



Physical inactivity and per capita household income in regions of Brazil: National Health Survey 2019

Inatividade física e renda familiar per capita nas regiões do Brasil: Pesquisa Nacional de Saúde 2019

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DOI

10.12820/rbafs.31e0454i



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ABSTRACT

Introduction: Physical inactivity could present association with adverse health outcomes and presents an unequal distribution according to sociodemographic indicators such as sex, ethnicity, and socioeconomic level. **Objective:** To estimate the prevalence of physical inactivity and verify its association with per capita household income, stratified by Brazilian regions. **Methods:** Cross-sectional study with data from the 2019 National Health Survey, including individuals ≥ 18 years ($n = 88,531$). The dependent variable was physical inactivity, defined as <150 minutes/week spent on leisure, commuting, domestic, and work-related physical activities. The main explanatory variable was per capita household income, categorized as: up to $\frac{1}{2}$ minimum wage; $>\frac{1}{2}$ to 1; >1 to 2; and >2 minimum wages. Poisson regression with robust variance was used to assess the association between variables. **Results:** The prevalence of physical inactivity in Brazil was 36.0% (95% CI: 35.3 – 36.7), higher in the North (39.6%; 95% CI: 38.2 – 41.0) and lower in the Southeast (33.2%; 95% CI: 31.9 – 34.4). After adjustment, higher income levels were associated with lower prevalences of physical inactivity in Brazil and in the regions, except in the North. **Conclusion:** It was observed that lower income was associated with greater physical inactivity, and that income and physical inactivity were interdependent in most regions, except for the North. These findings suggest that socioeconomic inequalities influence physical activity patterns, possibly reflecting greater involvement of lower-income groups in occupational and domestic physical activities, as well as differences in access to environments and resources that favor leisure-time practices.

Keywords: Motor activity; Socioeconomic factors; Health disparities; Health inequities; Epidemiological studies.

RESUMO

Introdução: A inatividade física pode apresentar associação com desfechos desfavoráveis em saúde e apresenta distribuição desigual conforme indicadores sociodemográficos, como sexo, etnia e nível socioeconômico. **Objetivo:** Estimar a prevalência de inatividade física e verificar sua associação com a renda familiar per capita, estratificada pelas regiões brasileiras. **Métodos:** Estudo transversal com dados da Pesquisa Nacional de Saúde 2019, incluindo indivíduos ≥ 18 anos ($n = 88.531$). A variável dependente foi a inatividade física, definida pelo tempo <150 minutos/semana em atividades físicas de lazer, deslocamento, doméstico e trabalho. A variável explicativa principal foi a renda familiar per capita, categorizada em: até $\frac{1}{2}$ salário-mínimo; $>\frac{1}{2}$ a 1; >1 a 2; e >2 salários-mínimos. Para avaliar a associação entre as variáveis, utilizou-se regressão de Poisson com variância robusta. **Resultados:** A prevalência de inatividade física no Brasil foi 36,0% (IC 95%: 35,3 – 36,7), maior no Norte (39,6%; IC 95%: 38,2 – 41,0) e menor no Sudeste (33,2%; IC 95%: 31,9 – 34,4). Após ajuste, maiores níveis de renda associaram-se a menores prevalências de inatividade física no Brasil e nas regiões, exceto no Norte. **Conclusão:** Observou-se que menor renda foi associada com maior inatividade física na maioria das regiões, com exceção do Norte. Esses achados sugerem que desigualdades socioeconômicas influenciam o padrão de atividade física, possivelmente refletindo maior envolvimento de grupos de menor renda em atividades físicas ocupacionais e domésticas, além de diferenças no acesso a ambientes e recursos que favoreçam práticas no lazer.

Palavras-chave: Atividade motora; Fatores socioeconômicos; Disparidades em saúde; Iniquidades em saúde; Estudos epidemiológicos.

Introduction

Physical inactivity, understood as insufficient physical activity regarding the levels recommended by the

World Health Organization, is associated with unfavorable health outcomes, such as chronic noncommunicable conditions, and, consequently, preventable

deaths¹. Worldwide, in 2022, approximately 31% of adults did not meet the minimum physical activity recommendations. In other words, they did not perform at least 150 minutes per week of moderate physical activity or 75 minutes of vigorous activity².

In Brazil, data from the National Health Survey (*Pesquisa Nacional de Saúde - PNS*) indicated that 45.7% of adults in 2013 and 40.3% in 2019 were physically inactive when the leisure, work, and commuting domains were considered^{3,4}. These values differ from those observed in surveillance systems such as the Risk and Protective Factors Surveillance System for Chronic Diseases by Telephone Survey (*Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico - VIGITEL*), which uses distinct indicators and data collection strategies restricted to Brazilian capitals. According to the 2025 Vigitel survey, the frequency of physically inactive adults remained relatively stable in the country between 2009 and 2024, ranging from 13.9% in 2009 to 9.4% in 2024. In the most recent period, between 2019 and 2024, the prevalence of physical inactivity remained virtually stable in the adult population, with no significant variations⁵.

Studies have shown an association between socio-demographic indicators and physical activity practice across different domains, marked by inequalities in sex, ethnicity, and socioeconomic status^{6,7}. Better socioeconomic conditions, measured by education, income, or socioeconomic position, are associated with a higher prevalence of leisure-time activity and a lower prevalence of occupational and commuting activity⁶⁻¹⁰. The prevalence of physical inactivity in the leisure, work, and commuting domains also varies across population subgroups, with higher prevalence levels among women, people aged 60 years or older, and individuals with lower educational attainment and income^{3,4}.

Although previous studies have investigated social inequalities in physical activity at the national level, gaps remain in the understanding of regional variations in inequalities in Brazil. Aggregated analyses for the country may conceal important heterogeneities, considering the marked socioeconomic, demographic, and structural differences across Brazilian macro regions. Income distribution, leisure opportunities, working conditions, urbanization, and the availability of public spaces vary substantially across regions and may distinctly influence physical activity and its association with socioeconomic indicators⁹.

Thus, a regional analysis of physical inactivity, fo-

cused on per capita household income, allows us to identify specific patterns and deepen the understanding of inequalities, contributing more context-sensitive evidence for public policy planning. Therefore, the present study aimed to estimate the prevalence of physical inactivity and assess its association with per capita household income, stratified by Brazilian region.

Methods

This cross-sectional study is based on secondary data from the second edition of the 2019 PNS. The study was conducted and reported as per the STROBE recommendations for observational studies, strengthening transparency and methodological quality. The PNS is a household-based survey resulting from an agreement between the Ministry of Health and the Brazilian Institute of Geography and Statistics. It is part of the Integrated Household Survey System³.

The 2019 PNS was approved by the National Research Ethics Commission of the National Health Council under Opinion N°3.529.376, issued on August 23, 2019. Respondents confirmed their participation by signing the informed consent form. Data were collected from August 2019 to March 2020. A three-stage cluster probabilistic sampling design was adopted: first, census tracts; second, households; and finally, one individual aged 15 years or older, randomly selected from among the household residents¹¹.

The PNS selected 94,114 individuals for the individual questionnaire. A total of 90,846 responded to the survey and 88,531 individuals were aged 18 years or older and were included in the present study.

The study's dependent variable was physical inactivity. It was based on the World Health Organization physical activity classification criteria¹. A weekly minutes score for physical activity was calculated by multiplying weekly frequency (in days) by duration (in minutes) of moderate and vigorous physical activity in leisure-time activities, at work, in household activities, and in commuting. Running or treadmill running, strength training, gymnastics, soccer, basketball, and tennis were considered vigorous physical activities; therefore, the time spent in these activities was multiplied by two. Individuals who did not meet the physical activity recommendations (150 minutes or more of moderate physical activity or 75 minutes of vigorous physical activity per week) in the sum of any physical activity domain (leisure, commuting, household, and work) were classified as physically inactive¹.

The main explanatory variable was per capita household income, divided into four categories: up to 1/2 minimum wage; more than 1/2 to 1 minimum wage; more than 1 to 2 minimum wages; and more than 2 minimum wages.

The covariates were sex (male and female), age group (18-34 years; 35-59 years; and 60 years or older), race/ethnicity (white; black, brown, asian/yellow, and indigenous), and educational attainment (no formal education; incomplete/complete elementary education; incomplete/complete secondary education; incomplete/complete higher education). The country's geographic region (North, Northeast, Southeast, South, and Midwest) was adopted as the stratification variable.

Prevalence levels and their respective 95% confidence intervals (95% CI) were calculated. Pearson's chi-square test was used to assess the bivariate association between the variables and physical inactivity. Moreover, the linear trend test was applied to assess the association between per capita household income, educational attainment, and physical inactivity. Crude and adjusted prevalence ratios (PRs) and their respective 95% CIs were estimated using Poisson regression with robust variance. An association was considered statistically significant when the p -value was ≤ 0.05 .

A multiple model with a multiplicative interaction term between per capita household income and region was fitted to test the modifying effect of region on the association between per capita household income and physical inactivity. The global interaction test was significant ($p < 0.001$). Data analyses were performed in Stata (version 15). All analyses were stratified by region.

Results

Approximately 43.4% of the 88,531 participants in this study were from the Southeast, 26.5% from the Northeast, 14.7% from the South, 7.9% from the North, and 7.6% from the Midwest. The prevalence of physical inactivity in the total population was 36.0% (95% CI: 35.3 - 36.7). Across regions, the highest prevalence of physical inactivity was in the North (39.6%; 95% CI: 38.2 - 41.0), followed by the Northeast (39.2%; 95% CI: 38.2 - 40.1), South (36.9%; 95% CI: 35.6 - 38.3), Midwest (35.8%; 95% CI: 34.3 - 37.4), and Southeast (33.2%; 95% CI: 31.9 - 34.4) (Figure 1).

In Brazil and in all studied regions, more than 1/2 of the respondents were female, and the age group with the highest percentage was 35 to 59 years. For the race/ethnicity variable, in Brazil, 56.7% of individuals were

classified as Black, Brown, Asian/Yellow, or Indigenous, with higher percentages in the North (81.5%) and Northeast (75.5%) and a lower percentage in the South (27.6%). As for educational attainment, the lowest percentage of individuals with higher education was observed in the Northeast (14.5%) and North (16.8%), and the highest in the Southeast (24.3%). In Brazil, 22.0% of respondents had a per capita income of up to 1/2 a minimum wage, with higher percentages in the Northeast (40.2%) and North (37.4%) and a lower percentage in the South (9.6%) (Table 1).

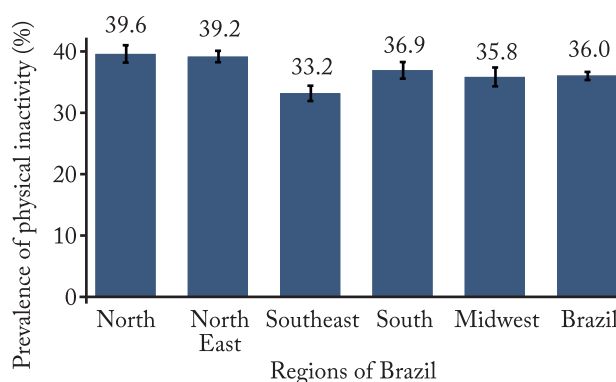


Figure 1 – Prevalence of physical inactivity in Brazil and regions, National Health Survey, 2019.

Captions: Prevalence of physical inactivity, North, Northeast, Southeast, South, Midwest, Brazil, Brazilian regions.

In the bivariate analysis, a higher prevalence of physical inactivity was observed in Brazil among women, individuals aged 60 years or older, white individuals, those with low or no educational attainment, and those with a per capita household income of up to one minimum wage. Similar results were observed for all regions, except in the North and South, where the prevalence of physical inactivity did not differ across race/ethnicity categories, and in the North, where it did not differ across per capita income categories (Table 2).

In the adjusted analysis (Table 3), the lower the per capita household income (up to 1/2 minimum wage), the higher the prevalence of physical inactivity in Brazil (PR: 1.27; 95% CI: 1.20 - 1.35) and in the Northeast (PR: 1.21; 95% CI: 1.11 - 1.33), Southeast (PR: 1.22; 95% CI: 1.10 - 1.37), South (PR: 1.49; 95% CI: 1.32 - 1.70), and Midwest (PR: 1.27; 95% CI: 1.11 - 1.46). Only the North did not show a statistically significant association (PR: 1.0; 95% CI: 0.88 - 1.13).

Discussion

In the present study, a high prevalence of physical inactivity was observed in the Brazilian adult population.

Table 1 – Distribution of sociodemographic characteristics of the adult population in Brazil and regions, National Health Survey, 2019 (n = 88,531).

Variables	Brazil		North		Northeast		Southeast		South		Midwest	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Sex												
Male	46.8	46.2 - 47.4	48.3	47.0 - 49.6	46.5	45.5 - 47.5	46.5	45.4 - 47.6	47.4	46.1 - 48.7	47.4	45.8 - 48.9
Female	53.2	52.6 - 53.8	51.7	50.4 - 53.0	53.5	52.5 - 54.5	53.5	52.4 - 54.6	52.6	51.3 - 53.9	52.6	51.1 - 54.2
Age group												
18-34 years	32.0	31.3 - 32.6	39.0	37.7 - 40.4	33.5	32.6 - 34.4	30.1	28.9 - 31.4	29.6	28.3 - 30.8	34.5	32.6 - 36.3
35-59 years	46.4	45.8 - 47.1	44.2	42.9 - 45.6	45.8	45.0 - 46.6	46.8	45.5 - 48.0	47.3	46.0 - 48.6	47.4	45.7 - 49.0
60 years and above	21.6	21.1 - 22.2	16.8	15.9 - 17.7	20.7	20.0 - 21.5	23.1	22.0 - 24.2	23.2	22.0 - 24.3	18.2	17.1 - 19.2
Race/ethnicity												
White	43.3	42.6 - 44.0	18.5	17.3 - 19.6	24.6	23.7 - 25.5	50.7	49.3 - 52.1	72.4	70.9 - 73.9	35.4	34.0 - 36.9
Black, brown, yellow, indigenous	56.7	56.0 - 57.5	81.5	80.4 - 82.7	75.5	74.6 - 76.3	49.4	48.0 - 50.8	27.6	26.1 - 29.1	64.6	63.1 - 66.1
Schooling												
No formal education	6.1	5.8 - 6.4	7.8	7.1 - 8.5	12.2	11.5 - 12.9	3.2	2.9 - 3.6	3.0	2.6 - 3.5	5.5	4.8 - 6.3
Incomplete/complete elementary	36.4	35.8 - 37.1	36.7	35.4 - 38.1	39.4	38.4 - 40.4	33.9	32.7 - 35.2	39.5	38.1 - 41.0	34.1	32.5 - 35.7
Incomplete/complete secondary	36.5	35.9 - 37.1	38.8	37.4 - 40.2	33.9	33.0 - 34.8	38.3	37.2 - 39.5	35.1	33.7 - 36.4	36.2	34.5 - 37.9
Incomplete/complete higher education	21.0	20.3 - 21.7	16.8	15.6 - 18.0	14.5	13.7 - 15.4	24.6	23.3 - 26.0	22.4	21.0 - 23.9	24.3	22.7 - 25.9
Per capita household income												
Up to 1/2 minimum wage	22.0	21.5 - 22.6	37.4	35.8 - 38.9	40.2	39.2 - 41.3	13.8	12.8 - 14.8	9.6	8.7 - 10.6	13.9	12.8 - 15.1
> 1/2 to 1 minimum wage	29.2	28.6 - 29.8	32.8	31.5 - 34.1	33.1	32.2 - 34.0	26.9	25.7 - 28.0	26.2	24.8 - 27.5	31.1	29.6 - 32.8
>1 to 2 minimum wages	28.2	27.6 - 28.8	18.7	17.8 - 19.7	17.0	16.3 - 17.7	33.5	32.3 - 34.7	36.1	34.8 - 37.5	31.4	30.1 - 32.8
>2 minimum wages	20.6	19.9 - 21.3	11.1	10.1 - 12.2	9.7	9.0 - 10.4	25.9	24.4 - 27.4	28.1	26.6 - 29.7	23.5	21.9 - 25.2

95% CI: 95% Confidence Interval. Minimum wage in dólares: US\$ 257,00.

Table 2 – Prevalence of physical inactivity according to sociodemographic characteristics in Brazil and regions, National Health Survey, 2019.

Variables	Brazil		North		Northeast		Southeast		South		Midwest	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Sex												
Male	30.6	29.7 - 31.5	32.0	30.3 - 33.8	33.6	32.3 - 34.8	28.1	26.5 - 29.8	31.5	29.8 - 33.2	30.9	29.0 - 32.8
Female	40.8	40.0 - 41.6	46.6	44.8 - 48.5	44.0	42.8 - 45.3	37.5	36.0 - 39.1	41.8	40.0 - 43.6	40.3	38.1 - 42.5
Age group												
18-34 years	29.0	27.9 - 30.1	33.8	31.6 - 36.1	31.2	29.6 - 32.8	26.3	24.2 - 28.5	28.2	26.0 - 30.5	30.8	27.8 - 34.0
35-59 years	31.5	30.7 - 32.4	35.8	33.7 - 37.9	34.5	33.3 - 35.8	28.5	27.0 - 30.0	32.6	30.8 - 34.4	32.3	30.3 - 34.4
60 years and above	56.0	54.8 - 57.1	63.2	60.5 - 65.8	62.3	60.5 - 64.1	51.5	49.5 - 53.5	56.9	54.5 - 59.2	54.5	51.5 - 57.6
Race/ethnicity												
White	36.8	35.8 - 37.8	40.5	37.7 - 43.4	42.1	40.5 - 43.8	34.4	32.8 - 36.0	37.7	36.2 - 39.3	38.2	35.7 - 40.7
Black, brown, yellow, indigenous	35.4	34.6 - 36.2	39.4	37.9 - 40.9	38.2	37.1 - 39.3	31.9	30.3 - 33.6	34.8	32.1 - 37.6	34.6	32.8 - 36.4
Schooling*												
No formal education	60.9	58.7 - 63.0	60.3	56.2 - 64.3	60.9	58.3 - 63.5	59.8	53.4 - 65.8	59.3	52.3 - 65.9	66.9	60.2 - 73.0
Incomplete/complete elementary	41.5	40.6 - 42.5	42.6	40.3 - 45.0	42.6	41.1 - 44.0	39.4	37.7 - 41.2	44.7	42.6 - 46.8	41.2	38.6 - 43.9
Incomplete/complete secondary	31.0	30.0 - 32.0	35.5	33.3 - 37.8	32.0	30.4 - 33.6	29.8	27.9 - 31.7	30.4	28.4 - 32.4	31.5	28.9 - 34.2
Incomplete/complete higher education	27.9	26.7 - 29.1	32.8	30.3 - 35.4	28.5	26.6 - 30.5	26.3	24.3 - 28.4	30.4	28.1 - 32.8	27.8	25.3 - 30.3
Per capita household income*												
Up to 1/2 minimum wage	39.1	38.0 - 40.2	38.5	36.2 - 41.0	39.7	38.3 - 41.1	36.8	34.0 - 39.6	43.7	39.7 - 47.8	41.6	37.5 - 45.7
> 1/2 to 1 minimum wage	38.6	37.5 - 39.7	41.8	39.5 - 44.1	41.4	40.0 - 42.9	35.1	33.0 - 37.2	40.3	37.6 - 43.0	39.3	36.7 - 42.0
>1 to 2 minimum wages	34.4	33.2 - 35.7	38.8	36.0 - 41.8	37.4	35.5 - 39.3	32.2	30.0 - 34.3	37.0	34.8 - 39.1	34.2	31.8 - 36.6
>2 minimum wages	31.2	30.0 - 32.5	38.0	34.7 - 41.5	32.2	29.9 - 34.5	30.6	28.6 - 32.6	31.4	29.4 - 33.5	30.1	27.9 - 32.4

%; prevalence in percentage; 95% CI: 95% Confidence Interval; * p < 0.05: Linear trend test. Minimum wage in dólares: US\$ 257,00.

Table 3 – Analysis of the association between per capita household income and physical inactivity (crude and adjusted) in Brazil and its regions, National Health Survey, 2019.

Variables	Model 1			Model 2		
	PR	95% CI	p-value	PR	95% CI	p-value
Brazil						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.10	1.04 - 1.16	0.001	1.06	1.00 - 1.12	0.052
> 1/2 to 1 minimum wage	1.24	1.18 - 1.30	<0.001	1.16	1.10 - 1.22	<0.001
Up to 1/2 minimum wage	1.25	1.19 - 1.32	<0.001	1.27	1.20 - 1.35	<0.001
North						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.02	0.91 - 1.14	0.710	0.97	0.87 - 1.09	0.654
> 1/2 to 1 minimum wage	1.10	0.99 - 1.22	0.079	1.02	0.91 - 1.14	0.759
Up to 1/2 minimum wage	1.01	0.91 - 1.13	0.806	1.00	0.88 - 1.13	0.985
Northeast						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.16	1.06 - 1.27	0.001	1.06	0.96 - 1.16	0.234
> 1/2 to 1 minimum wage	1.29	1.19 - 1.40	<0.001	1.11	1.02 - 1.22	0.016
Up to 1/2 minimum wage	1.23	1.14 - 1.34	<0.001	1.21	1.11 - 1.33	<0.001
Southeast						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.05	0.95 - 1.16	0.307	1.02	0.92 - 1.13	0.704
> 1/2 to 1 minimum wage	1.15	1.05 - 1.26	0.003	1.11	1.01 - 1.22	0.036
Up to 1/2 minimum wage	1.20	1.09 - 1.33	<0.001	1.22	1.10 - 1.37	<0.001
South						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.18	1.08 - 1.28	<0.001	1.16	1.07 - 1.27	0.001
> 1/2 to 1 minimum wage	1.28	1.17 - 1.40	<0.001	1.27	1.15 - 1.40	<0.001
Up to 1/2 minimum wage	1.39	1.24 - 1.56	<0.001	1.49	1.32 - 1.70	<0.001
Midwest						
Per capita household income						
>2 minimum wages	1.00	-	-	1.00	-	-
>1 to 2 minimum wages	1.14	1.03 - 1.26	0.015	1.06	0.95 - 1.19	0.277
> 1/2 to 1 minimum wage	1.31	1.19 - 1.44	<0.001	1.17	1.06 - 1.30	0.003
Up to 1/2 minimum wage	1.38	1.23 - 1.56	<0.001	1.27	1.11 - 1.46	0.001

PR: Prevalence Ratio; 95% CI: 95% Confidence Interval. Model 1: Crude analysis / Model 2: Analysis adjusted for sex, age group, race/ethnicity, and schooling.

This outcome varied across the country's regions, with higher prevalence levels in the North and Northeast and lower prevalence in the Southeast. Also, a significant association was found between per capita household income and physical inactivity in Brazil and in the Northeast, Southeast, South, and Midwest, indicating a higher occurrence of the outcome among individuals in lower per capita household income strata. Conversely, this association was not observed in the North, high-

lighting regional heterogeneity in the relationship between socioeconomic conditions and physical inactivity.

Regarding the prevalence of physical inactivity per individual characteristics, higher prevalence was observed among women, older age groups, white individuals, and those with lower educational attainment and lower per capita household income. Similar results have already been described in the literature⁴ and may be explained, in part, by differences related to the spe-

cific domains and intensities of physical activity⁶⁻¹⁰.

As for regional differences, the highest percentages of physical inactivity were observed in the North and Northeast compared with the other regions of the country. One possible explanation may be related to the increasing trend in leisure-time physical activity and the stable percentage of active individuals in the commuting, occupational, and household domains¹², as well as regional differences in the prevalence of leisure-time and commuting physical activity¹³⁻¹⁵. In 2019, according to PNS data, the Southeast and Midwest showed higher prevalence levels of leisure-time physical activity¹⁵. These differences may be related to the availability of and opportunities for access to adequate spaces for physical activity, to spatial segregation in Brazilian cities, and poor public transportation conditions^{16,17}.

The higher prevalence levels of physical inactivity in the North and Northeast may also be interpreted in light of regional socioeconomic inequalities, considering that these regions have lower average monthly per capita household income compared with the other regions³. Evidence from the literature indicates that factors such as income, education, and labor market participation influence the physical activity domains differently¹⁸. Individuals with lower socioeconomic status tend to have higher levels of physical activity in the occupational and commuting domains and lower levels in the leisure domain^{18,19}.

However, the literature has shown that the effects of physical activity on health may vary according to the context in which it is performed^{20,21}. Activities performed at work or during daily commuting, often associated with repetitive efforts, low autonomy, and adverse environmental conditions, may not produce the same physical and mental benefits observed in leisure-time physical activity²⁰. Thus, the total accumulated volume of physical activity may not uniformly reflect potential health gains across different socioeconomic groups.

Despite the process of institutionalization and strengthening of body practices and physical activities as Health Promotion actions within the PHC of the Brazilian Unified Health System, regional disparities still exist^{13,22,23}. In this context, different actions and strategies were created, such as the Health Academy Program and the Expanded Family Health and Primary Care Center¹³. In 2022, the Ministry of Health launched the Physical Activity Incentive, which aims to implement body practices and physical activity actions in primary health care²⁴.

The period of greatest expansion of the Health Academy Program was from 2011 to 2013, and the Northeast and Southeast had greater program uptake, but the North stood out with the highest number of municipalities with the Health Academy Program against the total number of municipalities²³. Ferreira et al.²² affirm that, in Brazil, awareness of public physical activity programs was more prevalent in the South and Southeast states, whereas physical activity within these programs was higher in the North, Northeast, and Midwest.

In the present study, region was found to modify the association between per capita household income and physical inactivity, with a positive association between lower per capita household income and physical inactivity for Brazil and for the Northeast, Southeast, South, and Midwest, and no association for the North. Evidence shows that the burden of behavioral risk factors is affected by socioeconomic status¹⁸. Less privileged social groups have a higher risk of adversities throughout life, preventing the adoption of healthy lifestyles. The social determinants of health permeate these adversities¹⁰.

We should also consider that participation in body practices and physical activities largely reflects social privilege, being conditioned by factors such as income, education, sex, and access to adequate spaces²⁵. In this study, an association between income and physical inactivity was observed in most regions of the country, except in the North. This result suggests that, in general, less privileged social groups face greater barriers to adopting active lifestyles, showing that physical activity practice does not depend only on individual choices, but also on structural conditions associated with social inequalities²⁶. Thus, we reinforce that the social determinants of health permeate opportunities and behavioral risks throughout life^{10,18,27}.

Both individual socioeconomic factors, such as income, education, and work, and contextual factors, such as area-level socioeconomic status, indicators of social inequality, safety, and access to walkable environments, play an important role in physical inactivity^{18,28}. These aspects help interpret the findings of the present study, in which a positive association between lower income and physical inactivity was observed in most Brazilian regions, except in the North.

Thus, it is possible to consider that lower-income groups²⁶, which are more represented in regions such as the North, perform a greater volume of physical activity in domains such as work and household activities¹⁴. Therefore, the lack of an association observed in the

North may reflect a distinct distribution of physical activity domains, in which leisure has a lower relative contribution¹⁴ but is partially offset by occupational and daily-life activities. This result suggests that socioeconomic inequalities influence opportunities to engage in physical activities, reflecting differences in access to resources and environments that favor the adoption of active lifestyles.

Although increasing physical activity practice among populations is desirable, we should consider that health effects vary according to the domain of practice. Occupational and household physical activity, often associated with repetitive effort and exhaustion, does not confer the same cardiovascular and psychosocial benefits observed for leisure-time physical activity²⁰. In this regard, urban environments that offer safe and accessible opportunities for physical activity, such as parks, public squares, bike lanes, adequate lighting and maintenance, safety, and transportation to these places, constitute relevant contextual factors for physical activity promotion and may curb health inequalities, especially among socially vulnerable groups¹⁸.

The present study's strength is using 2019 PNS data, which are nationally representative and allow disaggregated analysis by geographic regions, enabling the identification of regional patterns of physical inactivity. One of the limitations is its cross-sectional design, as it precludes causal inference between household income and physical inactivity. The assessment of overall physical inactivity, when associated with income, may vary according to the physical activity domain being evaluated.

Furthermore, physical activity data were self-reported, which may lead to underestimation or overestimation of the observed prevalence levels, affecting the magnitude of the findings. However, in population-based studies, self-reported information is considered valid and robust for monitoring health status²⁹. To minimize errors, the PNS standardizes and trains interviewers to ask questions and/or collect survey data, ensuring data quality¹¹.

Also, notably, categorizing the race/ethnicity variable into aggregated groups may not fully capture the specificities and heterogeneities among different racial groups, especially considering the distinct social experiences related to structural racism. The aggregation of categories was adopted because of the sample distribution across some racial groups in the analyses stratified by region, seeking greater stability of estimates. However, we recognize that different forms of stratification

of this variable may produce distinct interpretations in epidemiological studies³⁰. Despite the limitations inherent to the design, the findings are internally consistent and relevant to understanding socioeconomic inequalities in physical inactivity in Brazil.

In conclusion, physical inactivity had a high prevalence in the Brazilian adult population, with regional variations and higher levels in the North and Northeast. We observed an association between per capita household income and physical inactivity in Brazil and in most regions, with greater occurrence among lower-income individuals, except for the North, evidencing the influence of socioeconomic and regional inequalities on physical activity practice. These findings reinforce the need for public policies and intersectoral strategies that consider regional specificities, expand access to body practices and physical activity, especially leisure-time activity, and promote environments conducive to the adoption of active lifestyles, particularly among more socially vulnerable groups.

Conflict of interests

The authors declare no conflict of interest.

Funding

This work received no funding.

Authorship Contributions

Portela DS: Conceptualization; Methodology; Software development, implementation, and testing; Data and experiment validation; Data analysis; Research; Data curation; Data presentation design; Original manuscript writing; Writing - revision and editing; Approval of the final manuscript version. Gomes RS and Donato TAA: Conceptualization; Methodology; Data analysis; Research; Data curation; Data presentation design; Writing - revision and editing; Approval of the final manuscript version. Andrade ACS: Conceptualization; Methodology; Software development, implementation, and testing; Data analysis; Tool provision; Data curation; Supervision; Project administration; Writing - revision and editing; Approval of the final manuscript version. Bezerra VM: Conceptualization; Methodology; Data analysis; Research; Tool provision; Data curation; Supervision; Project administration; Writing - revision and editing; Approval of the final manuscript version.

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

The authors did not use artificial intelligence tools to prepare the manuscript.

Availability of research data and other materials

The underlying content of the research text is contained within the manuscript.

Acknowledgments

The authors are grateful to the Postgraduate Program in Public Health, Federal University of Bahia, Multidisciplinary Institute of Health, for their support in this research. They also thank the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* - CNPq) and the Mato Grosso State Research Support Foundation (*Fundação de Amparo à Pesquisa do Estado do Mato Grosso* - FAPEMAT) (Research Productivity Grant).

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Received: 12/16/2025

Reviewed: 02/23/2026

Approved: 05/21/2026

Editor in ChiefÁtila Alexandre Trapé 

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Section editorMathias Roberto Loch 

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Cite this article as:

Portela DS, Gomes RS, Andrade ACS, Donato TAA, Bezerra VM. Physical inactivity and per capita household income in regions of Brazil: National Health Survey 2019. *Rev. Bras. Ativ. Fis. Saúde*. 2026;31:e0454i. doi: [10.12820/rbafs.31e0454i](https://doi.org/10.12820/rbafs.31e0454i)

Reviewers' assessment

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