Revista Eletrônica Interdisciplinar
Barra do Garças – MT, Brasil
Ano: 2024 Volume: 16 Número: 3
ISSN 1984-431X

SLEEP, EATING BEHAVIORS AND LEVEL OF PHYSICAL ACTIVITY IN CHILDREN DURING THE COVID-19 PANDEMIC

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ABSTRACT
The aim of this study was to evaluate the impact of the COVID-19 pandemic on eating behaviors, sleep and sedentary behaviors in 2 to 5-year-old children and their guardians.
This is a cross-sectional study. Two questionnaires were administered to parents regarding parents and children. Sociodemographic characteristics, lifestyle habits, changes in dietary intake and eating behaviors during social distancing were collected. 174 guardians answer the questionnaire. No changes in sleep hours were observed, 50% of the guardians reported worsening sleep quality, and 36.2% of the children presented delays in falling asleep during this period. Snacking and an increase in screen time were associated with an increased consumption of sweets (Stuffed biscuits, chocolates and/or goodies) ($p<0.01$) and an increase in *fast-food* consumption ($p<0.01$). This research indicates that social distancing imposed by the COVID-19 pandemic had worsening eating habits and increased sedentary and screen time in children.
Keywords: Child, Diet, SARS-CoV-2, Sleep Quality, Sedentary Behavior.

RESUMO
Este estudo avaliou o impacto da pandemia de COVID-19 no comportamento alimentar, sono e sedentarismo em crianças de 2 a 5 anos de idade e seus responsáveis. Trata-se de um estudo transversal. Os responsáveis responderam dois questionários sobre os próprios hábitos e das crianças. Características sociodemográficas, hábitos de vida, ingestão alimentar e comportamentos alimentares durante o isolamento foram coletados. A amostra foi composta por 174 participantes. Não houve alterações nas horas de sono dos responsáveis ou das crianças, mas 50% dos responsáveis relataram piora na qualidade do sono e 36.2% das crianças apresentaram atraso no início do sono durante esse período. O hábito de beliscar e o aumento do tempo de tela estiveram associados ao aumento do consumo de doces (biscoitos recheados, chocolates e/ou guloseimas) ($p<0.01$) e ao aumento do consumo de fast food ($p<0.01$). Esta pesquisa indica um efeito negativo do isolamento social na pandemia de COVID-19 nos hábitos alimentares, na redução do tempo gasto em brincadeiras e no aumento do tempo de tela entre as crianças.
Palavras-Chave: Criança, Dieta, SARs-CoV-2, Qualidade do sono, Comportamento sedentário.

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Barra do Garças – MT, Brasil
ISSN 1984-431X
Ano: 2024 Volume: 16 Número: 3

1. INTRODUCTION

In December 2019, an acute respiratory disease caused by the SARS-CoV-2 virus (COVID-19) started to spread all over the globe, reaching a pandemic category, and was declared a public health emergency by the World Health Organization (WHO) in January 2020 (Romeo-Arroyo; Mora; Vázquez-Araújo, 2020). Different countries were sequentially affected by the pandemic situation, with a consequent confinement of the populations during different periods. It is known that social isolation can trigger psychological suffering and significantly affect the eating habits of a population, resulting in hypophagia or hyperphagia and binge eating (Romeo-Arroyo; Mora; Vázquez-Araújo, 2020; Sidor; Rzymski, 2020).

Several countries have implemented strategies to prevent the spread of infection, such as individual confinement, social distancing, school closures, and movement restrictions (Bosch *et al.*, 2022). As a consequence of isolation, children experienced a lack of socio-emotional stimuli and interruption of physical activity, making it necessary for parents to intervene to ensure that maintaining regular schedules and practicing healthy habits did not result in harm to the health of children in social isolation (López-Bueno *et al.*, 2021). Preliminary evidence since the onset of the COVID-19 pandemic-related quarantine measures has demonstrated sizeable (20–66%) increases in screen time consumption. A survey of 2427 Chinese children showed considerable increases in leisure screen time when evaluated before (January 2020) and after (March 2020) the COVID-19 pandemic lockdown (Bates *et al.*, 2020).

The period of confinement during the COVID-19 pandemic has led to an increase in sleep disorders, mainly affecting children and adolescents (Jahrami *et al.*, 2022). Circadian regulation is subject to disruption by the conditions created by COVID-19-related restrictions: the sunlight exposure needed for circadian regulation may be curtailed, since participation in outdoor activities and sports has dramatically decreased. There is likely a negative interaction of increased sedentary behaviors/screen time and poor sleep via circadian disruption (Bates *et al.*, 2020).

The main objective of this research was to evaluate the impact of the COVID-19 pandemic on sleep, eating behaviors and sedentary behaviors in 2 to 5-year-old children. In addition to evaluating the impact of the life habits of those responsible for the health of the child population during this period.

2. METHODS

This was a cross-sectional study that was realized in online method during the October to November 2020. The snowball sampling method was used for recruitment to achieve a large distribution of volunteers. Due to the pandemic being unexpected, cross-sectional studies are an

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alternative to understand changes in habits before and during social isolation (through retrospective reporting). The inclusion criteria were (1) having children from 2 to 5 years of age; (2) living in Brazil; and (3) understanding Portuguese.

The Human Research Ethics Committee of the Federal University of Lavras approved the study (CEEAE: 37211320.8.0000.514). The participants accessed the online survey through a web link between the Google Forms platform. The invitation to participate in the research occurred by social media (Instagram®, WhatsApp®) and Quick Response (QR) code was created and displayed on banners and flyers to allow people who were interested to access the survey by cell phone. On the first page of the survey, participants were informed of the aim of the study, justifications, procedures, risks, and benefits, and advised that participation in the study could be stopped at any time. They were invited to participate, and informed consent was obtained by a filling in a box with "yes" (invitation to participate accepted) or "no" (invitation to participate not accepted).

The questionnaire created for the research was composed of two parts: (1) one part regarding parents and (2) the other regarding children. Sociodemographic characteristics, lifestyle habits (i.e., sleep, physical activity, eating habits, and time using screens) about parents and children was collect.

The socioeconomic level was calculated by the "Criteria Economical classification Brazil" created by Brazilian Association of Research Companies (ABEP) which classifies socioeconomic levels from A, B1, B2, C1, C2, and DE, according to living conditions and monthly remuneration (ABEP, 2019). Moreover, the practice of social isolation was evaluated: whether they were socially isolating, how long they were socially isolating, and why they go out of the home (e.g., school, work, supermarkets, drugstores, family outings, medical clinics, gym, bars, restaurants, or other).

Participants reported bedtimes and waking times before and during the pandemic. If there was a change in sleep quality during social isolation, the answer options were "improved", "got worse", or "did not change". In addition, when sleep quality worsened, participants reported the changes they noticed. They also answered of parents whether the time using screens, time of work, alcohol consumption, cigarette consumption, and physical activity increased, decreased, did not change, or was not practiced.

To measure changes in dietary intake, the participants were asked which meals the children had before social isolation and which they had during social isolation. For the assessment of food consumption, the foods included in the questionnaire were based on dietary intake markers developed by the Food and Nutrition Surveillance System (SISVAN)

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(Brasil, 2015), along with some foods that the authors deemed necessary from a nutritional standpoint. After, the following 11 food groups, with intake options of did not change, increased, decreased or did not consume, were reported: beans; cereals; dairy products; fruits; meats; greens and vegetables; hamburger and/or sausage meat, ham, and mortadella; sweet drinks; instant noodles and/or snack packets; sugar and honey; and pizza, sandwiches, and savory snacks. Furthermore, four questions were asked regarding dietary intake before the pandemic: amount of food consumed; habit of "snacking" between meals; frequency of food delivery; and preparing meals at home. The answers were as follows: increased a lot, increased a little, stayed the same, decreased a little, decreased a lot, and do not know how to inform. To measure changes in the children's lifestyles, there were questions about sleep, the children's caregivers, time using screens, physical activities, and breastfeeding.

Descriptive statistics were used to define the proportion of responses for each question and the total distribution in the total score of each questionnaire. Normality of the data distribution was confirmed using the Shapiro–Wilks W-test. Association analysis was performed using the Chi-square test and Fisher's Exact Test. Multivariate multinomial logistic regression models were used to assess sociodemographic differences in eating and purchasing behaviors, where 'no changes in eating or purchasing behaviors' was included as a reference category. The statistical program used was the SPSS® and the significance level was considered as $p<0.5$.

3. RESULTS

In the present study, only the data of children between 2 and 5 years old and their mothers were included, resulting in a sample of 174 participants. The mean age of the mothers was 34.4 ± 6.1 years. Concerning social distancing, 40% of participants reported complete social distancing, while 53.4% reported partial social distancing. The mean duration of social distancing practices reported was 6.8±0.8 months. Additionally, 34% of our sample was classified as B2 regarding family income level (Table 1). When asked about sleep habits, there were no changes in sleep hours of either the mothers' or children during this period. In addition, 36.2% (63) of children started to present delays in falling asleep during this period.

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Table 1 – General characterization and sleep features of participant's during COVID-19 pandemic. Brazil, 2020.

Variables		Mean	Standard Deviation
Age mothers (years)		34.37	±6.104
Social distancing practices (months)		6.77	±0.81
Sleep duration			
Parents	Sleep duration before (h)	8.11	±1.16
	Sleep duration during (h)	8.02	±1.22
Children	Sleep duration before (h)	10.18	±1.09
	Sleep duration during (h)	10.08	±1.03
Variables		**n**	**%**
Social distancing practices			
Complete		71	40.8
Partial		93	53.4
Not social distancing		10	5.7
Family income classification			
Socio economic level A		37	21.3
Socio economic level B1		55	31.6
Socio economic level B2		60	34.5
Socio economic level C1		16	9.2
Socio economic level C2		6	3.4
Socio economic level DE		0	0

Regarding the children's eating habits, according to the reports of the mothers', 53.5% of the children increased the amount of food consumed, the act of snacking increased in 50% of the children, and 33.3% reported an increase in the use of delivery services (Table 2). There was an association between increasing the amount of food consumed and the increasing habit of "snacking" ($p<0.01$; Table 2).

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Table 2 – Children's eating habits during the COVID-19 pandemic. Brazil, 2020.

Variables	Amount of food consumed		Habit of "snacking"		Use of delivery services	
	n	%	n	%	n	%
Increased	93	53.4[1]	87	50[1]	58	33.3
Decreased	21	12.1	3	1.7	8	4.6
Remained the same	60	34.5	49	28.2	42	24.1
Does not snack/consume the delivery	-	-	35	20.1	64	36.8
I do not know how to answer	-	-	-	-	2	1.1

Note: [1]Fisher's Exact Test with p<0.01.

The changes in the frequency of consumption of some food groups in the period of social distancing. In relation to the quality of the children's diet, there was no change in the number of meals consumed per day; however, it can be highlighted that an important percentage reported an increase in the consumption of the following food groups: milk and dairy products (32.3%), fruits (25.9%), sugary drinks (23.6%), industrialized foods (21.8%), sweets and treats (36.8%) and fast-food consumption (31.6%).

An association was observed between the increase in the amount of food consumed and the increase in the consumption of fruits (p<0.01), sweets (p<0.01) and fast food (p<0.05). Associations analysis between the habit of "snacking" and an increase in screen time (p<0.01) with an increased consumption of sweets (Stuffed biscuits, chocolates and/or goodies) (p<0.01). In addition, physical inactivity was associated with non-consumption of vegetables (p<0.01) and fruits (p<0.01; Table 3).

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Table 3 – Association between eating habits and frequency of children's food intake during the COVID-19 pandemic. Brazil, 2020.

Variables		Amount of food consumed[1]			Habit of "snacking"[1]			Use of delivery services[1]			Physical activity[2]			Screen time[1]		
		n	%	p-value	n	%	p-value	n	%	p-value	n	%	p-value	n	%	p-value
Fruits	Increased	32	34.4[3]		30	34.5		16	27.6		1	25		36	25.2	
	Decreased	10	10.8		10	11.5		12	20.7		1	25		22	15.4	
	Remained the same	50	53.8	**0.003**	43	49.4	0.084	29	50	0.091	1	25	**0.009**	82	57.3	0.206
	Does not consume	1	1.1		4	4.6		1	1.7		1	25[3]		3	2.1	
Vegetables	Increased	16	17.2		9	10.3		8	13.8		1	25		16	11.2	
	Decreased	12	12.9		17	19.5		11	19.0		1	25		21	14.7	
	Remained the same	64	68.8	0.046	59	67.8	0.121	38	65.5	0.174	1	25	**<0.01**	104	72.7	0.046
	Does not consume	1	1.1		2	2.3		1	1.7		1	25[3]		2	1.4	

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Sweets or treats	Increased	44	47.3[3]	**<0.01**	41	47.1[3]	**0.004**	32	55.2[3]	**<0.01**	1	25	0.338	61	42.7[3]	**0.006**
	Decreased	7	7.5		2	2.3		1	1.7		0	0		6	4.2	
	Remained the same	25	26.9		24	27.6		20	34.5		2	50		45	31.5	
	Does not consume	17	18.3		20	23		5	8.6		1	25		31	21.7	
Fast food	Increased	38	40.9[3]	**0.015**	41	471[3]	**0.001**	39	67.2[3]	**<0.01**	1	25	0.125	51	35.7	0.123
	Decreased	6	6.5		3	3.4		2	3.4		0	0		7	4.9	
	Remained the same	32	34.4		29	33.3		16	27.6		3	75		56	39.2	
	Does not consume	17	18.3		14	16.1		1	1.7		0	0		29	20.3	

Note: Fisher's Exact Test; Statistically significant p-values are in bold; [1]Reference variable was considered “increased”; [2]Reference variable was considered “do not practice”; [3]For interpretation purposes, a residue value greater than 2.5 was considered.

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Regarding life routines during the period of social distancing, 48% of the mothers' reported an increase in working time, and 58.5% of the children had decreased time in active play. A positive association was observed between the decreased time in active play and increase in the screen time of the family and children (p<0.05; Table 4).

Table 4 – Life routines of parents' and children's during the period of COVID-19 pandemic. Brazil, 2020.

Variables		Play time								*p-value*
		Increased		Decreased		Not changed		I do not practice		
		n	%	n	%	n	%	n	%	
Screen time	Parents	18	13.5	89	66.9%[1]	24	18.0%	2	1.6%	<0.01
	Child	17	11.9	95	66.4%[1]	29	20.3%	2	1.4%	<0.01
Working time		14	16.9	54	65.1%	13	15.7%	2	2.3%	0.04

Note: Fisher's Exact Test; Variable of reference for screen time and working time was "increased"; [1]For interpretation purposes, a residue value greater than 2.5 was considered.

Regarding the lifestyle habits associated with food, it was observed that the children who had increased food consumption were those who had increased screen time (4.21[1.46-12.12) and decreased time spent in active plays (2.81[1.19-6.60]; Table 5).

Table 5 – Relationship between food quality and lifestyle habits of children's during the COVID-19 pandemic. Brazil, 2020.

Variables		Amount of food consumed			
		Increased		Decreased	
		OR	p-value	OR	p-value
Screen time	Increased	4.21 (1.46-12.12)	**0.008**	2.08 (0.38-11.34)	0.399
	Decreased	1.14 (0.16-8.09)	0.899	******	**
Active plays	Increased	2.41 (0.82-7.14)	0.111	1.07 (0.08-13.9)	0.959
	Decreased	2.81 (1.19-6.60)	**0.018**	6.04 (1.22-29.75)	**0.027**

Note: Multivariate multinomial logistic regression; Statistically significant p-values are in bold; It has "not changed" was reference category; **Value lower.

ISSN 1984-431X

4. DISCUSSION

The containment measures resulting from the pandemic led to several changes in the life routines of individuals, especially the population of children with the suspension of school classes, the impossibility of performing outdoor activities and consequently, more time at home. The main findings of the present study were the effects of the pandemic on children's routines, through increased screen time, reduced time spent playing active games and changes in eating habits.

The life routines of this population were strongly impacted by the new COVID-19 pandemic. Screen time increased in 82.2% of the children and 58.5% had decreased time in active play. This result reflects the suspension of school classes, with children spending more time at home engaged in sedentary activities, such as the use of electronic equipment. This change in life habits was also observed in the Italian infant population, where screen time increased by 4.85 hours/day and physical activity time decreased by 2.30 hours/week during the pandemic (Philippe *et al.*, 2021). Brazilian studies have indicated an increase in screen time of children over the age of three years, regardless of the period of social isolation (de Araújo *et al.*, 2018), and in children under 13 years of age during the first month of isolation, which reflects the increase in sedentary time and the decrease in the total time of physical activity (Sá *et al.*, 2021). Screen time can be associated with several determinants. In Brazil, research on screen time and associated factors is still incipient. A recent study conducted with children between 24 and 42 months of age found that television is still the main factor responsible for exposing children to screens and that screen exposure time was positively associated with family resources, economic level and language development (Nobre *et al.*, 2021).

This report was also recurrent among those responsible for the children in the study, where the increase in screen time was associated with an increase in working time during this period, which may be suggestive of the higher demand for work in the home office. In Brazil, studies conducted with adult individuals showed an association between screen time (>10.5 hours/day) and working/studying remotely during the pandemic, reflecting the need to adapt to the new demands brought by this period (Souza *et al.*, 2022). In addition, an increase in the screen time of the guardians was associated with an increase in the children's screen time ($p<0.01$).

In relation to the children's eating habits, according to the reports of the guardians, a significant association was seen between the increase in the amount of food consumed and the habit of "snacking" during the period of social distancing. When evaluating possible changes in food frequency, it was observed that the consumption of milk and dairy foods, fruits,

ISSN 1984-431X

sugary drinks, sweets/treats and fast food showed was increased in this period.

Second, the association between eating habits and the frequency of food consumed by the children was analyzed. The consumption of fruits, sweets/goodies and fast food was significantly associated with the "amount of food consumed", demonstrating an increase in the consumption of these foods during social isolation. Evidence suggests that the changes caused by the COVID-19 pandemic may be associated with whether healthy foods were consumed, and these changes are linked to children's health behaviors (Trofholz *et al.*, 2022). Similar to our findings, a longitudinal study conducted with obese children and adolescents in Italy showed that during the period of social isolation, there was an increase in fruit consumption by the target public [10]. In previous studies, an increase in the consumption of sweets/goodies and fast food was associated with a state of emotional eating in response to periods of stress, boredom and anxiety triggered by the pandemic in this population (Jansen *et al.*, 2021; Philippe *et al.*, 2021).

In a study with Italian children between 5 and 14 years of age, there was an increase in the consumption of so-called "comfort foods", especially chocolate, stuffed wafers, ice cream, pizza and bakery products, during the pandemic period (Pujia *et al.*, 2021). An increase in the consumption of foods such as ice cream, french fries and salted biscuits in response to stress was also observed in the American infant population (Jansen *et al.*, 2021). The consumption of ultra-processed foods, especially goodies, emerged during the current scenario in populations of Brazilian adults and adolescents (Malta *et al.*, 2020; Raphaelli *et al.*, 2021; Ruiz-Roso *et al.*, 2020; Ruíz-Roso *et al.*, 2020; Werneck *et al.*, 2021, 2020). Future studies are needed to evaluate changes in the eating behaviors of Brazilian children during the pandemic period.

In addition, changes in the behaviors of the guardians also impacted the changes in children's eating routines, such as flexibility of rules regarding eating, greater use of food as a form of love and greater feeding autonomy of the children (Philippe *et al.*, 2021; Trofholz *et al.*, 2022). It is known that the COVID-19 pandemic has resulted in numerous changes in the domestic food environment, which has been associated with the feeding patterns and food intake of children. A qualitative study conducted with a cohort of families with racial/ethnic diversity with children aged 2 to 5 years identified three main patterns that emerged on how the COVID-19 pandemic influenced domestic eating patterns: mothers were more directive on ingested foods; mothers had fewer rules at mealtime; and mothers had increased responsibilities for meals (Trofholz *et al.*, 2022).

The habit of "snacking" and screen time played an important role in these analyses. Children with a higher habit of snacking between meals and who spent more time using

ISSN 1984-431X

screens showed an increase in the consumption of sweets (Stuffed biscuits, chocolates and/or goodies), increase in the consumption of fast food and increased use of delivery services during this period. When evaluating the effect of home confinement on adult eating behaviors, a significant increase in the number of snacks between meals or evening snacks was seen during the period of restrictions due to the COVID-19 pandemic (Ammar *et al.*, 2020). Negative changes in most eating behaviors can be attributed to a decline in motivation for the practice of physical activity in adults (Gardner; Rebar, 2019). Through our findings, it is assumed that a longer screen time can lead to a decrease in the practice of physical activity and active play by children, and these factors are associated with changes in their behaviors. Additional research should address the relationship between this increase in food consumption between meals or the habit of "snacking" in children and its relationship with the consumption of specific foods such as sweets, goodies and fast foods and the practice of physical activity.

Regarding play time, a positive association was seen between physical inactivity (shorter duration time or absence) and no consumption of vegetables and fruits. This result may be due to the previously reported relationship between the longest screen time and the consumption of high energy dense foods, assuming the fact that sedentary children end up choosing to perform activities with the use of screens and increasing the consumption of caloric foods. The changes in the lifestyles of Brazilians in the period of social restriction resulting from the COVID-19 pandemic demonstrate a worsening lifestyle and increased health risk behaviors, such as decreased physical activity and increased time in front of screens, an increase in the intake of ultra-processed foods, a decrease in the frequency of consumption of healthy foods and vegetables, and an increase in smoke and the consumption of alcoholic beverages (Adriaanse *et al.*, 2011).

The quality of sleep of children and mothers was also analyzed. No significant changes were found between sleep hours before and during the pandemic in either group, but most of the guardians reported worsening sleep quality. In addition, it was seen that most of the children began to present a delay in falling asleep during this period. The worsening of sleep quality in the population may be associated with the increased levels of stress and anxiety that are observed in times of crisis, such as the pandemic, thus resulting in an increase in the perception of stress in individuals with a worsening of sleep quality (Liboredo *et al.*, 2021). In addition, sleep deprivation may also be positively associated with the increased consumption of foods with higher caloric density, resulting from hormonal changes, such as cortisol elevation, which are associated with periods of stress that may lead to emotional

ISSN 1984-431X

eating (Ingram; Maciejewski; Hand, 2020; Liboredo *et al.*, 2021).

Regarding the limitations of the study, the fact that the collections occurred in the online format, through the dissemination of questionnaires, may have compromised the understanding by the participants and consequently the reliability of the answers. However, there was a careful evaluation of the responses by the research team, in addition, the pandemic scenario made it difficult for the study methodology to be executed in person. However, it is worth mentioning that despite the limitations, this study relied on an analysis of the state of life of the population at the exact moment of public calamity, thus showing the reality of the impacts of social isolation on the child population.

5. CONCLUSION

The preliminary results of the research indicate there was no impact on the quality of children's sleep, however a negative effect of social isolation due to the COVID-19 pandemic on increasing screen time and reducing the time spent in active games was observed, which are indicative of a more sedentary lifestyle, in addition to changes in eating habits, such as an increased consumption of foods with high caloric density and an increased habit of snacking between meals. These observations may imply the development of multidisciplinary recommendations encompassing changes in the lifestyle habits of this population, such as nutritional recommendations, the practice of physical activity and correct sleep hygiene, which are changes that may have a long-term impact on the health of Brazilian children.

6. ACKNOWLEDGMENTS

For the financial support provided by the Coordination for the Improvement of Higher Education Personnel (CAPES) (process number 88887.966974/2024-00).

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