



## ORIGINAL ARTICLE

## Comparison of Physical Activity and Sedentary Behavior among Brazilian Preschool Children during the COVID-19 Physical Distancing Period

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### Summary

**Objectives:** This study aimed to evaluate the time spent on outdoor games and play, and screen time of preschoolers during the first wave of the COVID-19 pandemic in Fortaleza, Ceará, Brazil.

**Methods:** A cross-sectional, quantitative study was conducted with 286 mothers of preschool children aged 2-6 years. Data were collected via a Google Forms questionnaire, distributed through WhatsApp groups and social networks, following a Snowball sampling model. The questionnaire addressed socioeconomic data, daily physical activity (PA), and sedentary behavior (SB), particularly screen time (ST). Statistical analysis was conducted using STATA SE with the t-test for the means of two samples with equal variances.

**Results:** The majority of children (86%) attended private schools. Concurrently, a high percentage of mothers (83.6%) had completed higher education. Children whose mothers had completed higher education spent less ST during weekdays ( $p = 0.0458$ ). Over the weekends, female children spent more time on outdoor games and activities than male children ( $p = 0.0265$ ). Children not enrolled in school were more active ( $p = 0.0323$ ) but also spent more ST compared to children attending school ( $p < 0.001$ ).

**Conclusions:** Children's gender and time spent in school influenced their level of PA and ST during the pandemic, with girls and non-school children showing more physical activity. Sedentary behavior was prevalent, especially among children whose mothers had not completed higher education.

### Keywords

Physical activity, Preschool, COVID-19

### Introduction

Amidst the pandemic scenario caused by COVID-19, public health guidelines and governments mandates have necessitated the enforcement of lockdowns and restrictions. These measures, though instrumental in mitigating the transmission rates of the virus, can inadvertently yield detrimental consequences by curtailing engagement in routine daily activities. These activities encompass a wide range of physical activities (PAs), such as gym training, attending group meetings, outings, among others [1].

The propensity towards physical inactivity is

escalating in most societies around the world, affecting both adults and youth [2]. The preschool years represent a key phase for cognitive development and the establishment of lifelong health habit [3], including behaviors related to energy balance, physical activity (PA), and sedentary behaviors (SBs) [4]. The literature further suggests that the preschool years are a critical period for the development of obesity. As a result, this stage has accordingly become a focus of public health interventions [5].

The level of PA is associated with an improved composition of body weight, bone health, mental well-being, and academic performance. In early childhood, PA is paramount for the cultivation and sustenance of standard healthy habits, and it plays a substantial role in the socialization processes, and emotional welfare [6].

The aim of the present study was to analyze the time spent on outdoor games and play, as well as the screen time of preschoolers during the period of the first wave of the COVID-19 pandemic in Fortaleza, Ceará, Brazil.

## Methods

### Study design and participants

This was a quantitative study with a cross-sectional, descriptive, and analytical research design, conducted with mothers of preschool children aged 2 to 6 years, exposed to the social distancing induced by the first wave of the COVID-19 pandemic in Fortaleza, Ceará, Brazil.

In 2020, the year in which the study was carried out, the Municipality of Fortaleza had an estimated population of 2,669,342 inhabitants, with 274,142 children in the age group of 0 to 5 years, representing 10.27% of the population [7]. In the operationalization of the sample calculation, the following equation parameters were adopted to estimate the sample: A confidence level of 99% for the study ( $Z = 2.575$ ), a sample error of 3% ( $e = 0.03$ ), and a population size of 274,142 children [8]. With regard to the event's prevalence, a value of 50% ( $p = 0.5$ ) was considered as the expected average prevalence for various indicators due to the unknown proportion of the event. The calculation indicated the need for a sample size of 229 participants based on the established parameters.

The sample selection was done by convenience, and a questionnaire created on Google Forms was sent in WhatsApp groups of parents from both public and private schools network, according to the Snowball sampling model [9]. The research also had broad dissemination through the social networks of the postgraduate program in Public Health at the Federal University of Ceará and supporters.

The present study was approved by the Ethics and Research Committee of the Federal University of Ceará, CAAE: 36223020.3.0000.5054, and participant

acceptance was secured through the reading of the free and informed consent form before starting to fill out the electronic form.

### Survey and data processing

For the construction of the Google Forms questionnaire, all questions were made mandatory, meaning that the questionnaire could only be submitted when all questions were answered. Participants' responses appeared organized in a table, where each column corresponded to the answers to a question, and each row corresponded to a respondent. The data were exported into an Excel spreadsheet.

Questions related to socioeconomic data were based on the National School Health Survey (referred to as PeNSE) conducted in 2015 by the Brazilian Institute of Geography and Statistics (IBGE). We investigated the mother's education level, the total number of residents in the student's home, the number of bathrooms in the home, ownership of assets, and the availability of domestic service in the student's home.

For the collection of data related to physical activity (PA) measurement, an instrument was used that covers questions expressing the daily time of participation in outdoor games and activities. It also included questions targeted at measuring sedentary behavior (SB), such as the daily duration of screen time (ST). The selected instrument was translated into Portuguese and culturally adapted for conducting a school-based study in the city of Olinda, Pernambuco, Brazil [10].

For each period of the day - morning, afternoon, and evening - both on a typical weekday and weekend day, the reported time was documented. This was done using the following response categories, with corresponding numeric scores: 0 minutes (0), 1-15 minutes (1), 16-30 minutes (2), 31-60 minutes (3), and more than 60 minutes (4). For measurements relating to time spent on screen, the numeric scores assigned to each category were reversed. This ensured that the shortest duration was given the highest score, and the longest duration was awarded the lowest score. The scores for both the time spent participating in outdoor games and play and ST were calculated by totaling the responses for the three periods of the day. This total ranged from 0 to 12 points, providing a reflection of the children's daily behavior on weekdays and weekends. A combined total score for weekdays and weekends was also calculated, with a possible range from 0 to 24 points.

The frequency of PA was further classified into two levels: "active" and "less active." Children who reported fewer than 60 minutes per day of participation in outdoor games and activities - considering the combined information reported for the three periods of the day - were categorized as less active. A dichotomous classification was also applied to ST, grouping into a category of higher exposure those individuals who

reported spending more than two hours per day engaging in this type of activity.

### Statistical analysis

The statistical analysis was performed in the STATA SE program using descriptive statistical procedures (frequency distribution, mean, and standard deviation). The t-test for the means of two samples with equal variances was applied to evaluate if there was a significant difference between the samples. The significance level was  $p < 0.05$ .

### Results

This study included 286 mothers of children aged between 2 and 6 years, of which 15 (5.2%) were in Toddlers or Pre-Nursery, 28 (9.8%) in Preschool or Nursery, 42 (14.7%) in Pre-Kindergarten or Reception, 59 (20.6%) Kindergarten or Year 1, 66 (23.1%) in Grade 1 or Year 2, and 44 (15.4%) in Grade 2 or Year 3. Among the studied children, 86.0% attended private schools,

44.0% lived in a household with up to four people, and 52.8% had more than three bathrooms equipped with showers at home.

Regarding the mother's education level, it was observed that 239 (83.6%) of the children had mothers with completed higher education, and in terms of gender, 155 (54.2%) were female. Furthermore, 254 (88.8%) were enrolled in school (Table 1).

As described in Table 1, children of mothers who had completed higher education were found to spend less screen time (ST) during the week ( $3.49 \pm 2.95$ ), compared to those whose mothers did not have completed higher education ( $4.47 \pm 3.56$ ) ( $p = 0.0458$ ). Considering the gender of the child, it is important to note that during the weekends, female children spent more time on outdoor games and activities than their male counterparts ( $p = 0.0265$ ). Furthermore, children enrolled in school averaged less time in this regard ( $9.53 \pm 2.31$ ) compared to those not enrolled during the weekends ( $8.01 \pm 3.56$ )

**Table 1:** Mother's education level, gender, and school attendance of Brazilian preschool children compared to screen time, and outdoor games and activities time during the week and on weekends.

Analysis	Score	Group	Sample	Mean	Std. Error	Std. Dev.	95% CI		t-value	p-value
							Minimum	Maximum		
Mother's Education Level	TGP during the week	1	47	6.62	0.58	3.96	5.45	7.78	-0.6168	0.5379
		2	239	6.97	0.23	3.57	6.52	7.43		
	TGP during the WE	1	47	8.00	0.56	3.87	6.86	9.14	-0.3920	0.6954
		2	239	8.22	0.22	3.40	7.78	8.65		
	Total TGP	1	47	14.62	1.11	7.61	12.38	16.85	-0.5339	0.5939
		2	239	15.19	0.43	6.58	14.35	16.03		
	ST during the week	1	47	4.47	0.52	3.56	3.42	5.51	2.0063	0.0458
		2	239	3.49	0.19	2.95	3.11	3.87		
	ST during the WE	1	47	4.21	0.55	3.79	3.10	5.32	1.5059	0.1332
		2	239	3.41	0.21	3.24	3.00	3.82		
Total ST	1	47	8.68	1.01	6.91	6.65	10.71	1.8792	0.0612	
	2	239	6.90	0.37	5.73	6.17	7.63			
TOTAL	1	47	21.32	1.41	9.64	18.49	24.15	-0.7697	0.4421	
	2	239	22.48	0.61	9.43	21.28	23.68			
Children's Gender	TGP during the week	3	155	7.08	0.29	3.59	6.51	7.65	0.8494	0.3964
		4	131	6.72	0.32	3.68	6.08	7.35		
	TGP during the WE	3	155	8.60	0.28	3.53	8.04	9.16	2.2301	0.0265
		4	131	7.69	0.29	3.36	7.1	8.27		
	Total TGP	3	155	15.68	0.54	6.78	14.61	16.76	1.6020	0.1103
		4	131	14.40	0.58	6.66	13.25	15.56		
	ST during the week	3	155	3.68	0.24	2.98	3.21	4.15	0.1618	0.8716
		4	131	3.62	0.28	3.20	3.07	4.17		
	ST during the WE	3	155	3.66	0.27	3.35	3.13	4.20	0.6727	0.5017
		4	131	3.40	0.29	3.36	2.82	3.98		
Total ST	3	155	7.34	0.46	5.79	6.42	8.26	0.4607	0.6454	
	4	131	7.02	0.54	6.19	5.95	8.09			
TOTAL	3	155	23.03	0.78	9.68	21.49	24.56	1.4339	0.1527	
	4	131	21.42	0.80	9.14	19.84	23.00			

<b>Children's School Attendance</b>	TGP during the week	5	32	7.97	0.42	2.38	7.11	8.83	1.7459	0.0819
		6	254	6.78	0.23	3.74	6.32	7.25		
	TGP during the WE	5	32	9.53	0.41	2.31	8.70	10.37	2.3504	0.0194
		6	254	8.01	0.22	3.56	7.57	8.45		
	Total TGP	5	32	17.50	0.71	4.04	16.04	18.96	2.1507	0.0323
		6	254	14.80	0.44	6.96	13.96	15.66		
	ST during the week	5	32	5.38	0.66	3.76	4.02	6.73	3.4322	0.0007
		6	254	3.43	0.18	2.91	3.07	3.79		
	ST during the WE	5	32	5.75	0.69	3.89	4.35	7.15	4.0649	< 0.001
		6	254	3.26	0.20	3.18	2.87	3.66		
	Total ST	5	32	11.13	1.28	7.22	8.52	13.73	4.0626	< 0.001
		6	254	6.70	0.35	5.61	6.00	7.39		
	TOTAL	5	32	28.63	1.67	9.43	25.22	32.03	4.1339	< 0.001
		6	254	21.49	0.58	9.17	20.36	22.63		

Source: Authors.

Legend: Group 1 = Mothers without a complete higher education; Group 2 = Mothers with a complete higher education; Group 3 = Female children; Group 4 = Male children; Group 5 = Children not enrolled in school; Group 6 = Children enrolled in school; TGP = Time spent on games and play; ST = Screen Time; WE = Weekend; TOTAL = Total time adding up TGP and ST.

( $p = 0.0194$ ). The children without school affiliation appeared to be more active ( $p = 0.0323$ ). However, they also spent more ST compared to children who attended school ( $p < 0.001$ ). In general, school enrollment for a child may result in both less physical activity and increased sedentary behavior ( $p < 0.001$ ).

## Discussion

In the context of human development, understanding the characteristics of children immersed in an environment where their physical activities are influenced by surrounding individuals is of significant scholarly interest. Research has indicated that a substantial proportion of parents do not consistently maintain their own weight or participate in physical activities [11]. Yet, when these parents are physically active, they endeavor to act as facilitators for their children's physical exercise, thus establishing a directly proportional relationship between parental and child physical activity (PA) levels. In light of this evidence, it is recommended, as per the guidelines set forth by the National Association for Sport and Physical Education (NASPE) [12], that preschool-aged children eschew a sedentary lifestyle and instead, actively participate in physical activities for a minimum of 60 minutes per day. This recommendation is in alignment with the classification presented in the current research study.

Furthermore, the involvement of siblings or caregivers can lead to greater engagement in PA. Concurrently, the provision of accessible spaces and portable apparatus for recreational periods, particularly when engaged in conjunction with friends, tends to elevate this measure. Factors such as the immediate neighborhood context, the occupational status of the parents - which correlates with the time they have available for their children - and their marital status, constitute additional variables that

exert influence on the activity levels of children [11].

Daily routines are an important aspect of child development. These include activities such as completion of homework, involvement in domestic responsibilities, engagement in reading, and learning to play a musical instrument [13]. The role of family-led or parentally-guided play should not be underestimated due to its considerable influence [14]. There is a clear association reported between levels of family happiness and time spent playing with children. Free play is also important for fostering skills such as thinking and creativity. It is postulated that this could potentially forecast the degree of social success in adulthood, particularly if an ideal amount of PA is incorporated [15].

Nonetheless, the advent of the COVID-19 pandemic has engendered numerous deprivations, thereby leading to an increase in the accumulation of time designated for sedentary behaviors. In addition to enforced social distancing measures, there has been a transition from conventional classroom instruction to remote teaching modalities, facilitated through digital interfaces such as computer screens or mobile devices [16].

Contrary to the present study, research carried out prior to the COVID-19 pandemic period associated girls with a lower dependence on physical activity than boys, with this disproportion notably broad between genders, with cultural or social issues potentially acting as reasons [3,17,18]. However, the findings of Cachón-Zagalaz, et al. [14], during the COVID-19 pandemic period in Spain, showed that girls participated more in daily activities and boys spent more time on screens, while in Pombo, et al.'s [19] study with Portuguese children, there was no significant difference between the genders. This contradicts the previously assumed evidence that the male sex was more active, especially in the usual context.

In their research, Verbestel, et al. [20] endeavored to discern any correlation between parental reports and accelerometer readings regarding the PA and sedentary behavior (SB) of a broad sample of European children. The study employed tools like the Outdoor Playtime Checklist (OPC) and the Outdoor Playtime Recall Questions (OPRQ). It was observed that an increase in the time recorded on the OPC and OPRQ corresponded to a rise in the PA readings on the accelerometer. While Verbestel, et al.'s [20] results indicated that parental reports might not entirely substantiate their claims, these reports may nonetheless significantly contribute to this type of evaluation. The study further highlighted a positive correlation between time spent watching TV and accelerometer readings. However, when juxtaposed with SB of children aged between 2 and 9 years, this correlation was very weak. This observation underscores the need to explore additional, decisive explanations for the prevalent physical inactivity among children.

However, despite the inclusion of merely the "Screen Time" variable within our questionnaire, the resultant score was quite low. This poor outcome, approximately a third of the maximum possible, can be attributed to the considerable rise in SBs on a global scale, induced by the COVID-19 pandemic. Ten Velde, et al. [21] found that screen time (ST) during the pandemic increased substantially compared to before it for Dutch children. Schmidt, et al. [22] also observed this occurrence in all surveyed groups. Meanwhile, research by Xiang, Zhang, and Kuwahara [23] uncovered an escalation from 21.3% to 65.6% in physical inactivity among Chinese children and adolescents during the pandemic, coupled with an increase from 610 to 2,340 weekly minutes of aggregate ST. Moreover, a study by Eyimaya and Irmak [24] revealed an average increase of 6.42 hours per day in ST among Turkish children, as reported by 71.7% of the sampled families.

The World Health Organization (WHO) [25] has cautioned against the overutilization of screens and the pervasiveness of physical inactivity during early childhood. Although the excessive employment of Information and Communication Technologies (ICTs) by children has been a prevailing issue [26], the imposition of lockdown measures has accentuated its impact on both children and adults, given the widespread use of computers and near-universal access to the internet. The ramifications of this excessive screen usage have necessitated the proposal of preventive programs and the development of tools to identify addiction and other behavioral issues [27]. To ameliorate this situation, it has been established that a balanced amalgamation of lifestyle behaviors during childhood, encompassing reduced ST, the adoption of healthy dietary patterns, and regular PA, is necessary [28].

Studies indicate that both outdoor PAs and play, as well as the amount of time spent on them, have a

positive association [29]. However, it appears that the level of PA with outdoor play is not affected by a substantial increase in preschoolers [3,18,30,31]. Mota, et al. [32] suggested that socioeconomic status can influence the time children spend on outdoor activities, especially on weekends, with a high rate of time spent on games and play compared to weekdays observed. Furthermore, it is suggested that if some variables are added favorably or unfavorably to this issue, such as the aforementioned socioeconomic position of the parents, the characteristics of the physical environment, its resources and experiences, availability of equipment for games, parental involvement, and the difference between the week and the weekend are also determinant [3,32]. The latter variable is notably in favor of the weekend.

In McVeigh, Norris, and Wet's [33] study with South African children, mothers' education level was positively associated with the level of PA, as in the present study, but they spent less time watching TV and did not include preschoolers. However, these mothers with higher education in McVeigh, Norris, and Wet [33] also had greater purchasing power. The presence or lack of luxury items for leisure time may have been relevant in this differentiation regarding time spent on TV, which did not seem to affect children in the adverse situation of this research.

The free time available to children is largely allocated to SBs, and PA diminishes with age [3,34]. Following this logic, the preschoolers analyzed during the COVID-19 period remained within this same scenario, with certain additional particularities, characterized by a positive impact on PA when parents were more available or subjected to less stress when dealing with their children, a greater number of children in the area, and freedom to play outside the home [3,21,27,31,35].

Mallam's [36] research observed that children's PA tended to be higher outside school hours. The systematic review by Grao-Cruces, Velásquez-Romero, and Rodríguez-Rodríguez [37] showed that children and adolescents rarely achieve the necessary recommendation for physical exercises during school tasks. Furthermore, the research demonstrated that female engagement was significantly lower in this respect.

The availability of outdoor spaces for engaging in PAs was significantly curtailed, and the encouragement of sedentary activities, which were also practiced by parents, decreased substantially in COVID-19 pandemic scenario [31]. It is important to note that Pombo, et al. [19] stressed that, during periods of isolation, the children exhibiting higher levels of activity were those who had both availability of and access to outdoor spaces. Additionally, an increase in physical activity was associated with the availability of larger outdoor spaces.

The findings of Loprinzi, Schary, and Cardinal [38] corroborate those of the present research in comparisons between weekdays and weekends for time spent on PA, where there is an improvement on weekends. For the use of electronic devices, this did not resemble our ST category overall, as there was a decline on weekends. However, it is pertinent to note that, when Loprinzi, Schary, and Cardinal [38] analyzed parents of preschoolers with higher education, they achieved a much more satisfactory degree on weekends. This relationship was inverted on weekdays and was further reduced in this respect. This aligns with our study, which consisted of 83.56% of mothers having completed higher education and showing a similar trend in this aspect.

Our study, concentrating on Brazilian children, converges with the findings of the recently published Pombo, et al.'s [39] multinational research involving children from Brazil, Portugal, and Italy, indicating a common trend of increased sedentary behaviors. Similarly, both studies found that school enrollment paradoxically led to decreased physical activity and increased sedentary time. Intriguingly, we found gender differences, with female children engaging more in outdoor activities during weekends ( $p = 0.0265$ ). In contrast, Pombo, et al. [39] reported uniform increased sedentary time irrespective of gender or country, but they observed age-related differences in intellectual activities. It's noteworthy that Portuguese children outperformed in physical activity time across all age groups compared to Brazil and Italy ( $p < 0.001$ ).

Countries exhibit variances in numerous aspects, encompassing economic, social, and cultural dimensions. Nevertheless, it is conspicuous that, despite distinct sample populations, findings exhibited noteworthy similarities, particularly in the context of the ongoing pandemic. With a comprehensive understanding of the observed decline in PAs and the increase in SBs delineated in a plethora of studies, Shahidi, Williams, and Hassani [40] underscore the pivotal role of physical literacy. This critical component encapsulates the interplay of psychological, cognitive, and social variables that inform modes of engagement in PA. Therefore, the stimulation of physical literacy assumes paramount significance for individuals across all age groups, children and adults alike.

The hiatus from the school environment is likely to exert a profound influence on grade levels where students are expected to accomplish essential learning milestones, such as acquiring literacy skills in the concluding years of pre-school. The comprehensive assessment of the multifaceted post-pandemic impacts - encompassing health-related, social, educational, and economic dimensions - necessitates a meticulous, phased approach. This process of staggered evaluation would allow for a systematic and thorough understanding of

the residual effects instigated by the pandemic. These impacts would encompass the negative modifications to children's lifestyles during the COVID-19 enforced confinement and exacerbated by the protracted duration of absence from school.

Several limitations were identified in this study, with the primary constraint being the absence of similar research employing the same tools to facilitate closer comparisons for enhanced validation. Moreover, no longitudinal follow-up was conducted during this period to explore additional or specific factors that may have influenced this population over time. Additionally, the sample primarily comprised mothers with children in private schools, thus not fully representing the broader demographic situation of the Brazilian population.

## Conclusions

The gender of a child, notably more pronounced in males as compared to females, and longer time spent in school had a negative impact on the amount of physical activity performed within the COVID-19 pandemic scenario. It was observed that during weekends, girls engaged in games and play activities more frequently than boys, displaying higher levels of physical activity. Furthermore, it was identified that children without school involvement during the pandemic were more active, potentially spending more time engaged in games and play. The assessment of screen time, with the obtained low scores, indicated a significant prevalence of sedentary behavior among preschoolers amidst the COVID-19 pandemic, particularly pronounced among children whose mothers had not completed higher education.

This entire shift in circumstances, attributed to unique conditions, may have played a role in generating contrasts between the state of preschoolers as depicted in previous research and their status during the pandemic. This occasionally resulted in certain parallelisms but also exhibited specific disparities in comparison to our findings.

Programs encouraging outdoor play should be promoted, considering the possible harms of physical inactivity to the health of preschoolers, but more research is needed to fully understand how each variable influences the level of physical activity and whether they interrelate.

## Disclosure of Interest

The authors declare that they have no competing interest.

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