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Changes in physical activity and sitting time during covid-19 in Brazil: EPICOVID 2.0 study

Mudanças na atividade física e no tempo sentado durante a covid-19 no Brasil: estudo EPICOVID 2.0

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ABSTRACT

Introduction: The covid-19 pandemic led to substantial disruptions in daily routines worldwide, with potential impacts on physical activity and sedentary behavior. Objective: This study evaluated self-reported changes in physical activity (PA) and sitting time (ST) during the covid-19 pandemic in Brazil and examined sociodemographic correlates of these behaviors. Methods: Data were obtained from the nationwide EPICOVID 2.0 survey, which included 33,250 participants. Changes in PA and ST were self-reported, and weighted multinomial logistic regression analyses were conducted. Results: Overall, 29.3% (95% CI: 28.8 – 29.8) reported never practicing PA, 30.1% (95% CI: 29.6 – 30.7) reported decreased PA, 8.6% (95% CI: 8.3 – 8.9) increased PA, and 31.9% (95% CI: 31.5 – 32.5) no change. Regarding ST, 34.4% (95% CI: 33.8 – 34.9) reported an increase, 9.7% (95% CI: 9.4 – 10.1) a reduction, and 55.9% (95% CI: 55.4 – 56.5) no change. Participants reporting a decrease in ST had lower odds of reporting a decrease in PA (OR = 0.29; 95% CI: 0.22 – 0.40). Women had higher odds of decreased PA than men, with no gender differences observed for ST. Higher education was associated with higher odds of decreased PA and increased ST. Conclusion: These findings indicate that the pandemic affected PA and ST differently across population subgroups, with sociodemographic factors playing a key role. Targeted public health strategies are needed to promote PA and reduce ST, particularly among vulnerable groups.

Keywords: Covid-19; Physical activity; Sedentary behavior; Sociodemographic factors.

RESUMO

Introdução: A pandemia de covid-19 provocou mudanças nas rotinas diárias, com impactos na atividade física e comportamento sedentário. Objetivo: Este estudo avaliou as mudanças autorrelatadas na atividade física (AF) e no tempo sentado (TS) durante a pandemia de covid-19 no Brasil e examinou os correlatos sociodemográficos. Métodos: Os dados foram obtidos da pesquisa nacional EPICOVID 2.0, que incluiu 33.250 participantes. As mudanças na AF e no TS foram autorrelatadas e análises de regressão logística multinomial ponderadas foram realizadas. Resultados: No geral, 29,3% (IC 95%: 28,8 – 29,8) relataram nunca praticar AF, 30,1% (IC 95%: 29,6 – 30,7) relataram diminuição da AF, 8,6% (IC 95%: 8,3 – 8,9) relataram aumento da AF e 31,9% (IC 95%: 31,5 – 32,5) relataram nenhuma mudança. Em relação ao tempo sentado, 34,4% (IC 95%: 33,8 – 34,9) relataram aumento, 9,7% (IC 95%: 9,4 – 10,1) redução e 55,9% (IC 95%: 55,4 – 56,5) nenhuma alteração. Os participantes que reduziram o tempo sentado apresentaram menor probabilidade de reduzir a AF (OR = 0,29; IC 95%: 0,22 – 0,40). As mulheres apresentaram maior probabilidade do que os homens de relatar diminuição da AF, enquanto não se observou diferença entre os gêneros quanto ao tempo sentado. Indivíduos com maior escolaridade apresentaram maior probabilidade de reduzir a AF e aumentar o TS. Conclusão: Esses achados indicam que a pandemia afetou a AF e o TS de forma distinta entre os subgrupos populacionais. Estratégias de saúde pública direcionadas são necessárias para promover a AF e reduzir o comportamento sedentário, especialmente entre grupos vulnerabilizados.

Palavras-chave: *Covid-19; Atividade física; Comportamento sedentário; Fatores sociodemográficos.*

Introduction

The SARS-CoV-2 virus, responsible for covid-19, was first identified in December 2019 in China[1]. Characterized by its high transmissibility, the virus rapidly spread across the globe, prompting the World Health Organization to declare covid-19 a global pandemic in March 2020[2,3]. In response to the rapid transmission, the risk of severe respiratory disease, and the initial absence of vaccines or effective treatments, several countries, including Brazil, implemented social isolation measures to curb widespread contagion and mitigate the burden on healthcare systems[4,5].

These measures significantly disrupted daily life and routines for large segments of the population, leading to partial or complete restrictions on travel, outdoor activities, and social gatherings, as well as the closure of non-essential businesses and institutions, including schools and universities[6]. Preventive guidelines recommended that the entire population remain at home whenever possible to reduce the risk of contagion, particularly given the high proportion of asymptomatic individuals among those infected[5,6]. As a result, the routines of various population groups were significantly disrupted[7], and the context of home confinement likely contributed to an increase in sedentary behaviors, such as prolonged sitting time (ST), and a decrease in physical activity (PA) levels[8–10]. In this context, the prevalence of prolonged ST[11,12] and physical inactivity[13,14], which were already high among various population groups before the pandemic, may have become even more pronounced[8–10]. Furthermore, studies highlight significant variation in ST and PA based on sociodemographic factors[15–17], which may also have influenced these behaviors differently during the pandemic period.

In Brazil, several studies have shown a decline in PA levels and an increase in sedentary behavior during this period[18–21]. However, most of these studies were conducted during the early phases of the pandemic and were based on smaller or non-representative samples, limiting the generalizability of their findings to the Brazilian population. EPICOVID 2.0 is a countrywide population-based survey aimed at understanding the impacts of the covid-19 pandemic on the Brazilian population, including its behavioral aspects. Additionally, previous studies have often examined PA and ST separately, with limited attention to their combined patterns. Understanding whether these behavioral changes persisted beyond the acute phase of the pandemic, and how they are distributed across different population groups, remains essential for informing long-term public health strategies.

In this context, the present study aims to evaluate self-reported changes in PA and ST during the covid-19 pandemic and to examine sociodemographic inequalities in these changes in a nationally representative sample of the Brazilian population, contributing to the understanding of population behavioral responses to large-scale public health crises.

Methods

The National Survey to Assess the Real Impact of the covid-19 Pandemic in Brazil (EPICOVID 2.0) was a countrywide, population-based survey conducted in Brazil between March and June 2024. The Research Ethics Committee approved this study (CAAE: 68382923.8.0000.5313). All participants provided informed consent before data collection. For participants under 18 years of age, assent and consent were obtained from a parent or legal guardian. The study involved minimal risk and ensured voluntary participation and confidentiality.

The survey included 26 states and 133 municipalities. Each municipality had 25 census tracts selected with probability proportional to population size based on the Brazilian Institute of Geography and Statistics. Within each selected census tract, a systematic sample of 10 households was selected. The interviewer listed all inhabitants of the selected residence and randomly selected one interviewee. If the first and second inhabitants refused the interview, the interviewer selected an adjacent residence.

The interviewer conducted a face-to-face questionnaire with each interviewee, asking about sociodemographic aspects, post-covid-19 symptoms, financial, nutritional, educational, behavioral impacts, mental and physical health impacts, and vaccination against covid-19. In this study, we used sociodemographic elements and variables related to behavioral changes.

Changes in PA and ST were assessed through self-reported questions specifically developed for the EPICOVID 2.0 survey, aiming to capture perceived changes during the covid-19 pandemic. For PA practice and ST, we used the questions "Next, I would like to know if your behaviors have changed during the pandemic": a) PA practice categorized as (1) Decreased a lot, (2) Decreased a little, (3) Remained the same, (4) Increased a little, (5) Increased a lot and (8)

Never practiced PA; b) ST classified as (1) Decreased a lot, (2) Decreased a little, (3) Remained the same, (4) Increased a little and (5) Increased a lot. In our analysis, we combined the categories "decreased a lot" and "decreased a little" into "decreased," and "increased a lot" and "increased a little" into "increased."

We considered the variables region, gender, race/ethnicity, education, age group, and socioeconomic level as stratification factors in our analyses. EPICOVID used the categorization used by the Brazilian Institute of Geography and Statistics for race/ethnicity: white, brown (pardo), yellow, black, and indigenous. In this study, we used the categories of white, Afro-Brazilian (a combination of black and brown), and other (including yellow and indigenous). Age groups were divided into adolescents (< 18 years), young adults (18–24 years), adults (25–59 years), and older adults (≥60 years). Regarding education, our analyses encompass four levels, based on the duration of formal schooling: 1-4 years, 5-8 years, 9-12 years, and higher education. The regional analysis included the Brazilian political-administrative regions (north, northeast, southeast, central-west, and south). Socioeconomic status was assessed using a wealth index constructed through principal component analysis based on household assets and characteristics. This method, widely used in epidemiological surveys, enables the classification of participants into socioeconomic quintiles based on the ownership of durable goods, household conditions, and the educational attainment of the household head.

We conducted descriptive analyses for each outcome, stratified by sociodemographic characteristics. We used weighted analyses for all estimates, adjusting for the complex survey design using population weights included in the statistical software Stata 15 (StataCorp LLC, College Station, TX, USA) to obtain descriptive and association statistics, considering 95% CI and $p < 0.05$ as statistically significant. The associations between sociodemographic factors and changes in ST and PA during the covid-19 pandemic were examined using multinomial logistic regression.

Results

Table 1 describes socioeconomic characteristics of the sample from the EPICOVID 2.0 study population (n = 33,250). Figure 1 shows the changes that occurred during the covid-19 pandemic in PA and ST behaviors. Regarding PA, 29.3% (95% CI: 28.8 – 29.8) of participants reported never having practiced PA. 31.9% (95% CI: 31.5 – 32.5) stated that the pandemic did not change their activity levels, 30.1% (95% CI: 29.6 – 30.7) reported a decrease, and 8.6% (95% CI: 8.3 – 8.9) reported an increase in PA during the pandemic. Regarding ST, 55.9% (95% CI: 55.4 – 56.5) reported no change, 34.4% (95% CI: 33.8 – 34.9) increased ST, and 9.7% (95% CI: 9.4 – 10.1) reduced ST.

Table 1 – Description of characteristics of EPICOVID 2.0 study participants (n = 33,250).

Variable	n*	% (95% CI) **
Gender		
Male	11,782	52.5 (51.1; 53.9)
Female	19,097	47.4 (46.0; 48.9)
Race/ethnicity		
White	9,823	44.4 (42.4; 46.4)
Brown and Black	19,004	54.7 (52.7; 57.8)
Others	1,017	0.9 (0.7; 1.1)
Age group		
< 18 years	655	3.0 (2.5; 3.6)
18 – 24 years	2,372	10.6 (9.6; 11.6)
25 – 59 years	18,485	65.3 (63.7; 66.9)
≥ 60 years	9,371	21.1 (19.9; 22.4)
Education		
1-4 years	4,481	13.7 (12.6; 14.8)
5-8 years	6,630	17.9 (16.7; 19.1)
9-12 years	13,613	50.6 (48.9; 52.4)
Higher education	4,108	17.8 (16.2; 19.5)
Socioeconomic level		
Poorest tercile	10,511	28.8 (27.1; 30.6)
Intermediary	9,810	31.2 (29.4; 33.1)
Richest tercile	10,192	39.9 (37.9; 41.9)
Region		
Northeast	9,803	21.9 (21.4; 22.5)
North	4,895	9.1 (8.7; 9.4)
Centre-West	3,523	11.2 (10.7; 11.6)
Southeast	7,775	43.8 (42.8; 44.8)
South	4,887	13.9 (13.4; 14.5)

*Absolute number of people interviewed in each stratum; **Percentage adjusted for the Brazilian population; Differences in totals are due to missing data for specific variables.

The analyses describe the prevalence and associations of PA and ST with predictor variables (gender, race/ethnicity, age, educational level, socioeconomic status, and geographic region), considering the categories of decrease, maintenance, and increase (Table 2 and 3). We used multinomial logistic regression (Table 4 and 5) to investigate the association between PA, ST, and predictor variables, comparing the categories of reduction and increase in PA in relation to maintenance.

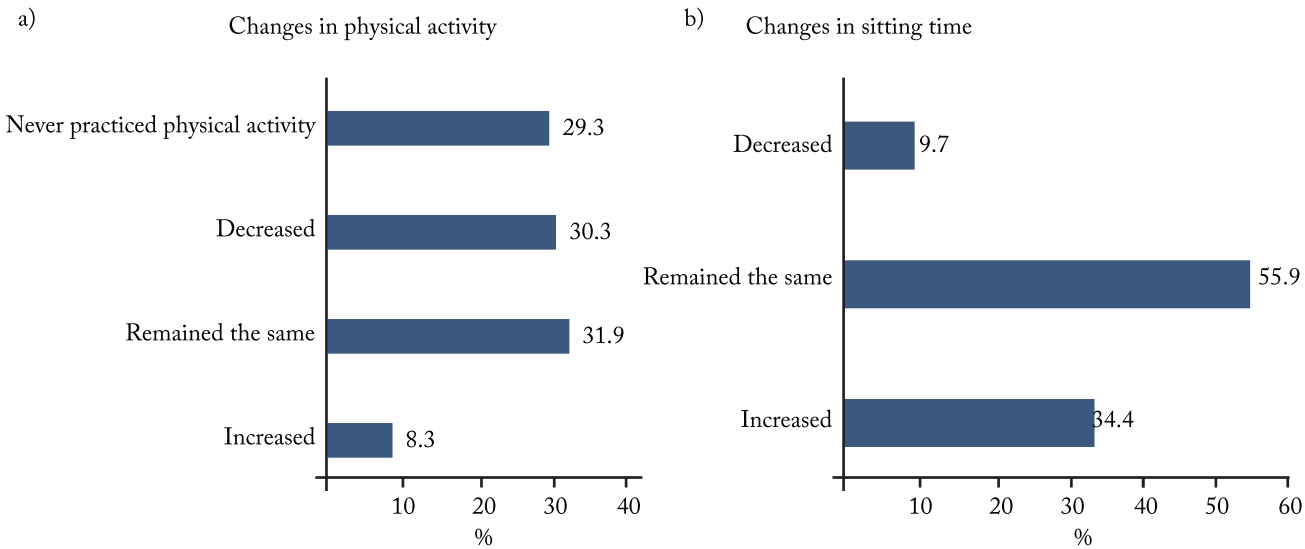

Figure 1 – Prevalence of changes in physical activity behaviors (A) and sitting time (B) during the covid-19 pandemic.

Table 2 – Association of sociodemographic factors with changes in physical activity during the covid-19 pandemic. EPICOVID 2.0 study.

Physical activity	Decrease % (95% CI)	No change % (95% CI)	Increased % (95% CI)
Gender			
Male	38.4 (35.5; 41.3)	47.2 (44.4; 49.9)	14.4 (12.4; 16.7)
Female	46.3 (43.9; 48.8)	41.8 (39.1; 44.6)	11.8 (10.2; 13.7)
Race/ethnicity			
White	41.3 (37.7; 45.1)	45.3 (41.5; 49.2)	13.3 (11.2; 15.7)
Brown and Black	42.5 (40.4; 44.6)	44.4 (42.3; 46.5)	13.1 (11.7; 14.7)
Others	37.8 (28.5; 48.1)	42.6 (34.1; 51.6)	19.6 (12.4; 29.5)
Age group			
< 18 years	39.0 (30.4; 48.4)	41.5 (30.9; 53.0)	19.4 (13.7; 26.8)
18 – 24 years	43.4 (36.5; 50.5)	36.6 (31.6; 41.9)	19.9 (14.8; 26.3)
25 – 59 years	43.4 (41.0; 45.8)	43.5 (41.1; 45.9)	13.1 (11.6; 14.7)
≥ 60 years	36.5 (33.4; 39.8)	54.6 (51.1; 58.0)	8.9 (7.2; 10.9)
Education			
1 - 4 years	34.9 (29.9; 40.2)	55.5 (50.4; 60.4)	9.6 (7.6; 12.0)
5 - 8 years	41.2 (37.3; 45.3)	49.4 (45.6; 53.3)	9.3 (7.5; 11.5)
9 - 12 years	41.2 (38.7; 43.6)	44.7 (42.2; 47.3)	14.1 (12.3; 16.2)
Higher education	50.1 (44.9; 55.4)	32.5 (28.5; 36.7)	17.4 (14.3; 20.9)
Socioeconomic level			
Poorest tercile	39.8 (36.1; 43.7)	46.9 (43.4; 50.5)	13.2 (10.4; 16.5)
Intermediary	41.9 (38.2; 45.6)	44.9 (41.3; 48.6)	13.2 (11.2; 15.6)
Richest tercile	43.4 (40.5; 46.3)	43.4 (40.5; 46.3)	13.2 (11.5; 15.1)
Region			
Northeast	46.1 (43.6; 48.7)	40.7 (38.3; 43.1)	13.2 (11.6; 14.9)
North	38.6 (35.5; 41.8)	46.3 (43.0; 49.7)	15.0 (12.7; 17.7)
Centre-West	34.9 (30.9; 39.2)	52.2 (48.3; 56.0)	12.9 (10.8; 15.4)
Southeast	43.7 (39.6; 47.9)	43.7 (39.4; 48.1)	12.5 (10.1; 15.5)
South	38.2 (35.9; 40.6)	46.9 (44.6; 49.2)	14.8 (13.2; 16.7)

95% CI: 95% confidence interval.

Table 3 – Association of sociodemographic factors with changes in sitting time during the covid-19 pandemic. EPICOVID 2.0 study.

Sitting time	Decrease % (95% CI)	No change % (95% CI)	Increased % (95% CI)
Gender			
Male	8.4 (7.4; 9.6)	55.1 (52.5; 57.6)	36.5 (33.9; 39.1)
Female	7.8 (6.9; 8.7)	50.9 (48.8; 53.0)	11.8 (10.2; 13.7)
Race/ethnicity			
White	7.2 (5.9; 8.6)	51.3 (48.4; 54.3)	41.5 (38.6; 44.4)
Brown and Black	8.9 (8.1; 9.7)	54.5 (52.6; 56.5)	36.6 (34.7; 38.5)
Others	10.8 (7.2; 15.8)	51.5 (43.3; 59.5)	37.7 (29.5; 46.7)
Age group			
< 18 years	8.1 (5.6; 11.6)	43.1 (34.3; 52.5)	48.7 (39.5; 58.0)
18 – 24 years	10.7 (8.1; 14.0)	43.3 (38.7; 48.0)	46.0 (41.2; 50.9)
25 – 59 years	8.0 (7.1; 8.9)	51.9 (49.7; 54.1)	40.0 (37.9; 42.2)
≥ 60 years	7.2 (5.9; 8.7)	63.0 (60.2; 65.7)	29.8 (27.3; 32.3)
Education			
1 - 4 years	8.9 (7.3; 10.7)	66.6 (62.7; 70.2)	24.5 (21.2; 28.1)
5 - 8 years	8.9 (7.3; 10.6)	58.5 (55.3; 61.6)	32.6 (29.8; 35.4)
9 - 12 years	8.6 (7.5; 9.8)	51.1 (48.9; 53.4)	40.2 (38.1; 42.5)
Higher education	5.1 (3.8; 6.9)	37.4 (33.2; 41.9)	57.4 (52.8; 61.9)
Socioeconomic level			
Poorest tercile	10.3 (9.0; 11.6)	55.5 (52.9; 58.1)	34.2 (31.7; 36.8)
Intermediary	9.0 (7.7; 10.6)	53.8 (51.0; 56.5)	37.2 (34.7; 39.7)
Richest tercile	5.9 (4.9; 7.3)	49.9 (47.4; 52.6)	44.0 (41.4; 46.7)
Region			
Northeast	11.7 (10.5; 13.1)	50.1 (48.1; 51.9)	38.2 (36.5; 39.9)
North	10.9 (9.4; 12.7)	59.1 (56.2; 61.9)	29.9 (27.4; 32.5)
Centre-West	8.8 (7.1; 10.9)	59.1 (56.5; 61.6)	32.1 (29.4; 34.9)
Southeast	5.8 (4.6; 7.2)	51.6 (47.9; 55.3)	42.6 (39.2; 46.1)
South	7.5 (6.5; 8.7)	53.8 (51.8; 55.7)	38.7 (36.8; 40.7)

95% CI: 95% confidence interval.

Physical activity

Among participants reporting PA, changes (decrease or increase) during the covid-19 pandemic were observed in 52.8% of men and 58.1% of women. Wom-

Table 4 – Multinomial logistic regression of changes in physical activity during the COVID-19 Pandemic.

Physical activity	Reduced PA vs. No change (Odds Ratio; 95% CI)	Increased PA vs. No change (Odds Ratio; 95% CI)
Age group		
< 18 years	1	1
18 – 24 years	1.27 (0.68–2.39)	1.07 (0.56–2.04)
25 – 59 years	1.19 (0.70–2.03)	0.68 (0.39–1.16)
≥ 60 years	0.89 (0.51–1.52)	0.41 (0.23–0.73) **
Gender		
Male	1	1
Female	1.31 (1.11–1.55) **	0.88 (0.66–1.18)
Race/ethnicity		
White	1	1
Brown/Black	1.17 (0.94–1.44)	1.06 (0.79–1.41)
Other	1.02 (0.62–1.70)	1.34 (0.67–2.69)
Education		
1 - 4 years	1	1
5 – 8 years	1.25 (0.92–1.70)	1.08 (0.76–1.53)
9 – 12 years	1.18 (0.90–1.54)	1.60 (1.14–2.23) **
Higher education	1.61 (1.15–2.24) **	2.85 (1.85–4.40) ***
Socioeconomic level		
Poorest tercile	1	1
Middle tertile	1.01 (0.81–1.26)	0.92 (0.64–1.33)
Richest tertile	1.01 (0.80–1.29)	0.82 (0.55–1.22)
Sitting time		
No change	1	1
Reduced	0.29 (0.22–0.40) ***	0.23 (0.15–0.33) ***
Increased	1.29 (0.96–1.72)	0.44 (0.31–0.64) ***

*** p < 0.001; ** p < 0.01.

Table 5 – Multinomial logistic regression of changes in sitting time during the COVID-19 Pandemic.

Sitting time	Reduced ST vs. No change (Odds Ratio; 95% CI)	Increased ST vs. No change (Odds Ratio; 95% CI)
Age group		
< 18 years	1	1
18 – 24 years	1.06 (0.58–1.94)	0.82 (0.44–1.51)
25 – 59 years	0.75 (0.45–1.23)	0.63 (0.36–1.10)
≥ 60 years	0.67 (0.38–1.18)	0.46 (0.26–0.84) **
Gender		
Male	1	1
Female	0.95 (0.75–1.20)	1.16 (0.96–1.42)
Race/ethnicity		
White	1	1
Brown/Black	0.97 (0.72–1.31)	0.82 (0.67–1.00)
Other	0.96 (0.53–1.75)	0.94 (0.59–1.50)
Education		
1 - 4 years	1	1
5 – 8 years	0.94 (0.65–1.36)	1.24 (0.91–1.69)
9 – 12 years	0.97 (0.68–1.37)	1.62 (1.27–2.05) ***
Higher education	0.85 (0.54–1.34)	2.98 (2.20–4.03) ***
Socioeconomic level		
Poorest tercile	1	1
Middle tertile	0.87 (0.65–1.18)	0.99 (0.80–1.23)
Richest tertile	0.65 (0.46–0.93)	1.06 (0.85–1.34)

*** p < 0.001; ** p < 0.01.

en showed a higher prevalence of reduced PA (46.3%; 95% CI: 43.9 – 48.8) (Table 2) and higher odds of reporting this change compared with men (OR = 1.31; 95% CI: 1.11 – 1.55) (Table 4). No association was observed between sex and increased PA.

No differences were observed across race/ethnicity groups. The prevalence of reduced PA was 41.3% (95% CI: 37.7 – 45.1) among white individuals and 42.5% (95% CI: 40.4 – 44.6) among Afro-Brazilians. Individuals classified as other (indigenous and Asian) showed a higher proportion of increased PA (19.6%; 95% CI: 12.4 – 29.5), although the wide confidence interval indicates low precision (Table 2).

PA varied according to age group. Higher prevalence of increased PA was observed among adolescents (<18 years) (19.4%; 95% CI: 13.7 – 26.8) and young adults (18–24 years) (19.9%; 95% CI: 14.8 – 26.3), whereas older adults (≥60 years) showed the lowest prevalence (8.9%; 95% CI: 7.2 – 10.9). Older adults also had lower odds of reporting increased PA compared with adolescents (OR = 0.41; 95% CI: 0.23 – 0.73) (Table 4). No differences were observed for reduced PA across age groups.

PA changes differed by education level. Individuals with higher education presented the highest prevalence of both reduced PA (50.1%; 95% CI: 44.9 – 55.4) and increased PA (17.4%; 95% CI: 14.3 – 20.9) (Table 2). Compared with those with lower education, they had higher odds of reporting reduced PA (OR = 1.61; 95% CI: 1.15 – 2.24) and increased PA (OR = 2.85; 95% CI: 1.85 – 4.40) (Table 4).

No associations were observed between socioeconomic status and changes in PA. The prevalence of reduced PA ranged from 39.8% (95% CI: 36.1 – 43.7) in the lowest tertile to 43.4% (95% CI: 40.5 – 46.3) in the highest tertile, while increased PA remained stable across groups (13.2% in all tertiles) (Table 2). Individuals in the highest tertile had lower odds of reduced PA associated with ST (OR = 0.65; 95% CI: 0.46 – 0.93) (Table 4).

Regionally, the Northeast showed the highest prevalence of reduced PA (46.1%; 95% CI: 43.6 – 48.7), compared with the North (38.6%; 95% CI: 35.5 –

41.8) and the South (38.2%; 95% CI: 35.9 – 40.6). The prevalence of increased PA ranged from 12.5% (95% CI: 10.1 – 15.5) in the Southeast to 15.0% (95% CI: 12.7 – 17.7) in the North (Table 2).

Sitting time

Changes in ST were reported by 44.9% of men and 19.6% of women. Increased ST was more frequent among men (36.5%; 95% CI: 33.9 – 39.1) than women (11.8%; 95% CI: 10.2 – 13.7), while decreased ST was reported by 8.4% (95% CI: 7.4 – 9.6) of men and 7.8% (95% CI: 6.9 – 8.7) of women (Table 3). No association was observed between gender and changes in ST in the multinomial logistic regression analysis.

Differences in ST were observed across race/ethnicity groups. Increased ST was more frequent among white individuals (41.5%; 95% CI: 38.6 – 44.4) than Afro-Brazilians (36.6%; 95% CI: 34.7 – 38.5) (Table 3). Adolescents (48.7%; 95% CI: 39.5 – 58.0) and young adults (46.0%; 95% CI: 41.2 – 50.9) more frequently reported increased ST compared with older adults (29.8%; 95% CI: 27.3 – 32.3). Older adults showed a higher prevalence of maintained ST (63.0%; 95% CI: 60.2 – 65.7), while decreased ST ranged from 7.2% (95% CI: 5.9 – 8.7) among older adults to 10.7% (95% CI: 8.1 – 14.0) among young adults (Table 3). Older adults had lower odds of increased ST compared with adolescents (OR = 0.46; 95% CI: 0.26 – 0.84) (Table 5).

ST patterns differed by education level. Individuals with higher education showed a higher prevalence of increased ST and lower prevalence of decreased and maintained ST (Table 3). In the adjusted analysis, higher education was associated with higher odds of increased ST. Participants with 9–12 years of schooling had higher odds of increased ST (OR = 1.62; 95% CI: 1.27 – 2.05), and those with higher education had even greater odds (OR = 2.98; 95% CI: 2.20 – 4.03) compared with those with lower education (Table 5).

A gradient was observed across wealth tertiles, with higher prevalence of increased ST among the wealthiest individuals (44.0%; 95% CI: 41.4 – 46.7), compared with the middle (37.2%; 95% CI: 34.7 – 39.7) and lowest tertiles (34.2%; 95% CI: 31.7 – 36.8) (Table 3). Individuals in the highest tertile had lower odds of decreased ST compared with those in the lowest tertile (OR = 0.65; 95% CI: 0.46 – 0.93) (Table 5). Regionally, increased ST was more prevalent in the Southeast (42.6%; 95% CI: 39.2 – 46.1) than in the North (29.9%; 95% CI: 27.4 – 32.5) and the Central-West (32.1%; 95% CI: 29.4 – 34.9) (Table 3).

Discussion

Our study reports changes in PA and ST during the COVID-19 pandemic in a countrywide sample of the Brazilian population. Our findings demonstrated that there was a higher prevalence of reduced PA and increased ST overall. Limitations of physical spaces, availability of materials, social support, knowledge about the possibilities of performing PA at home, and motivation may be some of the barriers to PA during this time[22]. Changes in routine imposed by social isolation, with classes and work shifting to online activities, may have contributed to the increase in ST[23].

Several studies have reported patterns like ours regarding PA decline and an increase in sedentary behavior during the covid-19 pandemic, supporting many of our interpretations. For instance, an extensive national Brazilian survey of 39,693 adults found that physical inactivity increased by approximately 26% during the pandemic, accompanied by dramatic rises in TV-viewing time (266%) and computer/tablet use (38%)[24]. Similarly, a time-series analysis of Brazilian capitals revealed that leisure-time PA trends, which had been increasing from 2009 to 2019, declined after 2019, coinciding with the onset of the pandemic period, while total screen time increased sharply[25]. However, some studies have found partial recovery of PA over time after the initial lockdown phases — for example, a study in Southern Brazil showed an increase in PA levels approximately ten months into the pandemic, although it did not return to pre-pandemic levels[26]. Beyond the Brazilian context, international evidence corroborates our findings, indicating that the decline in PA and rise in ST during the covid-19 pandemic were widespread phenomena. A global survey including more than 14 countries reported significant reductions in moderate to vigorous PA and increases in daily ST across all regions, particularly during the strictest lockdown phases[22]. Studies from Europe, such as in Spain and the United Kingdom, consistently documented sharp decreases in leisure-time PA and increases in screen-based sedentary behaviors, often exceeding two additional hours per day[27,28]. Similar patterns were observed in North America, where longitudinal cohorts showed that PA levels fell markedly in the early months of the pandemic and, despite partial rebounds, never returned to pre-pandemic baselines[23,29]. Collectively, this body of evidence reinforces the notion that the Brazilian experience reflects a global disruption

of movement behaviors. However, the magnitude and persistence of changes have varied according to regional policies, socioeconomic structures, and cultural contexts.

Although these global patterns are consistent, the Brazilian case provides unique insights because of its marked socioeconomic inequalities and regional heterogeneity[30] . Such findings highlight that while the pandemic acted as a universal disruptor of daily routines, its consequences were socially patterned, reflecting pre-existing structural inequities that were only magnified under conditions of crisis[31,32].

Women were at greater risk of reduced PA levels than men. Gender is consistently associated with PA, with women reporting lower activity levels at different stages of the life course[13,33]. During the covid-19 pandemic, it is likely that many pre-existing barriers to women's PA, such as the burden of unpaid domestic labor, childcare responsibilities, and the challenges of balancing professional and household roles, became even more pronounced under conditions of social isolation[34]. These gendered constraints may have contributed to the sharper reduction in female PA, but a less increase in ST observed in our study.

Our findings also demonstrated that older adults were less likely to increase their PA levels during the covid-19 pandemic. This population group was among those at the highest risk for severe covid-19 outcomes, which led to the adoption of stricter protective measures, including prolonged isolation and restricted mobility[35]. These circumstances may have contributed to the lower likelihood of increasing PA in older adults. At the same time, older adults were also less likely to increase their ST compared to adolescents. One possible explanation is that many older adults, particularly those already retired, experienced fewer disruptions to their daily routines. In contrast, adolescents faced a sudden shift from in-person to online classes, which substantially increased screen exposure and sedentary patterns[36,37].

Interestingly, higher education was associated with both reduced and increased PA. This apparent paradox may reflect divergent effects within this group. On one hand, individuals with higher education may have greater awareness of the health benefits of PA and better access to resources or alternative opportunities to remain active during restrictions[38]. On the other hand, this group was also more exposed to occupational demands linked to remote work, longer screen time, and digital engagements, which may have limited opportunities for PA and contributed to increased sedentary behavior[39].

Socioeconomic differences also played a role in changes in ST during the pandemic. Individuals in the richest socioeconomic tertile were less likely to reduce their ST compared to those in the middle tertile. This finding suggests that wealthier individuals may have faced greater structural or behavioral barriers to decreasing sedentary behaviors, such as increased access to screen-based entertainment, reliance on digital work, and reduced need for active commuting or household tasks[39]. Importantly, this highlights that higher socioeconomic status does not necessarily equate to healthier movement behaviors during disruptive periods such as the pandemic. Indeed, evidence from Brazil and other countries suggests that while higher socioeconomic status is often linked to better health outcomes, it can also be associated with more sedentary occupational routines and greater screen exposure[38,40].

Our study has some limitations. First, changes in PA and ST were based on self-reported perceived measures specifically developed for this survey and not derived from previously validated instruments, which may be subject to recall and reporting bias. In addition, these measures did not capture the actual duration or intensity of behaviors before and during the covid-19 pandemic. Furthermore, our cross-sectional analysis also has limitations because it did not track these behaviors longitudinally during the lockdown period, which would have provided more precise measures of the behaviors.

On the other hand, the strengths of this study include its large sample size, with a representative national sample from a middle-income country. In this context, the EPICOVID 2.0 study stands out globally as one of the largest covid-19 surveys in terms of sample size and territorial coverage. Additionally, the multidimensional nature of the research enabled us to evaluate various aspects related to covid-19, including changes in participants' lifestyle behaviors.

In conclusion, our findings underscore the interconnected nature of PA and ST, highlighting that promoting healthy movement patterns requires a comprehensive approach. While inequalities persisted, especially among socially disadvantaged groups, the diversity of responses to the pandemic also reveals opportunities: some individuals successfully increased their PA even under restrictive conditions. These findings contribute to the understanding of population behavioral responses during large-scale public health crises, showing that positive behavioral changes are possible even in adverse contexts. Our results highlight the importance of considering both structur-

al barriers and enabling factors when interpreting these patterns. Future public health strategies should aim not only to reduce barriers, particularly for vulnerable populations, but also to strengthen facilitators that encourage active lifestyles, even in challenging circumstances.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Kohn ER, Tornquist D, Tornquist L and Soares CAM: Conceptualization; Methodology; Formal analysis; Investigation; Project administration; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Siqueira FCV: Conceptualization; Methodology; Formal analysis; Investigation; Writing – original draft; Writing – review & editing; Approval of the final version. Hallal PC: Conceptualization; Methodology; Formal analysis; Investigation; Resources; Data curation; Supervision; Funding acquisition; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

For the preparation of this manuscript, the artificial intelligence tool ChatGPT was used for the following activity: text editing. The authors declare that all material derived from this process was reviewed, and the authors assume full responsibility for the entire content of the manuscript.

Availability of research data and other materials

Data is available upon request from reviewers.

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References

1. Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. Nature. 2020;579(7798):265–9. doi: https://doi.org/10.1038/s41586-020-2008-3
2. Shah SGS, Farrow A. A commentary on "World Health Organization declares global emergency: A review of the 2019 novel Coronavirus (COVID-19)." Int J Surg. 2020;76:128–9. doi: https://doi.org/10.1016/j.ijsu.2020.03.001
3. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. 2020. Available from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020> [2025 July].
4. Lotfi M, Hamblin MR, Rezaei N. COVID-19: Transmission, prevention, and potential therapeutic opportunities. Clin Chim Acta. 2020;508:254–66. doi: https://doi.org/10.1016/j.cca.2020.05.044.
5. World Health Organization. Risk Communication and Community Engagement Guidance for Physical and Social Distancing - World | ReliefWeb. 2020. Available from: <https://reliefweb.int/report/world/risk-communication-and-community-engagement-guidance-physical-and-social-distancing> [2025 July].
6. Silva LLS da, Lima AFR, Polli DA, Razia PFS, Pavão LFA, Cavalcanti MAF de H, et al. Social distancing measures in the fight against COVID-19 in Brazil: description and epidemiological analysis by state. Cad Saúde Pública. 2020;36:e00185020. doi: https://doi.org/10.1590/0102-311X00185020
7. Caroppo E, Mazza M, Sannella A, Marano G, Avallone C, Claro AE, et al. Will Nothing Be the Same Again?: Changes in Lifestyle during COVID-19 Pandemic and Consequences on Mental Health. Int J Environ Res Public Health. 2021;18(16):8433. doi: https://doi.org/10.3390/ijerph18168433
8. Mazo GZ, Fank F, Franco PS, Capanema B da SV, Pereira F da S. Impact of Social Isolation on Physical Activity and Factors Associated With Sedentary Behavior in Older Adults During the COVID-19 Pandemic. Aging Phys Act. 2022;30(1):148-52. doi: https://doi.org/10.1123/japa.2020-0456.
9. Sañudo B, Fennell C, Sánchez-Oliver AJ. Objectively-Assessed Physical Activity, Sedentary Behavior, Smartphone Use, and Sleep Patterns Pre- and during-COVID-19 Quarantine in Young Adults from Spain. Sustainability. 2020;12(15):5890. doi: https://doi.org/10.3390/su12155890
10. Caputo EL, Reichert FF. Studies of Physical Activity and COVID-19 During the Pandemic: A Scoping Review. J Phys Act Health. 2020;17(12):1275-84. doi: https://doi.org/10.1123/jpah.2020-0445
11. Bauman AE, Petersen CB, Blond K, Rangul V, Hardy LL. The Descriptive Epidemiology of Sedentary Behaviour. In: Leitzmann MF, Jochem C, Schmid D, editors. Sedentary Behaviour Epidemiology. Cham: Springer International Publishing; 2018. p. 73–106. doi: https://doi.org/10.1007/978-3-319-61552-3_4
12. Koyanagi A, Stubbs B, Vancampfort D. Correlates of sedentary behavior in the general population: A cross-sectional study using nationally representative data from six low- and middle-income countries. PLOS ONE. 2018;13(8):e0202222. doi: https://doi.org/10.1371/journal.pone.0202222
13. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. The Lancet Global Health. 2018;6(10):e1077–86. doi: https://doi.org/10.1016/S2214-109X(18)30357-7

14. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. Lancet Child Adolesc Health. 2020;4(1):23–35. doi: https://doi.org/10.1016/S2352-4642(19)30323-2
15. Lakerveld J, Loyen A, Schotman N, Peeters CFW, Cardon G, van der Ploeg HP, et al. Sitting too much: A hierarchy of socio-demographic correlates. Prev Med. 2017;101:77–83. doi: https://doi.org/10.1016/j.ypmed.2017.05.015
16. Loyen A, Ploeg HP van der, Bauman A, Brug J, Lakerveld J. European Sitting Championship: Prevalence and Correlates of Self-Reported Sitting Time in the 28 European Union Member States. PLoS One. 2016;11(3):e0149320. doi: https://doi.org/10.1371/journal.pone.0149320
17. Leite GS, Alves CPL, Leão OAA, Crochemore-Silva I. Gender, Ethnicity, and Socioeconomic Inequalities in Physical Activity Throughout the Life Course: A Systematic Review of Cohort Studies. J Phys Act Health. 2024;21(12):1276-85. doi: https://doi.org/10.1123/jpah.2024-0313
18. Brito LMS, Boguszewski MC da S, Souza MTR de, Martins F, Mota J, Leite N. Indoor physical activities, eating and sleeping habits among school adolescents during COVID-19 pandemic. Rev. Bras. Ativ. Fís. Saúde. 2020;25:1–6. doi: https://doi.org/10.12820/rbafs.25e0117
19. Botero JP, Farah BQ, Correia M de A, Lofrano-Prado MC, Cucato GG, Shumate G, et al. Impact of the COVID-19 pandemic stay at home order and social isolation on physical activity levels and sedentary behavior in Brazilian adults. Einstein (São Paulo). 2021;19:eAE6156. doi: https://doi.org/10.31744/einstein_journal/2021AE6156
20. Rocha BMS, Souto MFO, Mendes VCN, Ferreira JVB, Azevedo E de O, Cunha ALLPE, et al. Factors associated with the practice of physical activity among university students in social isolation during the covid-19 pandemic. Rev bras cineantropom desempenho hum. 2023;25:e90191. doi: https://doi.org/10.1590/1980-0037.2023v25e90191
21. Leite Miranda F, Fernandes CH, Myiamoto Meirelles L, Faloppa F, Ejnisman B, Cohen M. The Impact of COVID-19 Social Isolation on Physical Activity and Sedentary Behavior in Brazilian Children and Adolescents. Rev bras ortop. 2025;60:s00441800941. doi: https://doi.org/10.1055/s-0044-1800941.
22. Ammar A, Brach M, Trabelsi K, Chtourou H, Boukhris O, Masmoudi L, et al. Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey. Nutrients. 2020;12(6):1583. doi: https://doi.org/10.3390/nu12061583
23. Dunton GF, Do B, Wang SD. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S. BMC Public Health. 2020;20(1):1351. doi: https://doi.org/10.1186/s12889-020-09429-3
24. Silva DRP da, Werneck AO, Malta DC, Souza Júnior PRB de, Azevedo LO, Barros MB de A, et al. Changes in the prevalence of physical inactivity and sedentary behavior during COVID-19 pandemic: a survey with 39,693 Brazilian adults. Cad Saúde Pública. 2021;37:e00221920. doi: https://doi.org/10.1590/0102-311X00221920
25. Faria TMTR, Silva AG da, Claro RM, Malta DC. Time trends and COVID-19 post-pandemic changes in physical activity and sedentary behavior prevalence among Brazilian adults between 2006 and 2021. Rev bras epidemiol. 2023;26:e230011. doi: https://doi.org/10.1590/1980-549720230011
26. Caputo EL, Feter N, Leite JS, Doring IR, Cassuriaga J, Delpino FM, et al. Physical activity trajectory in the first 10 months of the COVID-19 pandemic in Southern Brazil: a follow-up study. BMC Sports Sci Med Rehabil. 2022;14(1):58. doi: https://doi.org/10.1186/s13102-022-00463-0
27. López-Bueno R, Calatayud J, Andersen LL, Balsalobre-Fernández C, Casaña J, Casajús JA, et al. Immediate Impact of the COVID-19 Confinement on Physical Activity Levels in Spanish Adults. Sustainability. 2020;12(14):5708. doi: https://doi.org/10.3390/su12145708
28. Smith L, Jacob L, Butler L, Schuch F, Barnett Y, Grabovac I, et al. Prevalence and correlates of physical activity in a sample of UK adults observing social distancing during the COVID-19 pandemic. BMJ Open Sport Exerc Med. 2020;6(1):e000850. doi: https://doi.org/10.1136/bmjsem-2020-000850
29. Meyer J, McDowell C, Lansing J, Brower C, Smith L, Tully M, et al. Changes in Physical Activity and Sedentary Behavior in Response to COVID-19 and Their Associations with Mental Health in 3052 US Adults. Int J Environ Res Public Health. 2020;17(18):6469. doi: https://doi.org/10.3390/ijerph17186469
30. Rocha R, Atun R, Massuda A, Rache B, Spinola P, Nunes L, et al. Effect of socioeconomic inequalities and vulnerabilities on health-system preparedness and response to COVID-19 in Brazil: a comprehensive analysis. Lancet Glob Health. 2021;9(6):e782–92. doi: https://doi.org/10.1016/S2214-109X(21)00060-7
31. Bambra C, Riordan R, Ford J, Matthews F. The COVID-19 pandemic and health inequalities. J Epidemiol Community Health. 2020;74(11):964–8. doi: https://doi.org/10.1136/jech-2020-214401
32. Baqui P, Bica I, Marra V, Ercole A, Schaar M van der. Ethnic and regional variations in hospital mortality from COVID-19 in Brazil: a cross-sectional observational study. Lancet Glob Health. 2020;8(8):e1018-e1026. doi: https://doi.org/10.1016/S2214-109X(20)30285-0
33. Strain T, Flaxman S, Guthold R, Semenova E, Cowan M, Riley LM, et al. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants. Lancet Glob Health. 2024;12(8):e1232-e1243. doi: https://doi.org/10.1016/S2214-109X(24)00122-6
34. Craig L, Churchill B. Dual-earner parent couples' work and care during COVID-19. Gend Work Organ. 2021;28(Suppl 1):66–79. doi: https://doi.org/10.1111/gwao.12563
35. CDC. Underlying Conditions and the Higher Risk for Severe COVID-19. 2025. Available from: <https://www.cdc.gov/covid/hcp/clinical-care/underlying-conditions.html> [2025 August].
36. Paterson DC, Ramage K, Moore SA, Riazi N, Tremblay MS, Faulkner G. Exploring the impact of COVID-19 on the movement behaviors of children and youth: A scoping review of evidence after the first year. J Sport Health Sci. 2021;10(6):675–89. doi: https://doi.org/10.1016/j.jshs.2021.06.005

37. Xiang M, Zhang Z, Kuwahara K. Impact of COVID-19 pandemic on children and adolescents' lifestyle behavior larger than expected. Prog Cardiovasc Dis. 2020;63(4):531–2. doi: https://doi.org/10.1016/j.pcad.2020.04.013

38. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? The Lancet. 2012;380(9838):258–71. doi: https://doi.org/10.1016/S0140-6736(12)60735-1

39. Knell G, Robertson MC, Dooley EE, Burford K, Mendez KS. Health Behavior Changes During COVID-19 Pandemic and Subsequent "Stay-at-Home" Orders. Int J Environ Res Public Health. 2020;17(17):6268. doi: https://doi.org/10.3390/ijerph17176268

40. Stockwell S, Trott M, Tully M, Shin J, Barnett Y, Butler L, et al. Changes in physical activity and sedentary behaviours from before to during the COVID-19 pandemic lockdown: a systematic review. BMJ Open Sport Exerc Med. 2021; 7(1):e000960. doi: https://doi.org/10.1136/bmjsem-2020-000960

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Reviewers' assessment

The authors and/or reviewers did not authorize the publication of either of the two reviews.