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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.

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