beverages per day (except to water)	1081	1.0 [0.0; 1.0]	1.0 [0.0; 1.0]	0.5 [0.0; 1.0]	0.189
Snacking: Yes	785	83% (125)	89% (238)	84% (310)	0.142
N° of glasses of water per day	946	4.00 [2.00; 5.00]	3.00 [2.00; 4.00]	4.00 [2.00; 4.75]	<0.001
Physical Activity: Yes	1021	80% (239)	71% (259)	71% (297)	<0.001

Since the need of water intake differs by age group (11), levels of water consumption in the 3 considered years were analyzed according to different age groups (Table 2). We found out that the levels of water consumption by age class were significantly different in 2011, 2012 and 2013, with pre-scholars (1-3 years of age) drinking significantly more water in 2013 compared to the previous 2 years and older children and adolescents drinking less glasses of water in 2012 compared to 2011 and 2013.

TABLE 2. Water intake (reported as glasses of water/day) in different age classes, according to NutriRun year. Data are median [I° and III° quartiles].

	2011	2012	2013	p-value
1-3	2.0 [1.0-4.0]	2.0 [1.0-3.0]	4.0 [3.0-4.0]	0.031
4-8	4 [2; 4]	3 [2; 4]	4 [2; 4]	0.049
9-13	6 [2; 6]	3 [2; 4]	4 [2; 5]	<0.001
14-18	5.50 [4.00-8.00]	2.00 [1.00; 3.75]	4.00 [3.00-5.00]	<0.001

The multi-level model (Table 3) showed that, among the considered factors, those that were significantly associated with water consumption were: age (p-value 0.025), male gender (p-vale 0.011), weight status (overweight/obese: p-value 0.013, normal-weights: p-value 0.043) and beverages consumption (p-value 0.014). Particularly, age, male gender and weight status were found to be in a positive relationship with water intake, while a higher level of beverages consumption was predictor of lower levels of water intake.

TABLE 3. Results of the multi-level model.

	Estimate	p-value
Gender: Male	0.361	0.011
Age	0.085	0.025
Normal-weights	0.582	0.043
Overweight/Obese	0.778	0.013
N° of servings of Animal Source Food & Legumes per day	0.010	0.819
N° of servings of Grains & Tubers per day	0.026	0.457
N° of servings of Fats & Sweets per day	-0.027	0.681
N° of servings of Fruits & Vegetables per day	0.061	0.243
N° of beverages per day (except to water)	-0.186	0.014
Snacking: Yes	-0.015	0.940
Physical Activity: Yes	0.186	0.290

DISCUSSION

The aim of our study was to assess trends and predictors of water consumption among Mexican children and adolescents, since this field has not been widely explored yet.

Participants were enrolled in 3 consecutive years (2011, 2012 and 2013), during a non competitive race that has taken place in Mexico City, and certified nutritionists assessed their health status, eating habits and behaviours.

Water consumption resulted to be significantly different in the 3 considered years, with children/adolescents enrolled in 2012 found to drink less glasses of water compared to 2011 and 2013. However, it's difficult to compare trends of water consumption between different studies, given different ways to express the amount of water drunk (in glass per days or per week, in ml per days or per week, water volume/kcal), differences in the age of the sample enrolled, differences in the definition of water

consumption (it could include only water or also water intake provided from food). Comparing our results with data from NAHNES (8) and NHNS (9) surveys (conducted, respectively, on U.S. and Mexican youths), children and adolescents enrolled in the present study seem to drink higher levels of water. This could be related to different characteristics of the participants included; since they were enrolled during a sporty event (consequently they could be more prone to adopt healthy behaviours). However, this could also be related to the fact that data were collected during the nutritional consultation and participants enrolled might tend to report higher levels of water consumption compared to the real ones (desirability bias).

Contributors of water consumption in children and adolescents are not widely analysed. The model estimation showed that few factors are significant predictors of levels of water intake (age, gender, weight status and beverages consumption). Age resulted to be positively associated with water consumption since children of higher age reported higher levels of water intake, according to the fact that hydration needing differs by age group and, particularly, increased with age (11). The fact that beverages consumption (the, coffee, soft drinks, aguafresca, licuados, milk and fruit juices) predicted lower water intake is consistent with previous studies: the National Youth Physical Activity and Nutrition Study (NYPANS) (14) demonstrated that, adolescents reporting inadequate eating habits were more likely to drink low levels of water; the Florida Youth Physical Activity and Nutrition Survey (YPANS) (13) showed that soft drinks and snack consumption during TV watching was a contributor of low water intake. Referring to the weight status, the present study found out that to be overweight/obese is a significant predictor of higher water consumption, this finding is consistent with the results of NYPANS, showing that obese youth had an OR of 0.7 for low water intake. This probably because, as it has been demonstrated by a recent literature review about the effect of water intake on weight status of children and adolescents (20), cross-sectional studies (as in that case) reported that obese subjects drink more water compared to normal-weights, even if longitudinal studies suggest that water consumption contributes to the reduction of body weight.

CONCLUSIONS

Weight status, beverages consumption, male gender and age were found to be significant contributors to the level of water intake in Mexican children and adolescents. In recent years, Mexican government has adopted (in order to reduce energy dense food intake, preventing overweight and obesity) strategies for reducing the consumption of soft drinks: raising prices (taxes policy) and regulating the distribution in schools. Still, one of the great challenges is to make drinkable water widely available, especially in public schools, and to reinforce water consumption at home. Our findings might be taken into account in the development of effective public health policies targeting on improving water consumption, which has been demonstrated to have beneficial effects on health, among kids and their families.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs “Programmi di alta rilevanza scientifica e tecnologica” Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Association between simple anthropometric measures in children of different ethnicities: results from the OBEY-AD study

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SUMMARY: Body mass index (BMI) is considered a good predictor of overall adiposity, with significant sensitivities in identifying overweight children. Recently, it has been suggested that other anthropometric measures may also be employed as adequate surrogates for imaging techniques and BMI. However, it is well known that differences exist in body fat distribution among different ethnicities. The present study aims at assessing the relationship between anthropometric measures in children from different geographical regions. The OBEY-AD is an international study enrolling 2720 children (3-11 years of age), balanced by gender. Children underwent anthropometric assessment. The association between these anthropometric measures was estimated using linear mixed models. South-American children had a higher BMI and waist and hip circumference compared to European and Indian ones. Conversely, Indian children were found to be taller and to have a higher waist-hip ratio than those of European and South-American kids, suggesting a different body composition of Indian children compared to those of the other ethnic groups. Overall, this data provides further evidence on the differences in anthropometric measures between the Indian, South American and European child populations.

Key words: Children, Body-Mass Index, Waist-Hip Ratio, Waist-to-Height Ratio, Ethnic Group.

RESUMEN. Relación entre las medidas antropométricas simples en niños de diferentes etnias: resultados del estudio OBEY-AD. El índice de masa corporal (IMC) es considerado un buen indicador de adiposidad general, con una capacidad significativa para la identificación de niños con sobrepeso. Recientemente, se ha sugerido que también es posible utilizar otras medidas antropométricas como sustitutos adecuados de las técnicas de diagnóstico por imagen y del IMC. Sin embargo, es bien sabido que existen diferencias en la distribución de la grasa corporal entre diferentes grupos étnicos. El objetivo del presente estudio es evaluar la relación entre las medidas antropométricas en niños de diferentes regiones geográficas. El OBEY-AD es un estudio internacional que incluyó a 2720 niños (de entre 3 y 11 años de edad), equilibrados por sexo. A los niños se les realizó una evaluación antropométrica. Se realizó la estimación de la asociación entre estas medidas antropométricas por medio de modelos lineales mixtos.
Los niños de América del Sur tuvieron valores más altos de IMC, circunferencia de cintura y cadera, en comparación con los resultados de los niños europeos e hindúes. Por el contrario, se encontró que los niños de la India tenían una mayor estatura y una relación cintura-cadera mayor que la de los niños europeos y sudamericanos, lo que sugiere la existencia de una composición corporal diferente en los niños hindúes respecto de los de los otros grupos étnicos. Este hallazgo fue confirmado asimismo en el modelo lineal. En general, estos datos proporcionan evidencia adicional sobre las diferencias en las medidas antropométricas entre la población infantil de la India, de América del Sur y de Europa.

Palabras clave: Niños; Índice de Masa Corporal; Relación cintura-cadera; Proporción cintura- talla; Grupo étnico.

INTRODUCTION

Childhood obesity is now an established pandemic in developed countries, with almost a quarter of children and adolescents being reported as obese in 2013(1). It is also a growing burden for newly industrialized countries as its incidence in these nations has been rising steadily since 1980(1). This is a highly concerning fact for fami-

lies and medical professionals around the world. Overweight children are prone to several metabolic and orthopedic disorders in childhood (2), and obesity in early life is associated with adverse cardiovascular risk factors and an increased prevalence of coronary artery disease in adulthood (1-3). Obesity has been reported also to have a severely detrimental effect on social interactions (4), as well as a negative impact on educational and financial achievements (5). Early clinical and behavioral interventions can prevent these complications, emphasizing the need for reliable measures to identify promptly affected individuals.

X-ray imaging techniques have been regarded generally as the most accurate measures of adiposity, and are often used as gold standard for fat mass assessment in research (6,7). For example, dual x-ray absorptiometry (DXA) is a reliable indicator of cardio-metabolic risk factors, such as visceral adipose tissue (8). Unfortunately, this technique is expensive, lengthy to carry out and impractical for routine clinical measurements.

Anthropometric measures are therefore more frequently used in the clinical setting. Body mass index (BMI) is generally regarded as a good predictor of overall adiposity (9), with significant sensitivities in identifying overweight children (6). Other measures, such as waist circumference, waist-to-height ratio and subscapular/triceps skinfolds, have also been shown to strongly correlate with DXA adiposity measurements (9-11), and have been proposed as adequate surrogates for imaging techniques and BMI.

Nevertheless, metabolism and body fat distributions vary between populations, so are these measures and their parameters applicable to all countries around the world? A number of studies have found positive and comparable associations between BMI, waist circumference and skinfolds in children from Western Europe (12-14), India (15, 16) and Brazil (17, 18). Research has also shown that, in certain populations, combinations of anthropometric measures can give a better overall picture of a child's weight status than individual parameters alone (17, 19). However, these associations are not universal. Reilly et al. found significant differences between the specificity and sensitivity of BMI and waist circumference measurements in British 9-10 year old (20). In two studies carried out in Brazil and the Netherlands, associations between BMI and skinfold were only found in individuals ranked at high percentiles (21, 22), while in other countries they were identified at all risk levels. Finally, Panjikkaran et al. stated that BMI and waist-to-height ratio were the most accurate combinations for Indian schoolchildren (23), while Hubert reported that waist circumference and BMI were consistently better in French youth (12).

It is therefore clear that differences exist in the association between anthropometric measures in different countries. Some measures, such as waist-hip ratio, have also been neglected in research, and there is a lack of data for certain measures due to their reduced clinical use in different healthcare systems around the world. These factors point towards a need for studies that can clarify the overall picture in anthropometric measure associations. Individual trials can be likened and analyzed, but differences in their methodology, accuracy and benchmarks can make reliable comparisons difficult.

Our study attempts to fill this knowledge gap in childhood obesity, by analyzing the relationship between anthropometric measurements (BMI, waist-hip ratio, waist-to-height ratio) in children from various regions in Europe, South America and India, providing insight into the geographical, ethnic and racial variations of childhood obesity.

MATERIALS AND METHODS

Study population

The OBEY-AD is an international study consortium aimed at investigating risk factors for obesity in childhood. The study enrolled 2720

children (3-11 years of age), balanced by gender, in three main geographical areas: South America (Chile, Mexico, Argentina and Brazil), Europe (Georgia, France, United Kingdom, Germany and Italy) and India. Kids were recruited in school facilities of metropolitan area of the involved countries: Santiago (Chile), Buenos Aires (Argentina), Fortaleza (Brazil), San Luis Potosí (Mexico), Paris (France), New Delhi, Kolkata, Surat, Mumbai, Hyderabad, Bangalore, Chennai (India), London (United Kingdom), Hamburg (Germany), Tbilisi (Georgia), Trieste (Italy). Study's detailed description is given elsewhere (24).

Children suffering of physical or psychological diseases were excluded from the sample. Informed consent was obtained by parents of participants explaining them study's aims. The procedures performed followed the ethical guidelines of the American Psychological Association (APA). Adequate permissions were obtained by the Institutional Review Boards.

Anthropometric Measurements

Children's anthropometric measurements were performed (using a body meter and a balance scale) by trained technicians with kids wearing light clothes and barefoot. All the measurements were taken at the nearest 0.1 mm.

Weight and height were taken with children's back against the wall, so that the feet's back were against the wall too, forming a straight angle between the wall and the floor. A straight surface was then placed on the kid's head to fix a mark on the wall, which represented the initial point. Body Mass Index (BMI) was computed as weight (in kilograms) divided by height (in meters) squared.

Waist circumference was measured midway between the lowest rib and the top of iliac crest. Waist-to-height ratio was calculated as waist circumference (in centimeters) divided by height (in centimeters).

Hip circumference was measured at the widest diameter of the buttocks. Waist-hip ratio was computed dividing waist circumference (in centimeters) by hip circumference (in centimeters).

The measure of abdominal skinfold was performed, and reported in millimeters, using Harpenden skinfold caliper by taking a fold of skin and subcutaneous fat midway between umbilicus and the spine of the iliac bone.

Statistical analysis

Categorical data were reported as percentages (absolute number), continuous data as median (I and III quartile). Wilcoxon-Kruskal-Wallis test and Pearson chi square test were performed whenever appropriate.

A linear mixed model has been estimated to take into account the heterogeneity in the considered sample; a fixed effect term has been included considering as explanatory covariates children's gender, age and anthropometric measure. In addition, a random effect term has been included: the intercept of the linear effect varies according to the geographical area in which the children lived, the strength (random slope term) of the effect is shared among children with the same anthropometric measures

Statistical analysis was performed using R system (25) and lme4 (26), hmisc (27) libraries.

RESULTS

Sample characteristics by geographical area are shown in Table 1. We found out significant differences among the three groups of children for all the considered anthropometric measurements. South-American children had higher BMI, waist and hip circumference compared to European and Indian ones. Indian children were found to have lower BMI, waist and hip circumference, but they are taller and had a higher waist-hip ratio than those of European and South-American kids, indicating probably a different body composition of Indian children compared to those of other ethnic groups. This finding is confirmed also by the li-

TABLE 1. Sample characteristics and anthropometric measurements according to geographical area. Data are percentages (absolute number) and median [I and III quartiles] whenever appropriate.

	India (n=1680)	Europe (n=360)	South America (n=680)	p-value
Gender, Male	50% (840)	50% (180)	50% (340)	1
Age	6.5 [5.0; 8.0]	6.5 [4.0; 9.0]	7.0 [5.0; 9.0]	0.43
Height (cm)	125.00 [115.40; 136.00]	123.25 [109.00; 137.00]	123.00 [112.00; 134.00]	<0.001
Weight (kg)	23.10 [18.40; 29.65]	24.55 [19.00; 32.00]	25.00 [20.00; 32.00]	0.021
BMI	14.67 [13.35; 16.88]	16.43 [15.30; 17.81]	16.61 [15.11; 18.63]	<0.001
Circumference				
waist (cm)	55.80 [52.00; 62.20]	57.50 [54.00; 62.00]	57.00 [53.00; 63.25]	<0.001
hip (cm)	63.0 [58.0; 71.0]	66.0 [60.0; 74.0]	67.0 [60.0; 75.0]	<0.001
Skinfold thickness				
abdominal (mm)	0.6 [0.2; 1.0]	4.0 [2.0; 6.0]	6.0 [4.0; 14.0]	<0.001
Waist-hip ratio	0.891 [0.851; 0.933]	0.881 [0.846; 0.922]	0.877 [0.835; 0.916]	<0.001
Waist-to-height ratio	0.455 [0.421; 0.496]	0.479 [0.445; 0.515]	0.521 [0.449; 0.521]	<0.001

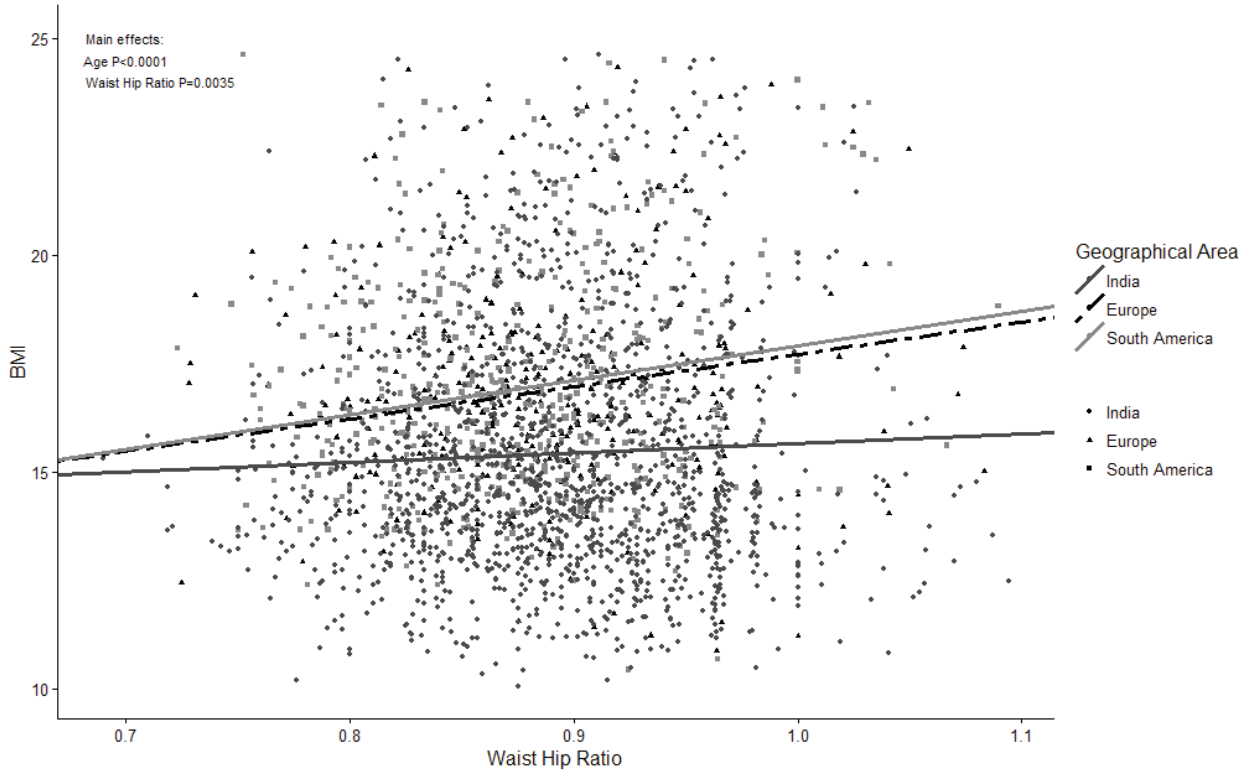

FIGURE 1. Relationship between BMI and Waist Hip Ratio in European, South-American and Indian children.

near model depicted in Figure 1, showing that the BMI is highly associated with waist-hip ratio (p-value <0.0035) in all children's groups but, for a given value of waist-hip ratio, the BMI of Indian children is lower than those of South-American and European ones. This observation is evident especially for higher values of waist-hip ratio, suggesting different body proportions for Indians. In addition to waist-hip ratio, also age, but not gender, is significant associated (p-value <0.001) to BMI.

Referring to the relationship of BMI with the other anthropometric measurements, Figure 2 shows the significant association between BMI and waist circumference (p-value <0.0001) and Figure 3 reports a high association (p-value <0.0001) between BMI and waist-to-height ratio. Figure 3 shows that the strength of the association between BMI and waist-to-height ratio seems to be similar among the geographical areas considered (lines are parallel), while there is a difference in the intercept (magnitude) of the effect. In both cases (Figure 2 and 3), Indians had lower BMI for a given value of waist circumference and of waist-to-height ratio compared to children from the other geographical areas. Conversely, the relationships between BMI and waist circumference, and particularly those between BMI and waist-to-height ratio substantially overlapped for European and South-American children. Age, but not gender, had significant main effect in both models (p-value <0.0001 for both).

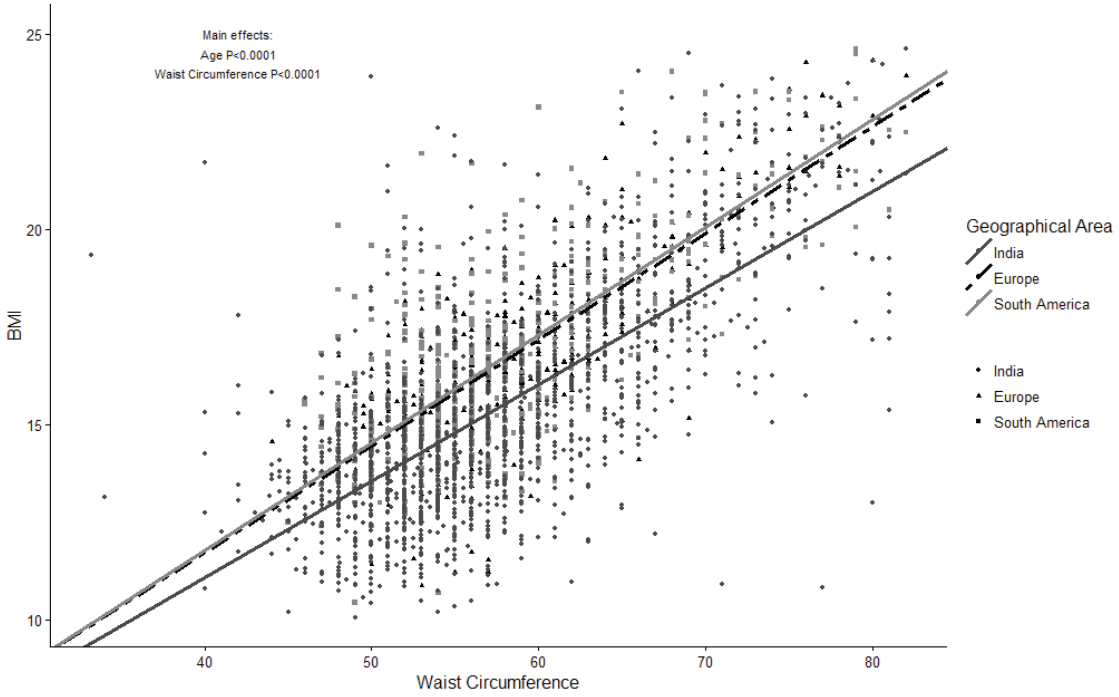

FIGURE 2. Relationship between BMI and Waist Circumference in European, South-American and Indian children.

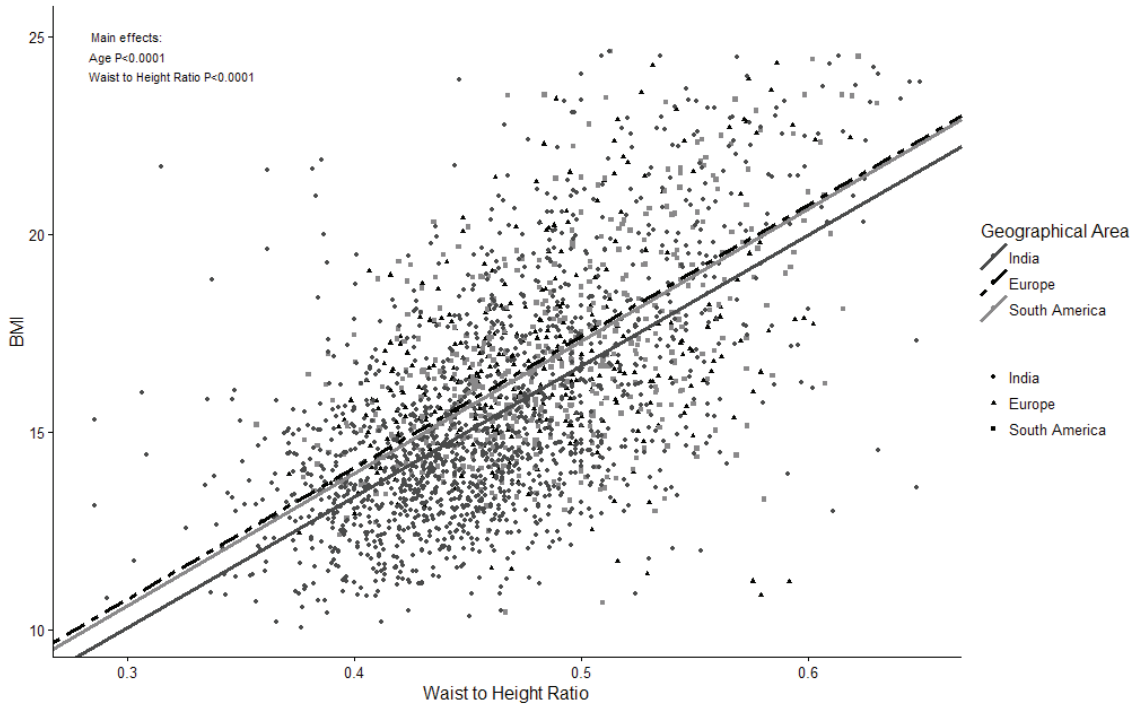

FIGURE 3. Relationship between BMI and Waist to Height Ratio in European, South-American and Indian children.

DISCUSSION

When observing the overall relationships between our measured variables, we see positive associations between BMI and waist circumference, waist-hip ratio and waist-to-height ratio in all three studied populations. This implies that a higher overall adiposity results in an increase of our measured parameters in all the three child subgroups, thus backing the use of anthropometric measures as surrogate markers of obesity. In addition, these associations have been reported by other studies looking at body fat distribution in Indian (19), Brazilian (17), German (13), French (12) and Italian (14) children, providing further evidence for our positive associations and the reliability and adaptability of these measures.

However, specific anthropometric patterns can also be seen relating to each studied population, and striking differences appear when comparisons between the subgroups are carried out.

When looking at the overall population differences, South American children were found to have the highest absolute weight, BMI, hip circumference, abdominal skinfold thickness and waist-to-height ratio amongst the studied groups, with statistical significance present for most of the aforementioned parameters. This suggests that on average South American children are larger compared to Indian and European children, probably due to a higher prevalence of obesity and greater levels of body fat in this continent. Certain Latin American nations have both the highest recorded prevalence of overweight preschool children and some of the fastest growing obesity rates in the developing world (28). Also, South American nations such as Brazil and Chile, have reported occurrence levels of childhood obesity comparable to those of several developed nations (29). Several causes have been suggested as the roots of this growing problem in the South American continent. These include a fast shift towards fat-rich foods with reductions in fiber in childhood diets

(30, 31); nutritional stunting and fat oxidation due to widespread low socioeconomic status (32); and the growing availability of population-wide education, which has been associated with an increase in obesity in several developing nations (30, 33). Overall, we can clearly see our utilized measures have highlighted the striking obesity problem present in Latin America, emphasizing the need for the local authorities to tackle the causes of this pandemic and further elucidate the characteristics specific to their population.

Further interesting differences were seen also when characterizing the anthropometric data and measure patterns specific to each studied population.

The most particular arrangement was detected in the Indian group. In addition to being the tallest (greatest average height), this cohort also included the leanest individuals, as they reported the lowest BMI, waist and hip circumferences and waist-to-height ratio and abdominal skinfolds, with measurements for the latter being lower than those of other populations. This lower body weight was also reported by another study comparing anthropometric measures of South Asian children with those of other origins living in the UK (34), suggesting these parameters detect a lower prevalence of overweight individuals amongst Indian populations. However, despite this apparent low adiposity, our study recorded a high waist-hip ratio average for this cohort, greater than the measurements for the "bulkier" South American and European children. This can be clearly seen in Figures 1 to 3, where the Indian group has larger waist-hip ratios, waist circumferences and waist-to-height ratios at a specific BMI compared to the other populations. This implies that adiposity in Indian children tends to be more centrally located, with the waist being the major site of deposition, and at equal levels of body fat, these kids express wider waists compared to children from other geographical regions. This deposition pattern is further supported by adult studies comparing body fat composition of Asian Indians with other populations(35, 36), as they found that Indians were more prone than other ethnicities to deposit fat in the abdominal region, both viscerally and superficially. In addition, greater waist-hip ratios have been associated with higher levels of insulin resistance in Indian children(37), emphasizing the clinical relevance of this anthropometric pattern and providing a potential cause for the high prevalence of diabetes amongst the Asian Indian population(38). This data therefore suggests that a peri-waist fat deposition is prominent amongst Indian children, and that this body composition needs to be tackled to reduce the morbidity toll exerted by obesity and insulin resistance in this region.

On the other hand, a more evenly distributed pattern was detected for the South American cohort. These children had the lowest waist-hip ratios amongst the studied populations, accompanied by the highest hip circumference measures. They therefore don't tend to express the same degree of pure central adiposity as Indian kids, as they were found to have narrower waists at a specific BMI compared to the other groups (Figures 1 and 2).

Finally, the European cohort generally occupied a middle ground in the anthropometric measures between the Indian and South American groups. However, their average values tended to be similar to the South American results, with many measures being only slightly lower. This can be explained by both the European origin for many South American populations and cultures, and the more developed status several Latin American countries possess compared to India. These cultural, socioeconomic and developmental similarities may therefore be the reason for the comparable results between the European and South American cohorts.

Despite reporting interesting anthropometric patterns and providing further evidence regarding fat deposition in several child populations, we need to take into account some limitations of our methodology. Firstly, the South American population reported a higher average age compared to the other two populations (7.0 versus 6.5 years). We found that BMI was positively associated with age, suggesting the other parameters may have also been raised due to

this difference in the child groups. As a result, this may reduce the importance of the higher body fat and skinfold thickness measurements for the South American children. Secondly, it is important to remember that the different countries and ethnicities present in all three geographical populations are significantly heterogeneous. This is especially true for the continental cohorts, thus highlighting the broadly descriptive role this data plays.

However, these limitations are unlikely to have affected the individual anthropometric patterns detected in our study, such as the even fat distribution in the South American children and the prominent central adiposity in the Indian cohort.

CONCLUSIONS

Overall, this data provides further evidence on the differences in anthropometric measures between the Indian, South American and European child populations. It also highlights the importance of specific cutoffs and benchmarks for each ethnicity and culture, and how they can be used to tackle prominent health burdens such as cardiovascular disease and diabetes. Further studies now need to be carried out for the aforementioned regions to better clarify the anthropometric patterns specific to these populations, and attempt to understand the reasons, implications and applications of these variations in body fat composition.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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ARCHIVOS LATINOAMERICANOS DE NUTRICIÓN
Órgano Oficial de la Sociedad Latinoamericana de Nutrición
Vol. 67 Suppl. 1, 2017

Cooking with alcohol: a matched case-control study in Italy and Germany assessing the risk of alcoholism due to an early exposure to alcohol in childhood

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SUMMARY: The study aims at understanding the role of early exposure to ethanol during childhood, in particular in the form of alcohol used in food preparation. A matched case control study was conducted in Italy and Germany. 300 cases were selected from the lists of the Alcoholics Anonymous Associations and 300 controls were matched from the general population. A CATI system was used for collecting information on drinking habits, family risk factors, age at first ethanol consumption, binge drinking episodes and alcohol ingestion as a food ingredient during childhood. Association of variables with the status of case were analysed using a multivariable conditional logistic regression. In the multivariable model four variables were selected: education, father drinking status, age at first ethanol consumption and binge drinking during adolescence. Consumption of food containing alcohol in common recipes was not associated with an increased risk of alcoholism in older ages. Drinkers having their first contact directly with alcoholic beverage before age 13 were more likely to suffer from alcohol dependence at some time during their life. On the contrary, using alcohol in food preparation during childhood does not appear to be related with subsequent risk for alcohol abuse.

Key words: Paediatric alcohol exposure; alcohol in food preparation; binge drinking

RESUMEN. Cocinar con alcohol: un estudio de emparejamiento de casos y controles realizado en Italia y Alemania para evaluar el riesgo de alcoholismo debido a una exposición temprana al alcohol durante la infancia. El estudio tiene como objetivo comprender el papel de la exposición temprana al etanol durante la infancia, en particular, la forma en la que se utiliza el alcohol en la preparación de alimentos. Este estudio de emparejamiento de casos y controles se llevó a cabo en Italia y Alemania. Se seleccionaron 300 casos de las listas de las Asociaciones de Alcohólicos Anónimos y se los emparejó con 300 controles obtenidos de la población general. Se utilizó el sistema CATI para la recolección de información sobre hábitos de consumo, factores de riesgo de la familia, edad del primer consumo de etanol, episodios de consumo excesivo de alcohol, e ingesta de alcohol como ingrediente alimentario durante la infancia. Se analizó la asociación de las variables con la situación de cada caso mediante una regresión logística condicional multivariable. En el modelo multivariable se seleccionaron cuatro factores: educación, relación del padre con el alcohol, edad del primer consumo de etanol y episodios de consumo excesivo de alcohol durante la adolescencia. El consumo de alimentos que contienen alcohol en las recetas comunes no se asoció con un mayor riesgo de alcoholismo en edades más avanzadas. Aquellos bebedores que han tenido su primer contacto directo con bebidas alcohólicas antes de los 13 años eran más propensos a sufrir de dependencia al alcohol en algún momento de su vida. Por el contrario, el uso de alcohol en la preparación de alimentos durante la infancia no parece estar relacionado con un riesgo posterior de abuso en el consumo de alcohol.

Palabras clave: Exposición al alcohol en edad pediátrica; alcohol en la preparación de alimentos; consumo excesivo de alcohol

INTRODUCTION

The Alcohol use usually begins in the second decade of life, typically in early adolescence, when youths frequently adopt a binge-like drinking pattern (1): for the majority this behaviour may signify nothing more than a transient phase of experimenting with a risk behaviour, and many drinkers reduce

their consumption in early adulthood (2). On the other hand, epidemiological data have shown that a potentially powerful predictor of progression to alcohol-related harm is age at first use, with studies suggesting that the earlier the age at which young people take their first drink of alcohol, the greater the risk of abusive consumption and the development of serious problems, including alcohol disorders (2).

Cross sectional (2) and longitudinal studies (3-6) investigating the relationship between early alcohol assumption and adult drinking pattern have mainly focused on alcohol use in adolescence, while little attention has been dedicated to the effects of alcohol exposure in childhood in determining later ethanol use and in developing alcohol use disorders (6). Moreover, exposure to alcohol during childhood seems to be a multilevel phenomenon including a wide spectrum of behaviours, such as using alcohol in food, or sipping or tasting others' alcoholic beverages (7). The prevalence of such behaviours can be expected to be high among children; however, the developmental process through which children's attitudes toward alcohol evolve in patterns of alcohol consumption during adulthood are largely unexplored and relatively little is known about this transition (8). The role played by the early exposure to alcohol in children due to food preparation is unclear and not well studied.

The aim of this case control study was to identify factors within family, childhood and adolescence which differente individuals experiencing hazardous and harmful alcohol use in adulthood from those who never experienced alcohol-related problems, with a particular focus on the role of exposure to ethanol during childhood and its use in food preparations.

MATERIAL AND METHODS

For the purpose of the study, cases were defined as individuals with a lifetime history of alcohol-related problems, having experienced alcohol abuse in the past or still currently experiencing it as a significant problem. Therefore, cases were selected from the lists of the Alcoholics Anonymous Associations operating in the North-East of Italy (Veneto and Friuli-Venezia Giulia regions) and in South-Germany (Bavaria) which adhered to the study.

Controls were randomly selected from the population of the same regions using a Computer Assisted Telephone Interview (CATI) system. In order to correctly identify controls (people who had never experienced alcohol related problems), respondents were screened for lifetime alcohol related problems by means of the CAGE questionnaire (9). Written informed consent was obtained from all participants prior to taking part in the investigation. Data were treated according to the Italian law of Privacy Protection (Lex. N. 196/2003).

The study was designed to identify an OR of 1.6 or greater for the "alcohol in food consumption", with an alpha level of 0.05 and a power of 0.80 in a 1:1 case-control study. We assumed an overall percentage of alcohol in food consumers of 30% of the total sample. In this scenario, a sample size of 596 subjects is needed, rounded up to 600.

Therefore, using the above mentioned procedure, 300 cases (150 Italians and 150 Germans) and 300 controls matched by age and sex were identified and underwent a face-to-face interview.

Cases and controls were interviewed individually by expert psychologists whose mother language was Italian or German (as appropriate depending on the sample) using a semi-structured interview. The interview aimed at extracting the information on all

factors relevant for the purposes of the study including socio-demographic characteristics, health related indulgence behaviours (smoking), current drinking habits (drinking quantity and frequency and reasons, if any, for heavy drinking), family risk factors (relative's drinking status), age starting alcohol consumption (including sipping or tasting others' drinks), alcohol ingestion during childhood as a food ingredient, and ethanol consumption during adolescence (frequency of binge drinking episodes). All interviews were digitally recorded. For the purpose of this study, the rich qualitative data collected during the interviews had to be converted into categories of variables. This process is known as quantification, by which qualitative data are treated with quantitative techniques to transform them into quantitative data(10). Therefore, on the basis of the structure adopted for the interviews, two psychologists made an observation recording sheet allowing for the extraction of information on participants' behaviours. The psychologists compiled the sheet independently, listening to the answers provided by the people during the interviews. The overall agreement between them in providing such dietary indications was very high, obtaining a Cohen's Kappa of 0.74. A consensus was thus obtained for all discrepant interviews under the coordination of the data-manager of the project.

In order to define participants' current drinking status, three substance use groups were derived from participants' responses: current drinkers, former drinkers (abstainers in the past 12 months) and non-drinkers. For current drinkers, the interview plan was aimed to investigate the (a) drinking frequency (number of drinking occasions per time unit) during past year and (b) the quantity (litres) of alcoholic beverage (wine, beer, spirit) per occasion. Information from (a) and (b) were used to construct a measure of weekly alcohol beverages consumption; therefore, the number of standard drinks per week was calculated and current drinkers were classified into 2 categories: moderate and heavy drinkers.

Criteria for heavy drinking were based on low-risk drinking guidelines for adults ≤65 from the National Institute on Alcohol Abuse and Alcoholism (NIAAA): daily limits of ≤4 drinks for men and ≤3 drinks for women, and weekly limits of ≤14 drinks for men, ≤7 drinks for women(11). All other respondents that declared to not exceed these limits were considered moderate drinkers. The frequency of binge drinking episodes at present and during adolescence was also investigated, with binge drinking being defined as consuming 5 or more US standard drinks (male) or 4 or more drinks (female) within approximately 2 hours. Parents' drinking habits were also evaluated adopting these definitions.

Finally, childhood exposure to alcohol was explored asking information about the age at first tasting (including direct tasting alcohol and consuming alcohol in food), frequency of ingestion of alcohol as a food ingredient and details regarding the type of food (meals or sweets) and the alcoholic beverages tasted in food.

Being a non-intervention survey, no formal evaluation by an Ethical Committee is needed in Italy. Written informed consent was obtained from all participants prior to taking part in the investigation. Data were treated according to the Italian law of Privacy Protection (Lex. N. 196/2003).

Distribution of the main socio-demographic characteristics and health related indulgence behaviours were compared in case and control, and drinking habits of both groups were described. Distribution of factors usually considered as developmental determinants

including parents' drinking status and alcohol exposure during adolescence were assessed. Moreover, differences in exposure to alcohol during paediatric age were also evaluated. Continuous variables were always expressed as median and inter-quartile difference and categorical variables as percentages and absolute numbers. Differences between groups were compared using Wilcoxon and Chi-Square Fisher test, as appropriate.

Association of variables with the status of case was investigated using a multivariate conditional logistic regression model, matched by age and gender.

All variables considered were entered into the model "as is", i.e. without any transformation or cut-off. If significant non-linearity using a score test was present, in relating the covariate's effect with survival, the specific covariate's effect was modelled using a restricted cubic spline. Selection criteria was the AIC (Akaike Information Criterion) applied backward for selecting significant covariates. The final model for each of the three steps was selected if superior in terms of AIC at a significance level of 0.05 and p-values were explicitly indicated if below the 0.25 threshold, otherwise the "NS" indication was used.

To account for possible overfitting in the regression model secondary to high ratio between covariates and events, cross-validation and bootstrap (2000 runs) techniques were applied. For the logistic regression model, Somer's concordance Index Dxy (the closer to one in absolute value, the better) was obtained and evaluated for this purpose.

Multivariate Odds Ratios are presented along with their 95% confidence intervals.

The statistical significance was settled at $p < 0.05$. The R System (release 2.7.0) statistical package and the Harrell's Design and Hmisc libraries were used for analysis.

RESULTS

Socio-demographic characteristics and health related indulgence behaviours of cases and controls are shown in Table 1. There are significant differences regarding education, working position, and the primary sources of income, with cases having less frequently reached higher education level and being more frequently unemployed. Moreover, smoking habits are more diffuse among cases, with the latter having started to smoke at a younger age than controls. Current drinking habits are described in Table 2. Fifty-six percent of cases reported to still being heavy drinkers. Among the reasons for heavy drinking, participants pointed out social reasons (31%), work and economic reasons (19%), pleasure (14%) and family problems (9%).

The distribution of developmental risk factors in cases and controls is shown in Table 3. Having a problem drinker among relatives is strongly associated with the status of case; similarly, a lifetime history of alcohol-related problems is predicted by early experiences with alcohol consumption (including sipping and tasting others' drinks) and by higher frequency of binge drinking episodes during adolescence. As opposed to the latter finding, consuming alcohol in foods during childhood is not related to subsequent risk to engage in problem drinking. In multivariable analysis (Table 4) the final model selected four variables: education, father drinking status, age starting drinking, tasting or sipping alcohol and binge drinking during adolescence. More specifically, a U-shaped association between alcohol drinking, tasting, sipping debut and alcohol abuse during adult age emerged, declining from age 13 to 16 years (OR 0.37 95% CI 0.25- 0.53) and increasing again in late adolescence (OR 3.31 95% CI 1.08-10.17) (Figure 1).

TABLE 1. Main socio-demographic characteristics and voluptuary habits of cases and controls. N refers to the number of valid cases for each variable. Numbers are percentages (absolute numbers in parenthesis) for categorical variables and I quartile/Median/III quartile for continuous variables. P-value refers to a significantly different distribution of each given variables among cases and controls.

	Cases (N=300)	Controls (N=300)	Combined (N=600)	P-value
Age (N=600)	37.00/46.00/55.00	36.25/46.00/55.00	37.00/46.00/55.00	0.936
Gender (N=600)				
Male	69% (208)	69% (208)	69% (416)	
Working position (N=600)				
Employed	40% (121)	63% (188)	52% (309)	<0.001
Self employed	6% (19)	12% (37)	9% (56)	
Part-time job	1% (2)	1% (2)	1% (4)	
Temporary job	7% (21)	1% (4)	4% (25)	
Unemployed	33% (98)	10% (31)	22% (129)	
Retired	13% (39)	11% (34)	12% (73)	
Student	0% (0)	1% (4)	1% (4)	
Primary source of money (N=549)	549			
Self work	60% (158)	81% (230)	71% (388)	<0.001
Retirement pension	15% (39)	12% (34)	13% (73)	
Parents' work	5% (12)	5% (13)	5% (25)	
Welfare services	21% (55)	3% (8)	11% (63)	
Education (N=600)				
University	7% (20)	21% (63)	14% (83)	<0.001
High school	18% (55)	35% (104)	26% (159)	
Professional school	27% (80)	28% (83)	27% (163)	
Mandatory school	47% (141)	17% (50)	32% (191)	
School for disabled	1% (4)	0% (0)	1% (4)	
Family status (N=214)				
Married	74% (81)	70% (73)	72% (154)	0.364
Stable relationship	5% (5)	10% (11)	7% (16)	
Divorced/separated	12% (13)	9% (9)	10% (22)	
Widowed	1% (1)	3% (3)	2% (4)	
Single	8% (9)	9% (9)	8% (18)	
Smoking Status (N=600)				
Current smoker	67% (201)	29% (88)	48% (289)	<0.001
Former smoker	21% (63)	23% (70)	22% (133)	
Non-smoker	12% (36)	47% (142)	30% (178)	
For current smokers: amount of smoking (N=210)	10.0/20.0/20.0	10.0/15.0/20.0	10.0/16.5/20.0	0.285
For former smokers: years quitting (N=112)	6/15/27	6/12/20	6/13/26	0.35
Age at starting smoking (N=385)	13/14/16	14/16/18	13/15/17	<0.001

TABLE 2. Drinking habits of cases and controls. N refers to the number of valid cases for each variable. Numbers are percentages (absolute numbers in parenthesis) for categorical variables and I quartile/Median/III quartile for continuous variables. P-value refers to a significantly different distribution of each given variables among cases and controls.

	Cases (N=300)	Controls (N=300)	Combined (N=600)	P-value
Drinking Status (N=600)				
Current drinker	51% (153)	86% (259)	69% (412)	<0.001
Former drinker	49% (147)	7% (20)	28% (167)	
Non-drinker	0% (0)	7% (21)	4% (21)	
For current drinkers: drinking frequency (N=384)				<0.001
Special occasions		14% (34)	9% (34)	
1-2 times per month	9% (12)	8% (19)	8% (31)	
1-2 times per week	17% (23)	41% (102)	33% (125)	
3-4 times per week	10% (13)	23% (58)	19% (71)	
Every day	65% (88)	14% (35)	32% (123)	
For current drinkers: number of drinks per day (N=355)	2.11/5.62/13.10	0.37/0.80/1.50	0.58/1.41/4.48	<0.001
For current drinkers: drinking categories (N=355)				
Moderate drinkers	44% (51)	100% (239)	82% (290)	<0.001
Heavy drinkers	56% (65)		18% (65)	
Frequency of binge drinking episodes (N=228)				
Never	43% (37)	100% (142)	79% (179)	<0.001
Special occasion	2% (2)	0% (0)	1% (2)	
1-2 times per month	34% (29)	0% (0)	13% (29)	
1-2 times per week	8% (7)	0% (0)	3% (7)	
3-4 times per week	6% (5)	0% (0)	2% (5)	
Every day	7% (6)	0% (0)	3% (6)	
For former drinkers: years quitting drinking	2.00/ 5.00/10.00	5.00/12.00/15.75	2.00/ 5.00/11.25	0.021

TABLE 3. Developmental risk factors including parents drinking status, pediatric and adolescence exposure to alcohol. Numbers are percentages (absolute numbers in parenthesis) for categorical variables and I quartile/Median/III quartile for continuous variables. P-value refers to a significantly different distribution of each given variables among cases and controls.

	Cases (N=300)	Controls (N=300)	Combined (N=600)	P-value
Alcohol related problems in family (N=600)				
Yes	40% (121)	22% (66)	31% (187)	<0.001
Mother's drinking status (N=331)				
Never	25% (42)	13% (21)	19% (63)	<0.001
Occasional drinker	36% (60)	61% (101)	49% (161)	
Moderate drinker	18% (30)	19% (31)	18% (61)	
Binge drinker	2% (3)	2% (4)	2% (7)	
Heavy drinker	18% (30)	5% (9)	12% (39)	
Father's drinking status (N=350)				
Never	6% (11)	3% (5)	5% (16)	<0.001
Occasional drinker	28% (48)	55% (99)	42% (147)	
Moderate drinker	16% (28)	26% (47)	21% (75)	
Binge drinker	13% (22)	3% (5)	8% (27)	
Heavy drinker	36% (61)	13% (24)	24% (85)	
Other Relatives with alcohol related problems (N=88)				
Brothers	38% (20)	6% (2)	25% (22)	<0.001
Sister	4% (2)	3% (1)	3% (3)	
Grandparents	15% (8)	31% (11)	22% (19)	
Uncle/aunt	25% (13)	34% (12)	28% (25)	
Husband/wife	2% (1)	9% (3)	5% (4)	
Stepfather	6% (3)	6% (2)	6% (5)	
More than a relative with alcohol related problems (N=600)	11% (6)	11% (4)	11% (10)	
Yes	33% (98)	38% (114)	35% (212)	0.172
Type of food (N=211)				
Meals	21% (21)	25% (29)	24% (50)	0.155
Meals & sweets	13% (13)	20% (23)	17% (36)	
Sweets	65% (64)	54% (62)	59% (126)	
Frequency of consumption of food with alcohol (N=189)				
Special occasion	17% (14)	32% (34)	25% (48)	0.057
1-2 times per month	13% (11)	16% (17)	15% (28)	
1-2 times per week	59% (48)	48% (51)	52% (99)	
3-4 times per week	1% (1)	2% (2)	2% (3)	
Every day	10% (8)	3% (3)	6% (11)	
Type of alcohol used in food preparation/consumption (N=131)				
Beer	8% (7)	7% (3)	8% (10)	0.16
Wine	37% (33)	50% (21)	42% (54)	
Spirits	47% (42)	42% (18)	46% (60)	
Various	8% (7)	0% (0)	5% (7)	
Age starting alcohol consumption (sipping, tasting, drinking) (N=600)	12/14/16	14/15/17	13/15/17	<0.001
Binge drinking during adolescence (N=376)				
Never	31% (50)	67% (144)	52% (194)	<0.001
Special occasion	2% (4)	7% (16)	5% (20)	
1-2 times per month	22% (36)	15% (33)	18% (69)	
1-2 times per week	38% (61)	7% (15)	20% (76)	
Every day	7% (11)	3% (6)	5% (17)	

TABLE 4. Multivariable conditional logistic regression model for the association of selected variables and Case/Control status, matched by age and gender. The column "value" refers to the interquartile difference for continuous variables or for specific reference categories for categorical variables. Age started drinking is showing a non-linear effect (p=0.0211). Somer's Dxy equal to 0.68.

Variable	Value	OR	95% C.I.		AIC p-value
Education	University Degree vs. Mandatory School	0.25	0.07	0.84	0.0042
	High School vs. Mandatory School	0.34	0.14	0.81	
	Vocational school vs. Mandatory School	0.13	0.04	0.42	
Father's drinking status	Occasional drinker vs. Never	0.16	0.04	0.68	0.0004
	Meal drinker vs. Never	0.20	0.05	0.91	
	Binge drinker vs Never	1.20	0.16	8.81	
	Heavy drinker vs. Never	1.14	0.23	5.78	
Age started drinking	3 years increment from age 13 to age 16	0.37	0.25	0.53	0.0405
Binge drinking during adolescence	Only in Special Occasions vs. Never	1.73	0.37	8.18	0.003
	1-2 times per month vs. Never	5.71	2.29	14.26	
	1-2 times per week vs. Never	10.28	3.07	34.38	
	More than 1-2 times per week vs Never	4.91	0.43	56.2	

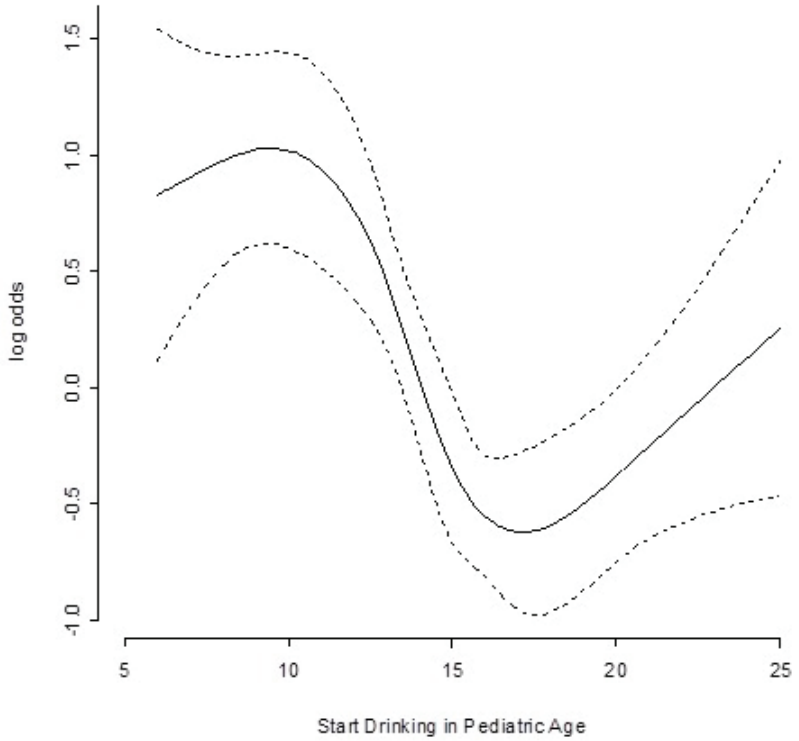

FIGURE 1. Increased risk of alcoholism according to age when the subject started consuming alcohol. The risk declines from 13 to 16 years (OR 0.37 95%CI 0.25- 0.53) of age and then increases up to 25 years of age (OR 3.31 95% CI 1.08-10.17). Non linear effect (p=0.0211) modelled using a cubic spline.

DISCUSSION

The consumption of alcohol is a socially accepted "norm" in most populations in western societies, with most individuals beginning to drink in their mid-teens (12). This behavioural pattern is similar for boys and girls and consistent across countries (13). Most of the studies agree that during the mid-teens the probability of drinking increases rapidly with each year beyond age 12, especially in cross-sectional and prospective evaluations rather than retrospective histories (12, 14).

Early experimentation with alcohol makes adolescence a critical period for the onset and increase of alcohol consumption. Problem drinking during adolescence is a public health issue not only because of the immediate consequences (e.g., road traffic accidents, contribution to other intentional or unintentional injuries, high-risk sexual behaviour, co-morbid substance use, academic problems) but also because early drinking may lead to long-term alcohol problems (12). Particularly, adolescent binge drinking seem to be a high-risk behaviour associated with significant later adversity including a higher risk of adult alcohol dependence/abuse as pointed out in previous studies and confirmed in the present case control study (15).

During the past two decades, a burgeoning literature has emerged establishing an association between age of drinking onset and risk for later hazardous alcohol consumption and dependence. Both cross-sectional (16-18) and longitudinal studies (19, 20) have indicated that the age at drinking onset is one of the strongest predictors for the development of later alcohol-related problems. Moreover, early onset also predicts tobacco and other drug involvement, psychopathology, poor academic achievement, unintentional injury, violence, and suicidality (21, 22).

Nevertheless, although frequently described, the mechanisms underlying the relationship between age at first drink and subsequent alcohol related problems remain unclear, with some studies finding age at first drink to be only a weak predictor of heavy drinking in adolescence (23, 24) or in later life (25).

The effects of alcohol consumption in pre-adolescence remain largely under-explored. In a longitudinal study only Fergusson et al.(26) focused on the relationship between childhood alcohol consumption and adolescent drinking patterns evaluated at 15 years of age. This study used a birth cohort of 739 children, and extensively investigated the effects of early exposure to alcohol. Age at first alcohol consumption was classified into four categories: 0 to 5 years, 6 to 10 years, 11 to 12 years, and after 13 years. The authors point out that children who had been introduced to alcohol before the age of 6 years were 1.9 to 2.4 times more likely to report frequent, heavy or problem drinking at age 15 years than children who did not drink alcohol before the age of 13.

In this retrospective study, we investigated the risk of alcoholism according to the age at which individuals started consuming alcohol, finding a non-linear effect: the risk in fact declines from 13 to 16 years (OR 0.37 95% CI 0.25- 0.53) of age and then increases up to 25 years of age thereafter (OR 3.31 95% CI 1.08-10.17).

These results are consistent with those reported in a study by Pape (27), which explored how age at first intoxication with alcohol relates to mental health, social integration and adjustment to adult role. A U-shaped association between intoxication debut and psychological problems arose among males, implying that not only early but also late beginners had more such problems than those who had followed the mainstream. In particular, male late beginners were psychologically healthy, but they showed indications of a delayed entry into the adult role. The authors concluded that getting drunk

for the first time in mid-adolescence seems to be a phenomenon in the normal development of young males.

Heavy alcohol consumption and associated problems may also be affected by a variety of factors other than age at first alcohol experience. One such domain relates to genetic factors as measured through a family history of alcoholism, which, while contributing most robustly to heavier drinking, alcohol problems, and alcohol use disorders (17), may also impact on the decision to drink (28). A related issue that might enhance drinking behaviour involves the home environment(12). Among younger adolescents, observing drinking at home, especially by their parents, can have an important impact on a person's decision to drink (12). Moreover, developmental studies demonstrate that the emotional context that accompanies parental use of ethanol has a profound effect on how young children (3 to 6 years) judge the pleasantness of the smell of an ethanol beverage, similar to what occurs with tobacco smoke (29). Children whose parents use ethanol primarily as a means of obtaining relief from their problems are more likely to consider the odour of beer as unpleasant than those whose parents drink for other reasons(30). Consistently with these observations, in our study, a lifetime history of alcohol-related problems seems to be strongly predicted by father drinking status.

Even if some studies testify that early childhood represents a "sensitive period" for the development of expectancies and cognitions about alcohol, and particularly that associative learning in the context of emotionally salient conditions is a powerful mechanism by which odours acquire personal significance, to our knowledge the present case control study is the first to expressly investigate the role of alcohol contained in food during childhood: interestingly, early familiarity with alcohol consumed in food, probably emotionally connected to family socialisation, seems not to be associated with later alcohol related problems.

Nevertheless, the present study shares the limitations of retrospective study designs, both in terms of inference and extrapolation from our results. Measures of behaviours and negative outcomes relied in fact on the honesty and accurate recollection of respondents (31). Studies have found that people can simultaneously hold conflicting conceptions and beliefs which may cause them to respond in seemingly contradictory or inconsistent ways (32). Additionally, poor or incomplete memory of events, external influences, and lack of time to fully recall information may lead to purposefully or accidentally inaccurate recall and responding. Also, some people may respond based on what they believe is socially desirable rather than what they think is true (32); problems related to data quality in terms of validity, accuracy, reliability and completeness (item non-response), have been largely discussed, mostly in terms of the accuracy of self-reports, in the studies evaluating alcohol consumption .

The method used in this study (i.e. semi-structured interviews) was specifically chosen to minimize any bias which may have been potentially occured by forcing people to choose, in answering, from a predetermined set of options, therefore leaving the maximum freedom and complexity to each answer.

SOURCE OF FUNDING

The work has been partially supported by an unrestricted grant from the Italian Ministry of Foreign Affairs under the programs "Programmi di alta rilevanza scientifica e tecnologica" Italia-Messico and Italia-Argentina, and from Prochild ONLUS (Italy).

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Volumen 67. Suplemento 1, Junio 2017

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