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Lifestyles of 2- to 11-year-old children during the COVID-19 pandemic

Estilos de vida de niños de 2 a 11 años durante la pandemia de COVID-19

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Abstract

Introduction: risk factors associated with obesity such as poor dietary quality, low physical activity (PA), screen time (ST), and poor sleep duration (SD) were affected during confinement resulting from the SARS-CoV-2 pandemic.

Objective: the aim of our study was to evaluate the association between PA, ST and SD with the consumption of non-recommended food groups (N-RFG) in children during the COVID-19 pandemic, using data from ENSARS-CoV-2 Girls and Boys.

Methods: data were gathered through a self-administered electronic survey carried out in four regions of Mexico during September and October 2020. Dietary patterns were established using k-means cluster analysis. Linear regression models were used to study the effect of food consumption patterns and PA on hours of ST per week.

Results: in all, 2,405 children aged 2 to 11 were studied. Three food group consumption patterns were identified. Group 1 or "high consumption of added sugars group" and Group 2 or "high consumption of N-RFG group" children reported more hours of ST than those in Group 3 or "low consumption of N-RFG group" ($p < 0.001$ and $p < 0.001$, respectively). Group 2 reported more hours per week of ST but also more days of PA vs Group 3.

Conclusion: confronted by the pandemic, it is essential to redouble efforts to reverse the harmful effects of lifestyles during the COVID-19 pandemic to improve the health of Mexican children in the years to come.

Keywords:

COVID-19. Children. Physical activity. Screen time. Dietary patterns. Sleep duration.

Resumen

Introducción: los factores de riesgo asociados a la obesidad, como la pobre calidad de la dieta, la baja actividad física (AF), el tiempo frente a pantallas (TP) y la corta duración del sueño (DS), se vieron afectados durante el confinamiento resultado de la pandemia por SARS-CoV-2.

Objetivo: el objetivo del estudio fue evaluar la asociación entre AF, TP y DS y el consumo de grupos de alimentos no recomendados (GANR) en niños durante la pandemia por COVID-19, utilizando datos de la ENSARS-CoV-2 Niñas y Niños.

Métodos: la información fue recolectada por medio de una encuesta electrónica autoadministrada durante septiembre y octubre de 2020 en las 4 regiones de México. Para establecer patrones de consumo de alimentos se utilizó un análisis de conglomerados por el método de las medias k. Se utilizaron modelos de regresión lineal para estudiar los efectos de los patrones de consumo de alimentos sobre AF y TP.

Resultados: la muestra fue de 2,405 niños de 2 a 11 años de edad. Se identificaron 3 grupos de patrones de consumo de alimentos. El grupo 1 o de "alto consumo de azúcares añadidos" y el grupo 2 o de "alto consumo de GANR" reportaron un mayor número de horas a la semana frente a una pantalla en comparación con el grupo 3 o de "bajo consumo de GANR" ($p < 0{,}001$ y $p < 0{,}001$, respectivamente). El grupo 2 reportó menos horas a la semana de TP pero también más días de AF con respecto al grupo 3.

Conclusión: se ha vuelto esencial duplicar los esfuerzos para revertir los efectos nocivos en los estilos de vida que se establecieron durante la pandemia para mejorar la salud de los niños mexicanos en los años subsecuentes.

Palabras clave:

COVID-19. Niños y niñas. Actividad física. Tiempo frente a pantalla. Patrones dietéticos. Horas de sueño.

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INTRODUCTION

On March 2020, the World Health Organization declared the COVID-19 pandemic, forcing global changes on social and family dynamics (1). In Mexico, weeks later, after the first case was reported (2), over 36 million Mexican children were forced to stop attending school and remain in their homes (3).

Studies have documented negative effects on children lifestyle as a result of the long period of confinement (4-6). The lack of outdoor activities increased screen time (ST) among children, either as part of academic activities or as entertainment, promoting a sedentary lifestyle and altered sleep patterns. A study on Dutch children observed an increase of one hour of ST in the first stages of the pandemic (7). These lifestyle changes can negatively affect both physical and emotional human health, particularly in children, for whom consequences may extend into adulthood (8,9).

Even before the pandemic happened, sedentary lifestyles were observed as increasing the risk of depression, anxiety, suicide and attention disorders among children (8,10,11), as well as the risk for respiratory diseases attributable to insufficient immune responses which decreased physical activity (PA) (12). Likewise, it has been observed that children with some levels of obesity have less perform than children with a normal nutritional status in terms of psychomotor development, such as motor activities, perceptual skills, social relationships, laterality, control respiratory and visual coordination, this difference is more accentuated in girls than in boys (13). A systematic review showed that unhealthy lifestyles (increased ST, unhealthy dietary habits, and lower levels of PA) during childhood, are associated with risk of adiposity (14). During COVID-19 pandemic, all of these conditions were observed more frequently than ever before (15,16).

In all, 38.2 % of Mexican school-age children were overweight or obese in 2020 (17). Periods of confinement were also associated with a decrease in fruit and vegetable consumption (18) and increased consumption of calorie-dense foods (19), causing changes in body mass (20-22) as well as vitamin D deficiency, which impacts growth and increases the risk of immune system suppression (23).

The objective of this study was to evaluate the association between physical activity, screen time and sleep duration with the consumption of non-recommended food groups (N-RFG) in boys and girls aged 2 to 11 years during the COVID-19 pandemic, using data from the special Mexican Health and Nutrition Survey applied to children under 12 during COVID-19 (ENSARS-CoV-2 Girls and Boys).

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLE

The ENSARS-CoV-2 Girls and Boys is a national survey of children aged 2 to 11 years. Data were collected during September and October 2020 using a self-administered electronic form, through phone messages and online social networks with key informants in multiple Mexican states from the 4 regions of the country (North, Center/Mexico City and South). A more detailed description of this distribution is published elsewhere (24).

Responses were obtained from parents and caregivers with the aim of understanding the health and nutrition conditions of minors during the COVID-19 pandemic (24), using the sampling procedure known as respondent-driven sampling (RDS) (25). Sampling procedures used 64 parents as a seed sample, each of whom referred two others, and so on; it was therefore expected that at reference level 5, approximately (64 x 25) = 2028 participants would be included.

Informed consent was obtained from parent or caregiver of the children at the beginning of the survey. The protocol was submitted to the ethics, research, and biosafety commissions of the National Institute of Public Health. Survey dissemination and data collection took place during September-October of 2020.

VARIABLES

Frequency of PA

PA was obtained through a question of frequency of physical activities in children's spare time, such as: running, jumping, etc. With response options: none, < 2 days/week, 2-3 days/week, 4-5 days/week, and daily.

Screen time (ST)

ST was defined as the time a child spent watching television, a tablet, or some mobile device for entertainment purposes. Hours/day that each child spent in front of the screen was self-reported by the participating parent or caregiver. With response options: none, 1-2 days/week, 3-5 days/week and daily. In case of affirmative response, the number of hours/day were asked. A variable representing ST hours/week was constructed, where the mean value of each response was assigned for days as: 1-2 days/week = 1.5; 3-5 days/week = 4; every day = 7; and for hours: < 1 hour/day = 0.5; 1-2 hours/day = 1.5; 3-4 hours/day = 3.5, and > 4 hours = 5. Finally, the mean number of days/week was multiplied by the mean number of hours/day to obtain hours/week of ST.

Sleep duration (SD)

SD was estimated by asking informants to indicate the approximate number of hours their children slept per day (including naps). Response options were: 1) < 8 hours, 2) 8-10 hours, 3) ≥ 11 hours.

Consumption of N-RFG

Dietary information was obtained through a food-frequency questionnaire with a reference period of seven days, previously used in the ENSARS-CoV-2 adults survey. This questionnaire was an adaptation of the Household Dietary Diversity Score methodology of the Food and Nutrition Technical Assistance Project (26), which estimates the consumption of 12 food groups in the home within a given reference period. An adapted version of this questionnaire was used in this study with 19 food groups including plant-based milk and N-RFG. The questionnaire used in the Mexican National Health and Nutrition Survey 2018-19 (ENSANUT 2018-19) (27) was used as a reference for consumption of water and sugar-sweetened beverages.

Food groups included: cereals; roots and tubers; fresh vegetables; processed vegetables; fresh fruits; processed fruits; meat and poultry; eggs; fish and seafood; legumes; oilseeds; milk and dairy products; plant-based milks; vegetable oils; added sugars; sugar-sweetened beverages; candies, desserts and snacks; and coffee, tea and infusions. The amount/day of sugar-sweetened beverages and water was also elicited.

The present analysis only considered the non-recommended food groups (N-RFG): processed fruits (canned, dehydrated, those found in smoothies or desserts), added fats (butter, mayonnaise, cream), added sugars (sugar, honey and other sweeteners such as Mexican piloncillo added to food or drinks), sugar-sweetened drinks (soft drinks, canned juices, powders to prepare sugary drinks, bottled flavored water), and candies, desserts and snacks (candies, chocolates, cakes, pastries).

Socioeconomic status (SES)

Parents were asked about certain goods or services present in their household in order to classify the population in seven categories SES according to the Mexican Association of Market Intelligence and Opinion of 2018 (AMAI) Index (28). This methodology uses an algorithm developed by the Socioeconomic Levels Committee to generate an index considering six household characteristics: head-of-household education level, number of bedrooms, number of full bathrooms, number of cars, number of household members aged 14 and up who work, and internet connectivity. From these characteristics, a score was generated and classified into seven categories of SES: A/B (highest), C+, C, C-, D+, D and E (lowest).

STATISTICAL ANALYSIS

To establish dietary patterns based on reported child consumption of N-RFG, a k-means cluster analysis was performed. Two to eight group patterns were determined; the first selection criterion was minimization of the sum of square errors; however, interpretation was also a final decision criterion. A linear regression model was used to estimate the effect of different food consumption patterns and PA on ST. A second linear regression model was used to determine the effect of different food groups, as well as water and sugar-sweetened beverage consumption, on the number of days per week children engaged in PA. Finally, an ordinal logistic regression model was used to study the effect of sugar-sweetened beverage consumption and number of days per week of PA on hours of sleep/day. All models were adjusted by socioeconomic status and age. Analysis was performed using Stata 16.0.

RESULTS

Final study sample included 2,405 children aged 2 to 11 from the ENSARS-CoV-2 Girls and Boys survey.

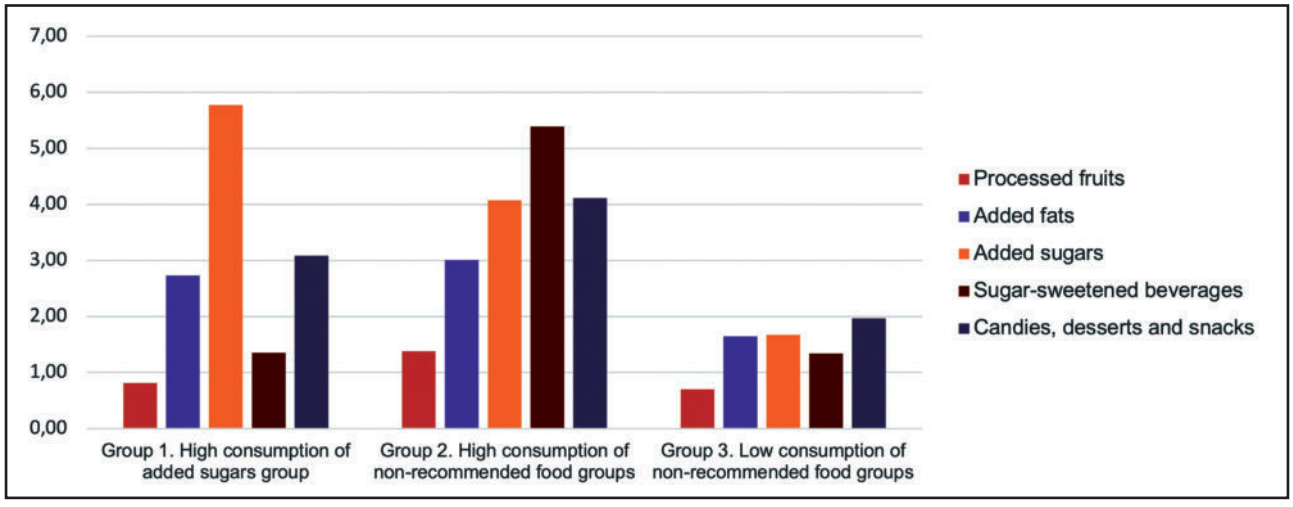

Figure 1.

Mean consumption of non-recommended foods, by dietary pattern.

Through a cluster analysis, three pattern groups were selected in which the residual error demonstrated an inflexion point, which was further affirmed by interpretation. Figure 1 shows the three patterns of child consumption of N-RFG. Group 1 (high consumption of added sugars group) was characterized by more days consuming sugar, honey and other sweeteners added to foods and beverages. Group 2 (high consumption of N-RFG) had more days consuming every N-RFG, except processed fruits, with the highest being sugar-sweetened beverages. Group 3 (low consumption of N-RFG) had less days consuming every N-RFG (≤ 2 days per week).

Table I shows characteristics of sample population according to the dietary patterns identified and for the total sample. Total study population included 1196 preschool children (2 to 4 years) and 1209 school age children (5 to 11 years); within this last group we made the distinction between children from 5 to 7 and 8 to 11 years to explore if there could be any differences among them because of the stage of development they were going through. The sample was evenly distributed by sex and more than 60 % was placed in the upper categories of socioeconomic status.

Children in Group 1 and Group 2 were associated with more ST than Group 3 ($p < 0.001$ and $p < 0.001$, respectively); Group 2 had on average 16 hours of ST, compared to 11 hours in Group 3 (Fig. 2A).

Figure 2B shows the relation between hours/week of ST and days/week of PA, as estimated through lineal regression; the most ST (15.7 hours) was observed in children who reported no PA, as compared to those who performed daily PA (12.5 hours) ($p = 0.15$).

When stratified by age, older children (8-11 years old) reported more ST (14.8 hours) as compared to younger children (2-4 years old, 11.9 hours) ($p < 0.001$). A tendency was also observed towards increased ST with higher SES level (data not shown).

Regarding the PA regression model, figure 3A illustrates the greater number of days of PA in Group 2 children compared to Group 3 ($p = 0.053$). Figure 3B shows on average 1.5 more days of PA in children who drank ≥ 2 liters of water per day, in comparison to those who drank < 250 mL ($p < 0.002$). Furthermore, children who did not consume sugar-sweetened beverages reported an average of 4.4 days of PA, compared to 4.1 days in those children who did ($p = 0.001$) (Fig. 3C). More frequent PA was observed in those children at the highest SES (Fig. 3D) and in younger children (2-4 years) (data not shown).

Results from the ordinal logistic regression model showed that the odds of sleeping fewer hours per night (< 8) were greater in children who consumed sugar-sweetened beverages and in those who did not perform PA (5.5 %, $p = 0.005$ and 11.6 %, $p = 0.003$; respectively). On the contrary, the odds of sleeping ≥ 11 hours were greater in those children who did not consume sugar-sweetened beverages and in those who performed PA every day (32.2 %, $p = 0.011$, and 31.8 %, $p < 0.001$; respectively) (Table II).

Table I. Study sample characteristics by dietary pattern. Mexico, ENSARS-CoV-2 Girls and Boys

	Group 1. High consumption of added sugars group			Group 2. High consumption of non-recommended food groups			Group 3. Low consumption of non-recommended food groups			Total		
Variables	***n***	**%**	**95 % CI**	***n***	**%**	**95 % CI**	***n***	**%**	**95 % CI**	***n***	**%**	**95 % CI**
Age (years)												
2-4	245	37.8	(34.1, 41.6)	273	49.2	(45.0, 53.4)	678	56.4	(53.6, 59.2)	1196	49.7	(47.7, 51.7)
5-7	188	29.0	(25.6, 32.6)	111	20.0	(16.9, 23.5)	246	20.5	(18.3, 22.8)	545	22.7	(21.0, 24.4)
8-11	215	33.2	(29.6, 36.9)	171	30.8	(27.1, 34.8)	278	23.1	(20.8, 25.6)	664	27.6	(25.9, 29.4)
Sex												
Male	321	49.5	(45.7, 53.4)	295	53.2	(49.0, 57.3)	585	48.7	(45.8, 51.5)	1201	49.9	(47.9, 51.9)
Female	327	50.5	(46.6, 54.3)	260	46.9	(42.7, 51.0)	617	51.3	(48.5, 54.2)	1204	50.1	(48.1, 52.1)
*SES**												
A/B	122	18.8	(16.0, 22.0)	75	13.5	(10.9, 16.6)	208	17.3	(15.3, 19.6)	405	16.8	(15.4, 18.4)
C+	196	30.2	(26.8, 33.9)	123	22.2	(18.9, 25.8)	307	25.5	(23.23, 28.1)	626	26.0	(24.3, 27.8)
C	150	23.1	(20.1, 26.6)	152	27.4	(23.8, 31.3)	264	22.0	(19.7, 24.4)	566	23.5	(21.9, 25.3)
C-	78	12.0	(9.7, 14.8)	77	13.9	(11.2, 17.0)	183	15.2	(13.3, 17.4)	338	14.1	(12.7, 15.5)
D+	65	10.0	(7.9, 12.6)	76	13.7	(11.1, 16.8)	122	10.1	(8.6, 12.0)	263	10.9	(9.7, 12.2)
D or E	37	5.7	(4.2, 7.8)	52	9.4	(7.2, 12.1)	118	9.8	(8.3, 11.6)	207	8.6	(7.5, 9.8)

**Socioeconomic status according to AMAI 2018 Index.*

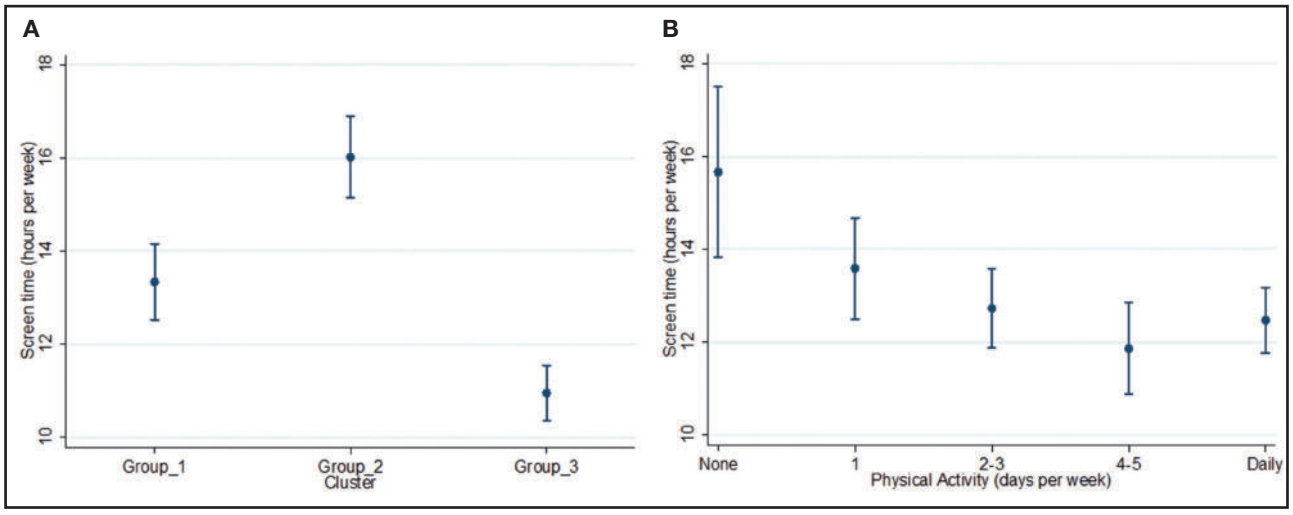

Figure 2.

Screen time per week model. A. Hours of ST per week in children according to dietary pattern. B. Relationship between hours of ST and PA in children.

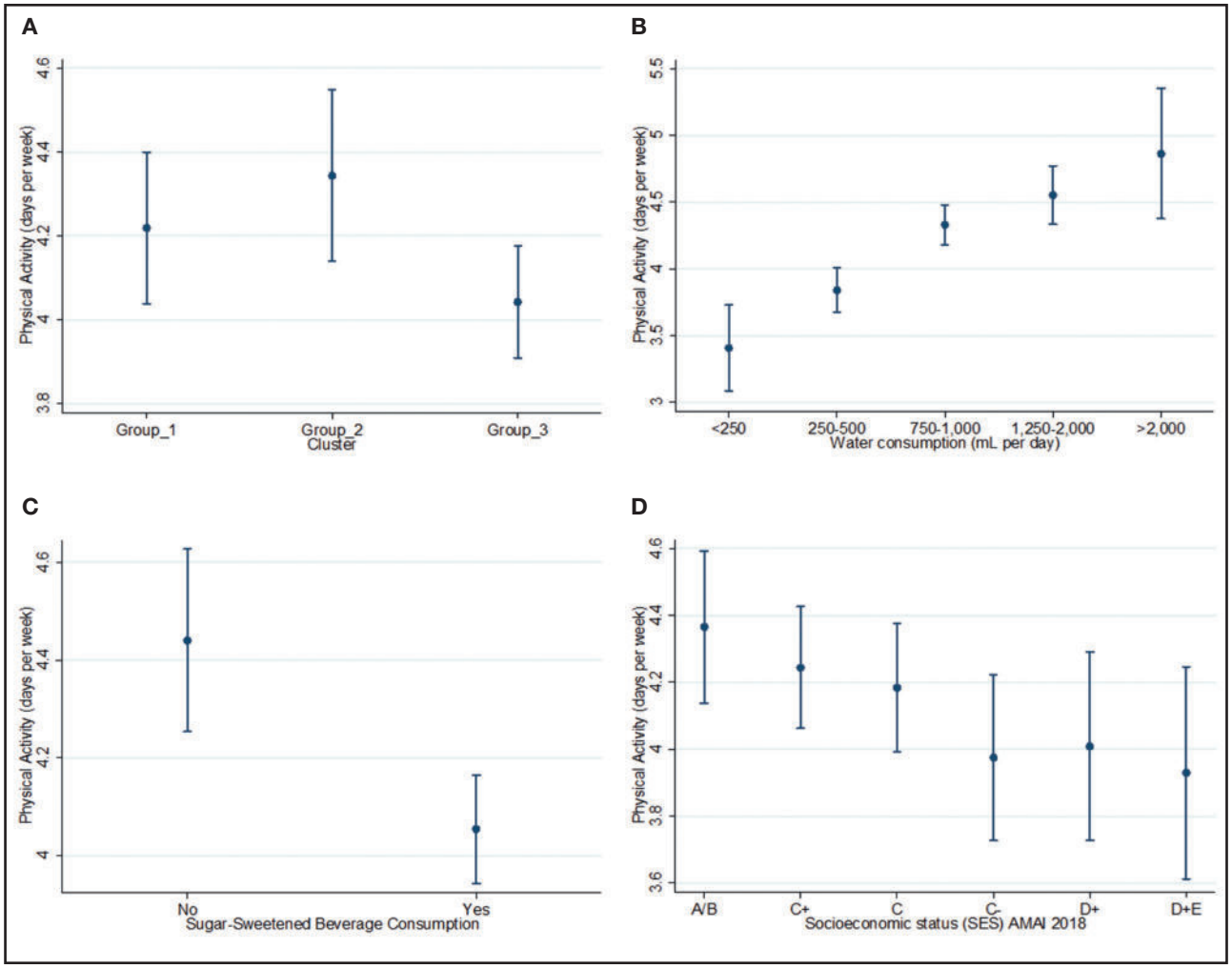

Figure 3.

Days of physical activity per week model. A. PA in children according to dietary pattern. B. PA in children according to water consumption. C. PA in children according to sugar-sweetened beverage consumption. D. PA in children according to SES.

Table II. Odds ratio of sleep duration by sugar-sweetened beverage consumption and physical activity. ENSARS-CoV2 Girls and Boys

	Sugar-sweetened beverage consumption		Physical activity (days per week)				
Sleep duration (hours per day)	**No**	**Yes**	**None**	**1**	**2-3**	**4-5**	**7**
< 8	4.0	5.5	11.6	5.4	5.4	4.2	3.6
8-10	63.8	68.5	75.9	70.3	70.4	67.0	64.5
≥ 11	32.2	26.0	12.5	24.3	24.2	28.8	31.8

DISCUSSION

This study analyzed patterns of non-recommended food groups (N-RFG) consumption and their association with physical activity (PA), hours of sleep and screen time (ST) in 2-11-year-old children who formed part of the ENSARS-CoV-2 Girls and Boys survey in Mexico.

One of the most relevant results of this study is that children who spent the most time on screens were also those who did less PA per week, perhaps resulting from confinement during the COVID-19 pandemic. Daily recommendations for children specify a maximum of two hours/day of ST, and a minimum of 60 minutes of moderate to vigorous PA (29). These recommendations have often not been met during the pandemic, as previously reported in studies such as one carried out in German children, that showed a decrease in PA during the confinement period while recreational ST increased (30). Likewise, another study reported that during the pandemic parents perceived a decrease in the PA of their children, and an increase in sedentary behavior (31). Another study found that at least two-thirds of participants exceeded two hours/day of total ST, reflecting the widespread use of screen-based media during this period (32). Notably, this trend was observed even prior to the pandemic, as reported by Dietz et al. (33), whose findings in children showed that an increase in ST was replacing hours spent performing PA, and that the consequently lower energy expenditure may lead to increased body weight.

Regarding the link between consumption of N-RFG and ST during the pandemic, our study observed that children in Group 2 reported the most ST, while Group 3 reported less. This is consistent with previous studies, where a significant relationship has been observed between ST and adverse effects on diet such as reduced dietary quality, including higher consumption of unhealthy foods and lower consumption of fruits and vegetables. Pietrobelli et al. reported that some dietary behaviors of Italian children worsened during pandemic confinement, such as consumption of sugar-sweetened beverages; however, others improved, such as fruit consumption (18). Greater ST has been associated with higher consumption of sugar-sweetened beverages and energy-dense snacks with high fat and sugar content. A contributing factor may be the abundance of advertisements for poor nutritional quality foods which are attractive to children (34,35).

Regarding SD, our study found that children who did not consume sugar-sweetened beverages were more likely to sleep ≥ 11 hours, unlike those who reported drinking sugar-sweetened beverages, implying that consumption of these beverages affects SD.

In a study carried out in Egyptian children and adolescents during COVID-19 confinement, less nighttime sleep was correlated with higher consumption of unhealthy foods (36). In addition, even before the pandemic, there was consistency with our results. The results of one cross-sectional multinational study showed that a shorter SD among children was associated with greater consumption of soft drinks. Children were also observed to be more likely to get the recommended 9-11 daily hours of sleep when they reported lower soda consumption (37). In another study, Pérez Farinós et al. reported that shorter SD (< 9 hours per day) in children was associated with more frequent consumption of soft drinks containing sugar, but not fruit juices (38).

Our study found that children in Group 1 and Group 2 reported more days of PA per week as compared to Group 3. One study carried out prior to the pandemic in a prospective cohort in the Netherlands observed that a higher level of PA was related to greater consumption of high-calorie foods (39); however, further research is required.

Finally, we observed that as age increases, PA decreases and ST increases; this is likely attributable to the evidence previously mentioned, which shows ST as replacing PA in children. Recommended levels of PA and sedentary behavior for the first years of life have been highlighted previously, as promoting healthy lifestyle behaviors during early childhood through methodologically sound prevention studies (40).

One limitation of the present study is that the sample obtained is not random or representative of the Mexican population. It is therefore impossible to extrapolate results further than the surveyed population, which includes an over-representation of the middle and high socioeconomic strata with greater access to electronic devices and connectivity. The study therefore cannot be considered representative of the population with lower SES. This situation can be attributed to two factors: 1) the study design did not seek a randomized sample, and

2) in order to respond to the electronic form, an electronic device was required such as a computer, tablet or smartphone, as was the knowledge necessary to successfully complete this type of questionnaire.

CONCLUSIONS

Risk factors associated with obesity such as poor dietary quality and sedentary lifestyles were potentiated in the period of widespread confinement resulting from the COVID-19 pandemic. This has resulted in negative behaviors in both children and parents, which are difficult to reverse. Learning healthy eating habits during childhood is crucial for these to be put into practice throughout the life course. Therefore, it is critical to reinforce efforts to reverse the adverse effects triggered by pandemic confinement in the Mexican population to improve child health in the years to come.

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