Revista Médica del
Hospital General de México

PERMANYER

Check for updates

ORIGINAL ARTICLE

Physical activity, eating habits, and nutritional status of school children in Tepic Nayarit Mexico

*Dulce C. Barajas-García[1] and Gilberto Mercado-Mercado[2]**

[1]School of Nutrition, Universidad Vizcaya de la Américas, Tepic, Nayarit; [2]Department of Chemical Biological Sciences, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, Chihuahua, Chihuahua. Mexico

Abstract

Background: *Obesity (Ob) is a chronic problem that causes health problems mainly in infants.* **Objective:** *The objective of the study was to assess the nutritional status (NS), eating habits (EH), and physical activity of elementary school children.* **Materials and methods:** *Two hundred and twenty-six school children participated, all of whom were fourth grade (78 students), fifth grade (93 students), and sixth grade (55 students) school children of both sexes, aged 9-13 years. Questionnaires were conducted asking about parents' availability to prepare lunch for their children before taking them to school, food preferences at breakfast, children's food preferences within the school, and children's physical activities during and after school. The questionnaire of EH was made to the children expressing itself as the frequency of consumption of the food groups. The food consumption preference index (PI) was determined. The International Physical Activity Questionnaire for Children's was used to estimate the level of physical activity during the school day. Anthropometric parameters were determined to diagnose their NS.* **Results:** *About 55% of parents of 4th graders buy food for their children. About 44% of 6th graders are given money to buy them at school. Hamburgers (PI = 6 in 6th), fried foods (PI = 9 in 4th; PI = 6 in 5th and 6th), pizza (PI = 9 in 5th y 6th), cookies (PI = 9 in 4th y 5th), and soft drinks (PI = 9 in 4th and 6th; PI = 6 in 5th) are foods most often eaten inside the school. Physical activity decreases as the school grade increases. Fourth prefer to play bring it (41%) and have fun in some kind of sport (35%); while 5th prefer to sit (26%) or to talk and walk (28%). There is a high prevalence of Ob in all three grades assessed (71% 4°, 69% 5°, and 78% 6°).* **Conclusions:** *School children have moderate and low levels of physical activity during school hours and junk food is prevalent in school schedules.*

Key words: *School children. Obesity. Eating habits. Physical activity. Tepic. Elementary school.*

Introduction

Obesity (Ob, body mass index [BMI] ≥ 30 kg/m^2) is a systemic, chronic, and multifactorial disease involving genetic susceptibility, lifestyles, and environmental characteristics, influenced by various underlying determinants such as globalization, culture, age groups, ethnicities, and all social classes, economic status, education, urbanization, the political and social environment, lack of physical activity, and high intake of high-calorie foods[1,2]. In this phenomenon, individual behavior, as well as the family, community and social environment, play a predominant role[2]. This disease has reached epidemic proportions worldwide, which is why the World Health Organization (WHO) has called it the epidemic of the 21st century[3]. This disease can be harmful to health, especially to children and adolescents[1,3]. Mexico has the gold medal in childhood Ob worldwide, three out of every ten children suffer from

Correspondence:
*Gilberto Mercado-Mercado
E-mail: gilberto.mercado@uacj.mx

Date of reception: 07-02-2020
Date of acceptance: 25-05-2020
DOI: 10.24875/HGMX.20000030

Available online: 22-01-2021
Rev Med Hosp Gen Mex. 2021;84(1):18-27
www.hospitalgeneral.mx

this disease[4]. The previous studies have recorded that the prevalence of Ob in school children in Mexico has increased alarmingly in the past 20 years, from 23% to 37%[4,5-8]. In 2019, Nayarit is among the first places at the national level by Ob among the school children, being Chihuahua the first place at a national level, with a record of 32.2%, according to data reported by the Economic Development Council of the State of Chihuahua[5,9]. In the same way, the Ob in school children of Puebla increased by 23% in 2016[10].

The main causes of increased Ob in infants are the food choices and styles of parents and the type of food children eat when they are in school[4]. It should be noted that eating habits (EH), a trigger for the development of Ob, which are taken within the classrooms of elementary schools have allowed to trigger the accelerated increase of this pathology in a premature way[11]. Studies from the Universidad Michoacana de San Nicolás de Hidalgo evaluated the risk factors (among them the consumption of junk food) of children's Ob in the school stage in two schools, a public and a private (Simón Bolívar Elementary School and Piaget Institute, respectively), finding that there is a higher risk of Ob in the public school due to the high intake of fast food, combined with the lack of physical activity, economic level, and sedentarism[12,13]. Likewise, in the "Defensores de la República" Elementary school in Mexico City a significant association was identified between the frequency of junk food consumption and Ob in school children[14]. These encouraging data put the health of infants on alert by the formation of EH that they acquire in school and that can have repercussions throughout their adult lives. For this reason, in 2013 the Federal Official Gazette published that the Ministry of Public Education decided to ban junk food in all Elementary schools in the country. However, this ban did not work and the school authorities were "ignored" and, today, stands of candy, snack and soda are observed inside and outside public elementary schools[10]. Therefore, the Ob is a situation that children are developing an obesogenic environment that makes them to suffer from different chronic degenerative diseases (type 2 diabetes mellitus, hypertension, dyslipidemias, and cancer) in the future[5,6].

It should be noted that the economic situation of health institutions (IMSS, ISSSTE, and Ministry of Health) does not have sufficient resources to cope with the treatment especially to treat the sequelae that will have these diseases in patients in a future of approximately 10 years[4,15]. Therefore, it is necessary to implement "Diet and Exercise" health programs to begin to change the lifestyle in which most infants are living. For this reason, it has been indicated that to mitigate the problem that Mexico has, it would be necessary around 200 clinics specialized in Ob and overweight, in addition to sufficient economic resources to invest in research and prevention measures, so the situation is a problem that must be solved by all Mexican society and it is necessary for people to approach their health units to obtain an accurate diagnosis that can begin to attack the condition[4,15]. Therefore, the aim of this research was to evaluate, analyze, and identify factors in the decisions that parents make about the nutritional status (NS) of their children on the causes of Ob and to evaluate the EH within the elementary school in Tepic Nayarit, Mexico.

Materials and methods

Ethical considerations

Our university's institutional review board approved this study. To protect participants' identities, we did not collect identifying information. Participants were not compensated for their time.

Subjects

The observational, descriptive, retrospective, and correlational research study was carried out on the infant student population from 9 to 13 years of primary school "Lic. Presidente Miguel Alemán" of the morning shift located in the municipality of Tepic, Nayarit Mexico. The groups of school children were listed, which was made up of 226 total students, fourth grade (78 students), fifth grade (93 students), and sixth grade (55 students). The sampling was carried out in a single stage in the months of June 2018, whose objective was to identify the relationships of EH and NS in school children. To carry out the study, authorization was requested from the management of the elementary school, parents' society, and the parents or guardians of the children subject to the study. Informed consent specified exclusively the carrying out of measurements of weight, height, and BMI, as well as the implementation of an anonymous questionnaire on lifestyles in terms of nutrition and exercise in and out of elementary school, for which was selected based on the Institute of Epidemiology and Health Care, and some questionable ones that have been published[16-18]. Parents were invited to answer the questionnaire during the school schedule to ensure that they were answered by themselves and not by other relatives. A written request was

made to the teacher of each group for 45 min of class time, once a week and the presence of the parents for the application of the questionnaire.

Questionnaires

A questionnaire was developed for parents and a questionnaire about their child, to be filled in together. These questionnaires included questions about parents' availability to prepare lunch before taking their children to school, food preferences at breakfast, food preferences of children within the school, and physical activities (PA) of children during and after school.

The food preferences were calculated as a semi-quantitative index using a scale for the frequency of eating (FE, range 0-3) and another for the usual amount of intake (AI, range 1-3). The preference index (PI) was calculated by multiplying these two amounts: FE × AI (range 0-9). The index will be close to 9 if a specific food is consumed frequently and in large amounts during a week, while it will be close to 0 if a food is consumed rarely or in small amounts. This questionnaire is semi-quantitative because it allows information to be obtained on the pattern of habitual consumption; in addition to being a cheap, quick, and easy to apply method, it does not alter the habitual consumption pattern of children and allows information to be extracted on the influence of the variability of consumption of types of food. Likewise, this type of questionnaire is capable of classifying individuals according to their EH. The EH questionnaire for children before and during school entry was expressed as the frequency of consumption of the food groups without establishing rations or quantities, not for the purpose of converting food into nutrients but to find out the pattern of EH using the data as estimates of the average frequency of consumption of the different foods. Regarding PA, the information requested is related to the practice of PA, the nature of the activity or its frequency and aspects related to sedentary activities by the students. The analysis of the data from the questionnaires was performed using absolute and relative frequencies of each food, parental decision, and PA during for the total number of children.

Level of physical activity

For this study, the International Physical Activity Questionnaire for Children's[19] was used, which is applicable to children and allows us to obtain comparable estimates of the PH that children carry out during the school day, making it possible to list the different types of PH in school children, taking into account that they do not provide an estimate of caloric expenditure. PH level items were evaluated with a frequency scale (0, 25, 50, 75, and 100%).

Anthropometric measurements

Students were measured weight, height, and percentiles. Students wore underwear. Weight was measured to the nearest 0.1 kg using a digital scale (Omron HBF-514C, USA) with a capacity of 150 Kg. Height was measured using a wall-mounted stadiometer (Seca, model 786, Germany) to the nearest 0.1 cm. BMI was calculated as weight (Kg) divided by height (m) squared. Data analysis was performed using absolute frequencies by NS (normal, malnutrition, overweight, and Ob).

Analysis

For the study of the descriptive parameters, percentages were used to describe all the variables of the study; likewise for the study of the comparative type between degrees, contingency tables, independent samples t-tests, and ANOVA with the statistical package Statistica v10 (Stat Soft. Inc., Tulsa, OK, USA). The level of statistical significance used in all cases was $p < 0.05$. To carry out the analysis, a weighting factor was applied, which allowed the proportionality of each stratum to be kept in relation to the real distribution.

Results

We analyzed the behavior of parents who had before taking their children to school.

Table 1 shows that parents who have children in 4th prefer to buy their children anything to eat (55%) that to prepare it (15%). They mentioned that it was due to lack of time; shopping habits and that most prefer to eat lunch later. For the 5th, there was no significant difference ($p \geq 0.05$) between buying something at the *tiendita* and giving money to buy it at school, which were the most frequent decisions (37% and 31%, respectively). This behavior is reduced in those who have children in 6th; however, children in this grade are given money to buy at school (44%). However, when evaluating between school grades it could be observed that buying food at the *tiendita* or elsewhere before arriving at school was more frequent for most 4th and 5th grade school children, while the least frequent and without significant difference was for those children who do not

Table 1. Parents' decisions for school children's pre-school food intake

	Grade (%)		
Parents' decisions	4th	5th	6th
They prepare lunch	15^{cC}	27^{bB}	36^{aB}
Shopping in a *tiendita* or some other place	55^{aA}	37^{bA}	12^{cC}
Give money to buy at school	29^{cB}	31^{bA}	44^{aA}
They do not usually eat lunch	1^{aD}	5^{aC}	8^{aD}

Values with lower case letters represent a significant difference between school grades. Values with Capital letters represent differences between parents' decisions within the same school grade ($p \leq 0.05$).

Table 2. Type of food eaten by children before entering school

	Grade (%)		
Food group	4th	5th	6th
Fruits	2^{bE}	11^{aD}	3^{bD}
Vegetables			
Legumes and tubercules	26^{aC}	16^{bD}	10^{bD}
Cereals and derivatives	19^{aD}	8^{bE}	1^{bD}
Meal	0^{aE}	0^{aF}	0^{aE}
Egg	48^{aA}	39^{bB}	51^{aA}
Dairy	2^{aE}	4^{aF}	1^{aE}
Milk	5^{bE}	13^{aD}	6^{bD}
Meat (beef, fish, and chicken, other)	0^{aE}	0^{aF}	0^{aE}
Fluor			
Corn tortilla	54^{aA}	48^{bA}	44^{bA}
Fluor tortilla	12^{aD}	20^{aC}	21^{aC}
Snack, junk food	0^{cE}	13^{bD}	29^{aC}
Drinks			
Water	0^{aE}	0^{aF}	0^{aE}
Bottled water	0^{aE}	0^{aF}	0^{aE}
Tap water	0^{aE}	0^{aF}	0^{aE}
Coffee	0^{cE}	41^{aA}	25^{bC}
Fruit water	26^{aC}	23^{aC}	1^{bD}
Natural juice	32^{aB}	3^{bE}	8^{bD}
Processed juice	15^{cD}	29^{bC}	40^{aB}
Soft drinks	27^{aC}	4^{bE}	26^{aC}

Values with lower case letters represent a significant difference between school grades. Values with Capital letters represent differences between food group within the same school grade ($p \leq 0.05$). Values with different lowercases are significantly different ($p \leq 0.05$).

usually eat lunch before going to school (Table 1). Therefore, we also wanted to evaluate whether school children ate at home before going to school, and we observed that the food most frequently consumed by 4th is eggs (48%), natural juices (32%) and legumes and tubercules (26%), fruit water (26%), and soft drinks (27%). The most common drinks mentioned above made no significant difference to children in this scholar grade (Table 2). Unfortunately, it is very rare to consume fruit (2%) and milk (5%). Children of 5th and 6th also consume eggs more frequently (39% and 51%, respectively) but 5th accompany them with coffee (41%), while 6th with processed juice (40%). It should be noted that there was no significant difference in dairy consumption between the school grades and a low frequency of consumption. Likewise, there is no natural water and meal consumption by all children before going to school. However, when assessing the frequency of locations where children ate breakfast before arriving at school, the children of 4th preferred to eat breakfast at home (42%), followed by school (38%) and go to school (20%) with a significant difference between them. Nevertheless, 61% of 5th prefer not to eat breakfast and about 30% prefer to eat breakfast at home (29%), while 6th eat breakfast go to school. There was a significant difference at home and while going to school, as the children (6th) try not to do it at home and prefer it while going to school (Fig. 1). Thus, foods and beverages preferred by elementary school children (Fig. 2) are fried foods, hamburgers, hot dogs, pizza, cookies, candies, and soft drinks (Table 3). Therefore, the physical activity of the children is noticeable, since the children of 4th prefer to play brings it (41%) and different types of sports (35%); while there was no significant difference with the children of 5th who prefer to be seated (26%) in any part of the school (stairs, corridors, patio, and among others), to play some sport (27%) or to talk and walk (28%). Thus, children's PA decrease as the school grade increase, they prefer to be sit, talk and walk, and the boys prefer play any sport (Table 4). As a result, there is a significant difference in the level of PA, 6th was lower than 4th (Fig. 3). Three grades of elementary school were analyzed to determine the NS of the students (Table 5). According to the results obtained from the anthropometric analyses, a high prevalence of Ob was observed among elementary school children in the three grades evaluated. In 5th, normal and overweight were not significance difference. It should be noted that there are several factors compared to the 4th, may be that absence of PA (Fig. 3) (Table 4) and inadequate EH (Fig. 2) (Table 2) that begin to opt within the school.

Discussion

Parents' influence on children's breakfast

One aspect of paramount importance in the NS is the habits and EH, which are influenced by the environment

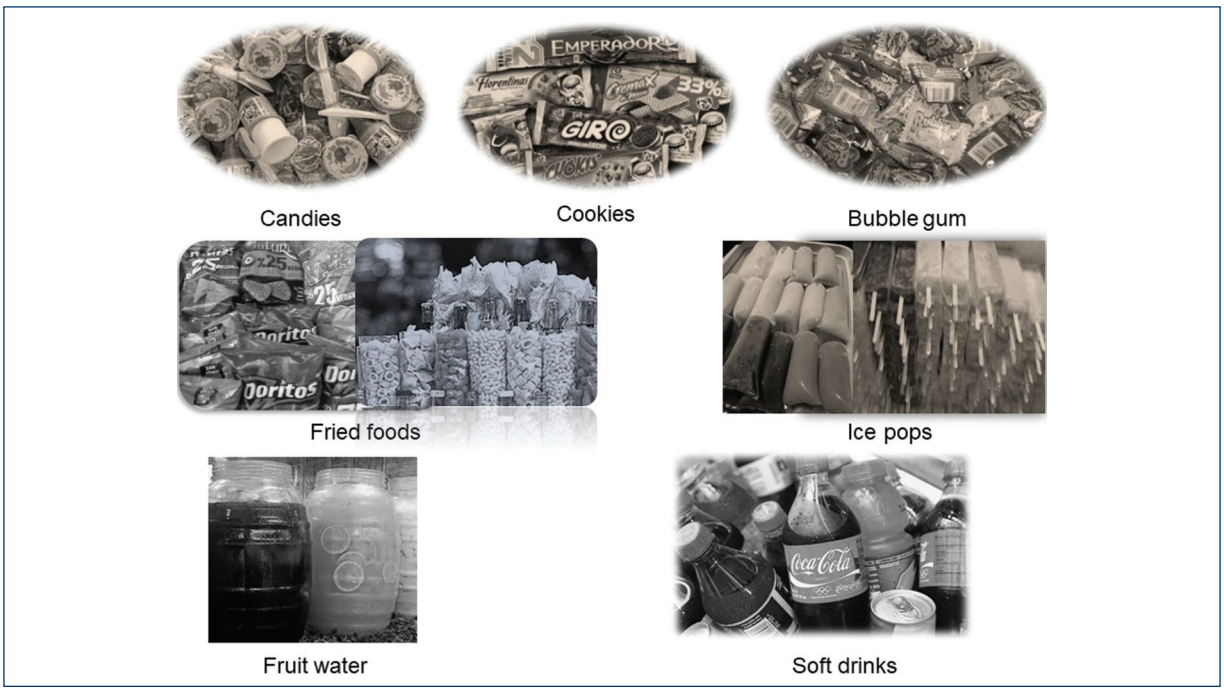

Figure 1. Main foods consumed by children inside in the elementary school.

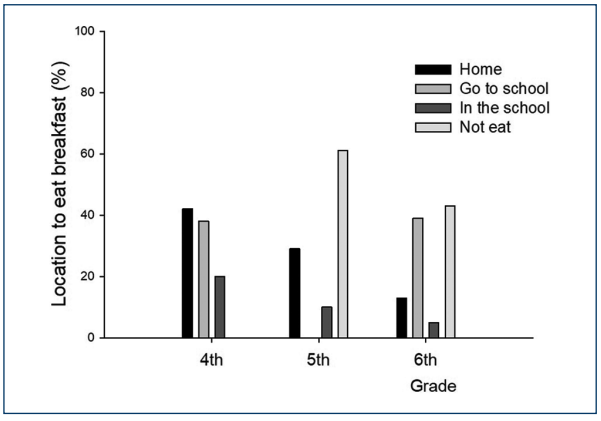

Figure 2. Frequent location of the school children's breakfast.

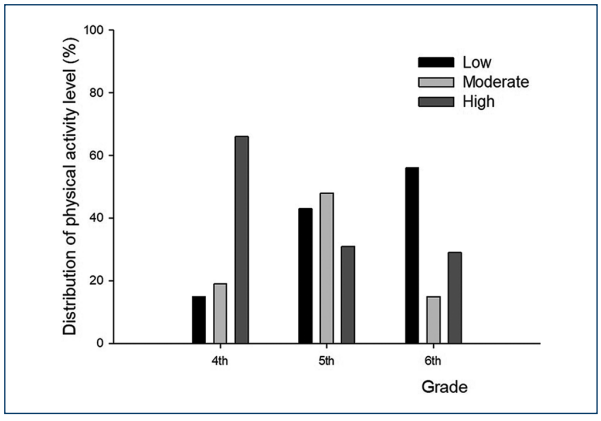

Figure 3. Distribution of physical activity level in school children.

where the children develops[20]. The influence of the family environment is quite strong in the child stage because that is where it is decided which types of food can be bought and prepared according to the economic aspect, the availability of time, and the preferences for food selection[20,21]. In our study, we saw significant aspects in the parents' decisions about their children's food. There is a positive trend among parents who prefer to give money to their children's last school grade (6th) to buy something at school while their 4th buy food at the *tiendita* for lunch (Table 1). These results are consistent with Savage[22] which notes that family integration into a child's EA is greatest when the child is younger; while the age of the child tends to be more capricious. In addition, the availability of money allows them to buy food without parental control. It is important to give and account of the family context to the infant, as it identifies how the development of different EH that may benefits or affect the health of school children is influenced[21]. New generations of parents have stopped

Table 3. Foods and beverages consumed by students within the elementary school

Food consumed	Grade (%)								
	4th			5th			6th		
	FE	AI	PI	FE	AI	PI	FE	AI	PI
Fruits	0	1	0^{b}	1	1	1^{a}	0	0	0^{b}
Vegetables	0	0	0^{b}	0	0	0^{b}	1	1	1^{a}
Yogurts	0	0	0^{b}	1	1	1^{a}	0	1	0^{b}
Fried foods	3	3	9^{a}	2	3	6^{b}	2	3	6^{b}
Hamburgers	2	1	2^{c}	1	3	3^{b}	2	3	6^{a}
Hot dogs	0	0	0^{c}	2	1	2^{a}	1	1	1^{b}
Pizza	2	3	6^{b}	3	3	9^{a}	3	3	9^{a}
Doughnuts	2	1	2^{b}	2	2	4^{a}	2	2	4^{a}
Cookies	3	3	9^{a}	3	3	9^{a}	2	2	4^{b}
Ice cream	0	0	0^{c}	1	1	1^{b}	1	2	2^{a}
Candies	3	3	9^{a}	3	2	6^{b}	3	3	9^{a}
Ice pops	3	3	9^{a}	3	3	9^{a}	3	3	9^{a}
Bubble gum	2	1	2^{b}	2	2	4^{a}	2	1	2^{b}
Drinks									
Bottled water	0	0	0^{b}	0	1	0^{b}	1	1	1^{a}
Tap water	2	2	4^{c}	3	3	9^{a}	3	2	6^{b}
Fruit water	3	3	9^{a}	2	2	4^{b}	3	3	9^{a}
Natural juice	0	0	0^{b}	1	1	1^{a}	1	0	0^{b}
Soft drinks	3	3	9^{a}	3	2	6^{b}	3	3	9^{a}

FE: frequency eating, range 0-3; AI: amount of intake; range 1-3; PI: preference index. Values with different lowercases are significantly different ($p \leq 0.05$).

Table 4. Physical activities performed by students within the elementary school

Activities	Grades (%)		
	4th	5th	6th
Talk and walk	0^{cD}	28^{aA}	14^{bC}
Sport (soccer and basketball)	35^{bB}	27^{cA}	49^{aA}
Brings it	41^{aA}	7^{bC}	4^{bD}
Jump rope	24^{aC}	12^{bB}	0^{cE}
Sit	0^{cD}	26^{bA}	33^{aB}

Values with lower case letters represent a significant difference between activities in school grades. Values with Capital letters represent differences between activities within the same school grade ($p \leq 0.05$).

Table 5. Description of the children's nutritional status (NS) of the elementary school "Lic. Presidente Miguel Alemán"

NS (%)	Grade academic		
	4th	5th	6th
Malnutrition	7.6^{aC}	0^{bC}	1.2^{aC}
Normal	2.8^{bC}	16^{aB}	14.5^{aB}
Overweigh	17.8^{aB}	15^{aB}	6.3^{bC}
Obesity	71.8^{cA}	69^{aA}	78^{aA}

NS: nutritional status. Values with lower case letters represent a significant difference between school grades. Values with Capital letters represent differences between same school grade ($p \leq 0.05$).

questioning what food they are buying for their children. Likewise, habits are behaviors that children adopt in their lives from a family member or group of friends[20,23]. It is highly worrying to see more children who are having this disease due to lack of information from their parents and also because they make decisions without conscience and responsibility in their EH. It is worth nothing, the grandparents or great-grandparents did not have this type of disease, it was not common to hear about Ob because the diet of Mexicans was different

way, because they only ate what Mexico produce[23,24]. In contrast, since the Free Trade Agreement that has allowed the entry of companies selling high processed foods, the health of infants has been put at risk because these foods have been found to have excess calories and other substances harmful to their health[7]. Therefore, it is not a question of stopping the consumption of the packages but of trying to inform oneself and improve the habits of the parents for the betterment of the habits of the children. Similarly, it is strange to demand from children about eating well, not spending money on junk food if they do not have or follow an example from their parents and it will be very difficult for them to consider it as a habit, as well as PA, it sound incongruous to ask and not do it. It is worth nothing that some school children commented that they come from families with low food availability and they can eat three meals per day but with limited consumption and preparation, as well as in nutritional quality. This type of population eats breakfast (bean 10-26%], eggs [48-51%], tortillas [88%], and coffee 25-41%]), and sometimes they have to sacrifice breakfast to eat the food (1-8%, Table 1). There was no significant difference and very few children who do not usually eat breakfast (Table 1). Therefore, it is important to emphasize that not having breakfast implies in the cognitive function of children[25]. These children's lunch is also precarious and in many cases consists of a slice of roll with scrambled egg and ham or beans.

On the other hand, it is very important the feeling habit in the child since it begins to generate the acceptance to a food or the rejection, although it is certain that in the food election there are biological determinants or genetic predispositions such as innate preference by sweet tastes and aversion to bitter tastes, which the vast majority of preferences and rejection learned in the process at this stage. In general, when asking the school children what the food they preferred, they referred to food that commonly no consumes at home (hamburgers, hot dogs, candies, soft drinks, cookies, pizza, and others). In particular, children with high economic availability have a high tendency to taste fried foods, candies, and others that they acquire in the school store (*tiendita*) or in the surrounding area. It was surprised to observe a significant difference in burger consumption between school grades, with the highest frequency of consumption being among 6th (PI = 6). It was also striking to observe that soft drinks and sweets had a greater preference (PI = 9) than natural juices and bottled water, which had no preference at all. The School Health Survey 2008 placed Mexico in the first place of consumption of soft drinks and among the five most consumed products in primary and secondary public schools in the country[26]. The 2016 Midway National Health and Nutrition Survey (ENSANUT) indicated that 81.5% of school children (5-11 years) consume caloric beverages[27]. Therefore, there is a significant percentage of the school population (Table 1) who tend to "*eat breakfast*" at school which is deficient in quantity and quality, thus predisposing them to a high consumption of fats and carbohydrates that cause an increase in adipose tissue[7,20,25].

Physical activity of school children

During recess, food, and drink intake is integrated into a variety of activities (talking, playing, walking, and sitting) that children engage in, some alone, most in groups. Although a general trend could be observed associating, on the one hand, greater food consumption by girls in the context of "*quiet*" games, slow walks in the playground and conversations, and on the other hand, less food consumption by boys involved to a greater extent in games, soccer being a game that summons, and identifies most boys. We were also able to observe a significant difference and increasing trend in how children prefer to sit as they progress through the grades (Table 4). The results show that physical inactivity by the children of 6th (33%) is maintained regardless of the sex or NS of the children. However, games during recess are centrally influenced by the characteristics of the spaces, the availability of elements (ropes, elastics, balls, and others) provided by the school or carried by the children and, above all, by institutional rules (principals and teachers) regarding permitted games, which generally restrict games with movement (soccer, stains, hide-and-seek, *poliladron*, and others) to preserve the physical integrity of the students and prevent accidents. In this sense, it was striking how, despite the prohibition of playing soccer in almost all of the school, children recreate scenes of this game using a variety of elements such as balls (empty bottles, caps, paper buns, and others). It is, therefore, important to pay attention to the type of play in the playground, not only because for many children it is one of the few spaces available for physical-recreational activities on a daily basis but also because the type of play is related to greater or lesser food consumption. Because of these restrictions, the PA of most Mexican school children (Fig. 3)[28,29]. This effect leads to a higher prevalence of Ob in 6th grade school children (Table 5). This finding was similar to that reported

in the WHO[26] where > 80% of school children did not comply with the recommendation, which resulted. This data are alarming given the relevance of PA for health in childhood that will last until adulthood. Numerous studies point to a progressive decline from physical-sports practice as one moves from childhood to adolescence[29-31].

In Mexico, research has evaluated the intensity of physical activity in primary school physical education and recreation classes and has found that about 70% of the total time spent in physical education class is used for physical activity instruction and 30% for exercise[32]. These results are consistent with the comments the children made to us that the large amount of time spent standing while the teacher organizes the group is long lines (> 30 school children) and class time was running out and not enough to play. According to the Mexican Report Card for Physical Activity in Children and Youth[33], an instrument for monitoring children's PH, Mexico is not providing adequate opportunities for PH across its different domains, mainly in school. The picture is even more alarming considering that most primary schools are surrounded by high-energy foods (discussed below).

The results obtained in our study show a higher prevalence of overweight and obesity compared to those reported in Paraguay, Chile and Brazil (Florianópolis)[34-36]. Our results are also consistent with studies conducted with Spanish children where they showed that 57.5% of young school children are inactive at recess[37]. Our study is consistent with the WHO study where it was reported that 62% of school children are not enough in PH within the school[38]. The result is consistent with another study with Spanish elementary school children that showed 70% of children to be insufficiently active[39]. In our study, data on PH were similar to those reported in other countries such as Colombia and Mozambique[40,41], which noted that PA may be related to the lack of space, facilities, opportunities, equipment, and human resources within school premises, making it difficult for children to engage in any sport during school hours. In addition, many elementary schools in Mexico have two shifts, which reduce opportunities for extracurricular PA. In addition, the time allocated to physical education, leisure, and recreation in schools, especially in elementary schools, has declined to give greater priority to theoretical disciplines[42]. This has increased children's sedentary activities which can make a crucial contribution to their health[30]. Therefore, there are numerous studies that agree to show positive changes with PA and that it has been linked to a reduction in the risk of suffering from more than 25 chronic health conditions[29,30,43]. Seeing this effect, schools should provide more and better PH opportunities to children and adapted to their basic needs[38]. It is also necessary to ensure that schools contribute at least twice a week of varied and enjoyable PH to improve, maintain and develop children's lifelong PA habits[44]. It should be noted that most elementary schools in Mexico have playgrounds that are poorly equipped for PA and active play, and should, therefore, be maintained and better equipped. Thus, variety of programs have been implemented in Mexico to foster PH within the school environment[34]. To date, the impact of this intervention is unknown, so it is impossible to attribute the increase in sports activities among school children. It is worth mentioning that there is currently no definitive evidence on PA carried out by children during school time in Mexico; likewise, the amount of caloric expenditure, the intensity of the duration of PH and its relationship with health and nutrition parameters, gender, age or school grade and socio-cultural, and economic environment is unknown.

NS of school children

The results of this research present remarkable evidence of weight gain in children, with a significant difference between NS at each grade level. This is directly related to the inadequate food preferences that children acquire in school, as it is a very important factor in the appearance of child Ob; coupled with the quantity, continuity of consumption and quality of food[44]. Evidence also suggests that it is a lack of commitment by parents to their children's health. The results obtained with the school children population not only explain the index of Ob but also coincide with researches, in terms of the risk of chronic non-degenerative diseases since the habits and attitudes that will predominate throughout life are formed in the school stage[5,7,20,36,40]. The sedentary habits incurred by this population cannot be ignored, which is why it coincides with some studies carried out in Mexico where they investigated the prevalence of overweight and Ob, as well as recognized risk factors related to these pathologies, such as EH when watching TV, taking a nap after eating, watching TV after eating, chatting with the cell phone while lying down or sitting down, and others[45,46]. The fundamental cause of Ob is an energy imbalance between calories consumed and spent[1]. Around the world, an increase in the intake of high-calorie but micronutrient-poor foods is prevalent, as well as a decrease in PA, as a

result of the increasingly sedentary nature, including new modes of travel (car, public transport, and shuttle service [uber and taxi]) to get children to school[2,4,7]. Furthermore, the nutritional transition that Mexico is experiencing is characterized by a westernization of the diet, specifically: (1) an increase in the availability of low-cost junk food with high amounts of calories and salt; (2) a decrease in the time available for food preparation at home; (3) a significant increase in the exposure to advertising and the supply of industrialized foods; and (4) a decrease in the population's PA. Thus, in the present investigation these causes were observed that harm in a way the health of the infants. The high incidence of Ob, which is alarming figures, so it is possible to conclude that in Mexico there, is no public policy to promote EH and PH, which is necessary to implement strategic health programs in basic schools to reduce this problem in children. In addition, the influence of parents on NS is essential to meet the basic needs of the child, who's inadequate EH and PA from childhood will be a reflection of their future health condition. It is important to implement nutrition education in schools o establish healthy choices for children and set goals, including: (1) promoting PA in the school environment; (2) reducing the consumption of sugars and other added caloric sweeteners in food and beverages; and (3) increasing the daily consumption of fruits and vegetables, legumes, whole grain cereals, and fiber in the diet.

Conclusions

In relation to the objective of this research, we identified the factors that influenced the NS of their school children and the EH within the primary school in Tepic Nayarit, Mexico. The results showed that junk food is prevalent in school schedules and that it has a direct impact on the development of Ob in school children. School children have moderate and low levels of physical activity during school hours. With these results, it can be concluded that schoolchildren have an alarmingly high incidence of Ob, which may be influenced by physical activity and EH generated within the school.

Acknowledgments

The authors thank the Nutrition Coordinator and the Principal of University for the permissions granted to develop this project. Also, they would like to thank the primary school principal and parents for agreeing to work with the children in the development of this project.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Funding

No funding is declared

References

1. Jenelle S, Krishnamoorthy CH, Elissa J. The epidemic of childhood obesity: review of research and implications for public police. Soc Res Child Dev. 2006;20:1-20.
2. Chin SH, Huang WL, Akter S, Binks M. Obesity and pain: a systematic review. Int J Obes. 2019;44:969-79.
3. Birkin M, Wilkins E, Morris MA. Creating a long-term future for big data in obesity research. Int J Obes. 2019;43:2587-92.
4. Pérez-Herrera A, Cruz-Pérez M. Childhood obesity: current situation in Mexico. Nutr Hosp. 2019;36:463-9.
5. NTv. IMSS: Existe una Epidemia de Obesidad en Población Escolar en Nayarit por Doreida Zuñiga; 2019. Available from: https://www.ntv.com.mx/2019/11/11/1aimss-existe-una-epidemia-de-obesidad-en-poblacion-escolar-en-nayarit. [Last accessed on 2019 Dec [24].
6. Casillas-Ávila JM, Fuentes-García RA, Casillas-Ávila MP. Prevalencia de obesidad infantil en Tepic y Xalisco. Rev Educ. 2007;11:149-59.
7. Montes SI, Velarde ER, Garibay VE, Rico JC, Ramírez HR. Obesidad en niños de 6 a 9 años, factores socioeconómicos, demográfico y disfunción familiar. Rev Med Inst Mex Seg Soc. 2010;48:485-90.
8. Shamah-Levy T, Cuevas-Nasu L, Gaona-Pineda EB, Gómez-Acosta LM, Morales-Ruán MC, Hernández-Ávila M, et al. Sobrepeso y obesidad en niños y adolescentes en México, actualización de la Encuesta Nacional de Salud y Nutrición de Medio Camino 2016. Rev Sal Pub Mex. 2018;6:244-56.
9. El Diario Digital. Tiene Chihuahua Primer Lugar en Obesidad Infantil. Escrito por Manuel Quezada Barrón; 2019. Available from: https://www.diario.mx/estado/tiene-chihuahua-primer-lugar-en-obesidad-infantil-20190420-1505345. [Last accessed on 2020 May [21].
10. Ángulo. 2017. Available from: https://www.angulo7.com.mx/2017/01/31/obesidad-infantil-puebla-crece-3-prohibir-chatarra-no-sirvio. [Last accessed on 2020 May 08].
11. Chávez GA, Chanssin AD, Andrade IS, Mansalve RC, Esqueda LE, Moran RM. Factores de riesgo cardiovascular asociados a obesidad abdominal en adultos aparentemente sanos. Rev Med Inst Mex Seg Soc. 2008;46:273-9.
12. Ramírez OE. Obesidad en la niñez: la pandemia. Rev Mex Pediatr. 2009;76:38-43.
13. Ceballos LT. Síndrome metabólico en la infancia. Ann Pediatr. 2007;66:159-66.
14. Aviña OL. Propuesta para disminuir la obesidad infantil en escuelas primarias y preprimarias del estado de Jalisco. Rev Diabetes. 2005;6:1486-90.
15. Hernández-Cordero S Cuevas-Nasu L, Morales-Ruán MC, Méndez-Gómez Humarán I, Ávila-Arcos M, Rivera-Dommarco JA. Overweight and obesity in Mexican children and adolescents during the last 25 years. Nutr Diabetes. 2017;7:e247.
16. Institute of Epidemiology and Health Care. Eating Behavior Questionnaires. London: University College. Available from: https://www.ucl.ac.uk/epidemiology-health-care/research/behavioural-science-and-health/resources/questionnaires/eating-behaviour-questionnaires. [Last accessed on 2019 Dec 26].
17. Kliemann N, Beeken RJ, Wardle J, Johnson F. Development and validation of the self-regulation of eating behavior questionnaire for adults. Int J Behav Nutr Phys Act. 2016;13:87.
18. Lassetter JH, Macintosh CI, Williams M, Driessnack M, Bay G, Wisco JJ. Phychometric testing of the healthy eating and physical activity elf-efficacy questionnaire and the healthy eating and physical activity behavior recall questionnaire for children. J Spec Pediatr Nurs. 2018;23:e12207.
19. Voss C, Ogunleye AA, Sandercock GR. Physical activity questionnaire for children and adolescents: English norm and cut-off points. Pediatr Int J. 2013;55:498-507.

20. Domínguez-Vásquez P, Olivares S, Santos JL. Influencia familiar sobre la conducta alimentaria y su relación con la obesidad infantil. Arch Latinoam Nutr. 2008;58:249-55.
21. Brown R, Ogden J. Children's eating attitudes and behaviour: a study of the modelling and control theories of parental influence. Health Educ Res. 2004;19:261-71.
22. Savage JS, Fisher JO, Birch LL. Parental influence on eating behavior: conception to adolescence. J Law Med Ethics. 2007;35:22-34.
23. Rivera JA, Barquera S, González-Cossío T, Olaiz G, Sepúlveda J. Nutrition transition in Mexico and in other Latin American Countries. Nutr Rev. 2004;62:S149-57.
24. Santos JL, Martínez JA, Pérez F, Albala C. Epidemiología genética de la obesidad: estudios familiares. Rev Med Chile. 2005;133:349-61.
25. Adolphu K, Lawton CL, Dye L. The effects of breakfast and academic performance in children and adolescents. Front Hum Neurosci. 2013;7:425.
26. World Health Organization. Global Health Observatory Data Repository. Prevalence of Insufficient Physical Activity among School Going Adolescents. Geneva: World Health Organization; 2016. Available from: http://www.apps.who.int/gho/data/view.main.2463ADO?lang=en. [Last accessed on 2019 Nov].
27. Barquera S, Campirano F, Bonvecchio A, Hernández-Barrera L, Rivera JA, Popkin BM. Caloric beverage consumption patterns in Mexican children. Nutr J. 2010;9:47.
28. Pérez-Herrera, A, Cruz-López, M. Situación de la obesidad infantil en México. Nutr Hosp. 2019;36:463-9.
29. Nuviala A, Ruíz JF, García-Montes ME. Tiempo Libre, Ocio y Actividad Física en los Adolescentes. La Influencia de los Padres. Vol. 3. Revista Retos. Nueva Tendencia en Educación Física, Deporte y Recreación; 2003. p. 13-20.
30. Román B, Serra L, Ribas L, Pérez-Rodrigo C, Aranceta J. Actividad Física en la Población Infantil y Juvenil Española en el Tiempo Libre. Estudio Enkid (1998-2000). Vol. 151. Apunts. Medicina de L'esport. 2006. p. 86-94.
31. Cervelló EM, Santos-Rosa FJ. Motivación en las clases de Educación Física: un estudio de la perspectiva de las meta de logro en el contexto educativo. Rev Psicol Deporte. 2000;9:51-70.
32. Jennings-Aburto N, Nava F, Bonvecchio A, Safdie M, González-Casanova I, et al. Physical activity during the school day. Salud Pub Mex. 2009;51:141-7.
33. Galaviz KI, Arroyo MA, Gonzalez-Casanova I, Villalobos MF, Jauregui A, Ulloa EJ, et al. Results from Mexico's 2016 report card on physical activity for children and youth. J Phys Act Health. 2016;13:S206-12.
34. Atalah E, Urteaga C, Rebolledo A, Delfín S, Ramos R. Prevalencia de obesidad en escolares de la Región de Aysén. Rev Chil Ped. 1999;70:208-14.
35. Filozof C, González C, Sereday M, Mazza C, Braguinsky J. Obesity prevalence and trends in Latin-American countries. Obes Rev. 2001;2:99-106.
36. Kain J, Vio F, Abala C. Obesity trends and determinant factors in Latin America. Cad Saúde Pública. 2003;19:S77-86.
37. Román-Viñas B, Serra-Majem L, Ribas-Barba L, Pérez-Rodrigo C, Aranceta-Bartrina J. Actividad física en la población infantil juvenil española en el tiempo libre. Estudio enKid (1998-2000). Apunts Med Esport. 2006;41:86-94.
38. World Health Organization. Health behaviour in school-aged children: a WHO cross-national Study (HBSC). Conpenhagen: World Health Organization; 2004.
39. Lasheras L, Aznar S, Merino B, Lopez EG. Factors associated with physical activity among Spanish youth through the National Health Survey. Prev Med. 2001;32:455-64.
40. Tremblay MS, Gray CE, Akinroye K, Harrington DM, Katzmarzyk PT, Lambert EV, et al. Physical activity of children: a global matrix of grades comparing 15 countries. J Phys Act Health. 2014;11:S113-25.
41. Medina C, Barquera S, Katzmarzyk PT, Janssen I. Physical activity during recess among 13-14 year old Mexican girls. BMC Pediatr. 2015;15:329.
42. Hardman, K. The situation of physical education in schools: a European perspective. Hum Mov. 2008a;9:5-18.
43. Vizcaino VM, Aguilar FS, Gutierrez RF, Martinez MS, Lopez MS, Martinez SS, et al. Assessment of an after-school physical activity program to prevent obesity among 9-to 10-year-old children: a cluster randomized trial. Int J Obes. 2008;32:12-22.
44. Trudeau F, Shephard RJ. Physical education, school physical activity, school sports and academic performance. Int J Behav Nutr Phys Act. 2008;5:10.
45. Alvear-Galindo MG, Yamamoto-Kimura LT, Morán-Álvarez C, Solís-Días MG, Torres-Durán PV, Juárez-Oropeza MA, et al. Consumo alimentario dentro y fuera de la escuela. Rev Med Inst Mex Seguro Soc. 2013;51:450-5.
46. de Rivera AD, Mata-Miranda C, De Lira-García C. Preferencias alimentarias durante el recreo escolar: niños de primaria de 9 a 10 años. Mex J Eating Dis. 2018;9:250-63.