





RESEARCH SUBMISSIONS

Socioeconomic and geographic inequalities in headache disability in Brazil: The 2019 National Health Survey

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Abstract

Objective: To map the socioeconomic and geographic inequalities in headache disability in Brazil.

Background: Headache disability and its social determinants are poorly investigated in Brazil.

Methods: This is a secondary, cross-sectional analysis of the 2019 National Health Survey database, a representative sample of the Brazilian population. Working-aged Brazilians (aged ≥ 14 years) were included in the analyses ($n = 225,563$). Headache disability was inquired through questions on the number of days the respondent was unable to perform customary daily activities in the past 2 weeks. Proportion estimates and the mean days lost were compared between socioeconomic categories. Sample weights were used.

Results: Among 14 disease-related disability groups, headache disability ($n = 1228$) was the second most prevalent disability in adolescents and fifth among adults aged < 50 years. In the headache disability sample, there was a higher proportion of females at 72.4% (95% confidence interval [CI] 68.5%–75.9%), with a mean (95% CI) age of 41.1 (40.1–42.0) years and days lost due to disability of 3.4 (3.2–3.6) days. The sociodemographic distribution across income strata (quartiles) of the headache disability sample showed the highest proportions at the lowest income quartile in the Northeast region (15.4%, 95% CI 12.8%–18.4%), for people of Brown color (17.5%, 95% CI 14.7%–20.7%), and with the lowest education level (13.6%, 95% CI 11.3%–16.2%). Black people, those from the North region, and those with the lowest education level had more days lost than White people (mean [95% CI] 4.1 [3.5–4.6] vs. 3.1 [2.8–3.4] days, $p = 0.008$), those from the Southeast region (mean [95% CI] 3.8 [3.4–4.2] vs. 2.8 [2.4–3.3] days, $p = 0.022$), and people with the highest education level (mean [95% CI] 3.9 [3.6–4.2] vs. 2.8 [2.3–3.3] days, $p = 0.005$), respectively.

Conclusion: In Brazil, headache disability is one of the leading causes of disability and it is characterized by socioeconomic inequalities.

KEYWORDS

epidemiology, headache disorders, health inequities, migraine, socioeconomic factors

INTRODUCTION

Socioeconomic inequalities are burdensome to societies, as they perpetuate a vicious circle of poorer health and lower productivity, the so-called health-poverty trap, even in developed countries.¹ Within the social determinants of health, socioeconomic inequalities must be mapped out continuously to guide public health policies at the national level. Headache disorders have long been associated with social determinants of health.² In general, a higher prevalence of major primary headache disorders has been associated with lower socioeconomic status (SES), even within the gradient of socioeconomic levels in low-, middle-, and high-income countries.³⁻⁸ The prevalence of migraine, the most studied headache disorder, is higher in populations facing food insecurity,⁸ with lower education,⁹ and lower income.⁷ Lower SES has been recognized as a potential risk factor for medication overuse headache, migraine chronification, and high attack frequency.^{7,10-12}

Notwithstanding the growing knowledge on the socioeconomic factors related to headache prevalence, less is known regarding the socioeconomic and geographic inequalities in headache disability. In developed countries, lower SES is associated with high attack frequency and migraine chronification.^{7,10,11,13} Having a higher frequency of migraine attacks, chronic migraine, or cluster headache is associated with higher work absenteeism or a lower likelihood of being employed.^{14,15}

Under the perspective of the social determinants of health, it has been accepted that the prevalence and related disability of headache disorders may be explained by the social causation hypothesis, meaning that conditions related to lower SES such as stressful lifestyle, poor diet, and unhealthy behaviors predispose to the onset and progression of the disease.^{2,6,11-13} As such, it seems that the prevalence of headache disorders also follows the most vulnerable and underserved populations.¹³

Additionally, a recent review by Charleston¹⁶ reveals that African-Americans in the US are more susceptible to being undertreated and misdiagnosed, they report more mistrust and lower quality communication with physicians and have increased migraine burden and comorbidities compared to non-Hispanic Whites, suggesting race-based disparities in headache disorders.¹⁶ In Brazil, to our knowledge headache disability has never been compared among racial/ethnic groups. Nationwide epidemiological studies have shown an association of unhealthy lifestyle behavior, major chronic non-communicable diseases, and health indicators with racial-ethnic groups, with Black/Brown Brazilians showing poorer outcomes compared to White ones.^{17,18} Despite the different methodologies employed for studying race/ethnicity among these countries, both US and Brazilian authors point to the harmful effects of racial/ethnic discrimination and segregation on population health.¹⁶⁻¹⁹ Regarding sex, despite the sex dimorphism in most primary headache disorders, sex inequalities in headache disability may be exacerbated by social contexts.²⁰

To date, to our knowledge no study has investigated the socioeconomic and geographic inequalities in headache disability in the

Brazilian population. As there is a huge gap in public health policies for headache disorders in Brazil, the need for research in this field is urgent.^{2,21} Recently, analyzing the database of the 2013 National Health Survey (Pesquisa Nacional de Saúde [PNS] 2013), we found that headache disability was the fourth leading cause of disease-related disability among Brazilian adults, and the second leading cause among young adult women.²² Still, adults with headache disability were more likely to report a poorer self-rated health perception, severe mental disorders symptoms, and unhealthy lifestyle compared to adults without headache disability.²²

A new edition of the PNS2013 survey has been recently conducted, the 2019 National Health Survey (PNS2019). The purpose of PNS2019 is to accomplish the health surveillance goal within the Brazilian Ministry of Health's *Strategic Action Plan for Coping with Chronic Diseases 2011-2022*.²³ Therefore, we performed descriptive and exploratory analyses of the socioeconomic and geographical characteristics of Brazilians reporting headache disability in the PNS2019 survey, a population-based study conducted in the macro-regions of Brazil. Based on the social causation hypothesis and headache prevalence in general, we predicted that the population reporting headache disability in the PNS2019 survey would be characterized by a lower SES, as well as would present sex, racial/ethnic, and geographical disparities.

METHODS

Participants and sampling

This is a cross-sectional, secondary data analysis of the PNS2019 survey database, a nationwide, door-to-door survey of a representative sample of the Brazilian population.²⁴ The government's Research Ethics Committees approved the survey under #3.529.376. Participants gave written informed consent. The PNS2019 survey was conducted between August 2019 and March 2020.²⁴

The PNS2019 survey adopts a complex sampling design.²⁴ Briefly, the sampling was based on a three-stage cluster sampling, with stratification of primary sampling units (PSU) from census tracts or sets of tracts and selection of PSUs for the main sample, followed by the selection of households from the *National Register of Addresses for Statistical Purposes*, then the definition of PSUs sample size.²⁴

Sample weighting for both the households and their residents was applied to estimate the variables investigated. The sample weighting was defined considering the PSU data with corrections for non-response and calibration of the estimates, according to the population totals estimated by the *Coordination of Population and Social Indicators*, from the Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística [IBGE]).²⁴

The PNS2019 sample consisted of 94,114 households visited, with 279,382 participants interviewed (93.6% response rate). Working-aged Brazilians (aged ≥ 14 years) were included in this analysis ($n = 225,563$). This sample was selected from 8015 PSUs,

composing 574 strata, with an estimated total population size of 171,576,461 working-aged Brazilians.

Headache disability assessment

Disease-related disability was determined according to a set of questions inquiring about the number of days the respondent was unable to perform customary daily activities (work, school, household chores, or recreation) due to a disease or any health condition in the past 2 weeks. The response options (single-choice questions) for the attributed cause included a list of 14 major diseases or health conditions groups. "Headache or Migraine" was an option in the list and was operationalized as headache disability here. Table 1 shows the questions and response options with the list of diseases.

Socioeconomic and geographic variables

Sociodemographic variables of interest were: sex assigned at birth (Female or Male), age groups (14–17, 18–34, 35–49, 50–64, ≥65 years), housing place (Urban or Rural Area), region (North, Northeast, Center-West, Southeast, and South), self-identified skin color (White, Black, Brown, or Others – Indigenous, Asian), marital status (Single, Married, Separated/Divorced, or Widower), Education (No formal instruction/Incomplete Primary, Complete Primary, Complete High-School, and Complete College), and household income per capita (fourth quartile – lowest, third quartile, second quartile, and first quartile – highest), labor force status (Inside or Outside the Labor Force), and employment status (Employed or Unemployed).

The PNS2019 uses the IBGE's 2010 Brazilian Census methodology and surveys the color or race of the Brazilian population

indistinguishably, based on participants' self-identification.²⁵ That is, people are asked about their race according to their skin color, following the options: White, Black, Brown (Pardo), Indigenous or Yellow. This methodology is dominant in Brazilian research, a few exceptions are related to mortality data, in which the person's characteristics are imputed by a healthcare professional or coroner. The race/ethnicity classification based on the skin color self-identification has been shown to be the most accurate considering historical and theoretical reasons.²⁵ Besides, race determined by self-reported skin color is a proxy of socioeconomic status and it has been associated with some health outcomes in Brazil.^{17,18}

Statistical analysis

Data were processed in Stata (version 17.0, StataCorp LLC). We employed complex sampling design svy commands with weights for the non-response sample corrections and post-stratification adjustments. The sample size was based on the available PNS2019 survey's dataset. Thus, no statistical power calculation was conducted prior to the study.

The projected Brazilian population with headache disability was estimated by setting the PNS2019 sampling design in Stata's svy module. The estimates are based on the number of strata, the number of selected PSUs in each stratum, and the number of households and residents included in the PSU and their respective expansion factors and sample weighting. The data on weights, number of PSUs, and strata are provided in the dictionary of variables file along with the PNS2019 database. The PNS2019 is an open database, and the microdata are available for download on the IBGE website: <https://www.ibge.gov.br/en/statistics/social/health/>.

In the PNS2019 survey, it was necessary to define expansion factors or sample weights of the PSUs, of the households and all their

TABLE 1 Disease-related disability questions in the Pesquisa Nacional de Saúde (PNS) 2019 Survey

Questions	Answer options
1. In the past 2 weeks, did you miss any habitual activities (work, school, household chores, or recreation) due to a health condition?	Yes/no
2. In the past 2 weeks, how many days have you lost from your habitual activities due to any health condition?	"n" days
3. In the past 2 weeks, which was the main health condition that prevent you from doing your habitual activities?	1. Musculoskeletal disorders (back or neck pain, pain in the limbs/hands, arthritis, or rheumatism), 2. Headache or migraine, 3. Gyneco-obstetrics problems (menstrual, pregnancy, or delivery problems), 4. Dental problems, 5. Respiratory diseases (Cold, flu, sinusitis, asthma, bronchitis, or pneumonia), 6. Gastrointestinal diseases (Diarrhea, vomit, nausea, gastritis, or stomach-ache), 7. Tropical infections (Dengue fever, Chikungunya, Zika, or yellow fever), 8. CVDs (hypertension or heart diseases) or stroke, 9. Diabetes, 10. Cancer (including chemotherapy), 11. Neurodegenerative diseases (Alzheimer, sclerosis, Parkinson, or other dementias), 12. Psychiatric disorders (depression, bipolar disorders, schizophrenia, anxiety disorders, or other mental health issues), 13. Injury by accident or violence, or 14. Other health conditions

Abbreviation: CVDs, cardiovascular diseases.

residents, and of the selected resident. The weights of the PSUs were calculated considering the probabilities of selection of these units for the main sample and for the research sample.

The weights of the households and all their residents, used to estimate the characteristics investigated for all residents and for all the elderly, were defined considering the weight of the corresponding PSU and the adjustments for correction of non-responses and also to calibrate the estimates, according to the population totals estimated by the IBGE's Coordination of Population and Social Indicators.

The weight of the selected resident was calculated considering the weight of the corresponding household, the probability of resident selection, adjustments for correction of non-response by sex and for the calibration of estimates, according to the population totals, by sex and age classes, estimated with the weight of all the residents.

Weighted proportion estimates were stratified by sex, age groups, skin color, geographic variables, education levels, household income, labor force status, and employment status variables and compared between headache disability and total samples. Weighted proportion estimates are reported in the descriptive analyses as a proportion (%) with a 95% confidence interval (CI).

In the hypotheses tests analyses within the headache disability sample only, the unweighted mean (95% CI) of days lost due to headache disability are reported and comparisons were made between categories of sex, age groups, household income, education, skin color, housing place, and geographic regions. Kolmogorov-Smirnov test was run for checking the sample distribution's assumptions of normality for continuous variables. As headache disability sample showed normal distribution on all variables assessed, only parametric statistics were employed. One-way analysis of variance (ANOVA) and independent *t*-test computed the differences in mean days lost between sociodemographic categories. Bartlett's equal-variances test and Levene's test were adopted for checking homogeneity between categories in the ANOVA and *t*-test statistics, respectively. Comparisons were adjusted by Bonferroni's corrections. To test for a linear trend in the means of days lost within categories of household income and education levels, the one-way ANOVA procedure computed weighted linear contrasts. A two-tailed $p < 0.05$ was considered statistically significant.

There were no missing data in the headache sample. There were 116 missing data for income in the total sample (<0.001%). However, they were not excluded as their proportion was negligible for the analyses.

RESULTS

Of 225,563 working-aged Brazilians, 18,321 (weighted point prevalence = 8.0%, 95% CI 7.8–8.2) lost at least 1 day of work, school, domestic chores, or recreation in the previous 2 weeks due to a disease or health condition. Disability due to headache was the sixth

most prevalent disease-related disability in Brazil, with a weighted proportion of 5.9% (95% CI 5.4–6.4). Considering the age groups, headache disability was the second most prevalent disability among adolescents and fifth among adults aged <50 years (Figure 1).

Brazilians with headache disability in the past 2 weeks were mostly female (mean [95% CI] 72.4% [68.5%–75.9%]), with a mean (95% CI) age of 41.1 (40.1–42.0) years. The mean (95% CI) of days lost due to headache disability in the past 2 weeks was 3.4 (3.2–3.6) days. Based on the PNS2019 sampling, the projected population with headache disability in the past 2 weeks was estimated to be 834,934 (793,187–876,680) working-aged Brazilians or 995,240 (945,478–1,045,002) Brazilians in the general population.

Table 2 summarizes the socioeconomic, self-reported skin color, and geographical distribution of the total and headache disability samples. Compared to the general population, Brazilians reporting headache disability showed a higher proportion of females (mean [95% CI] 72.4% [68.5%–75.9%] vs. 52.9% [52.6%–53.1%]), adolescents (mean [95% CI] 11.3% [8.6%–14.8%] vs. 7.2% [7.0%–7.4%]), or those who were middle-aged (mean [95% CI] 31.5% [27.7%–35.5%] vs. 26.8% [26.4%–27.2%]), people from the Northeast region (mean [95% CI] 40.4% [36.3%–44.6%] vs. 26.7% [26.2%–27.3%]), living in rural areas (mean [95% CI] 19.0% [16.1%–22.3%] vs. 14.0% [13.7%–14.4%]), of Brown color (mean [95% CI] 51.7% [47.2%–6.2%] vs. 43.8% [43.2%–44.3%]), with lower education (mean [95% CI] no formal/incomplete primary: 42.3% [38.2%–46.4%] vs. 35.4% [34.8%–35.9%]) and lower household income (mean [95% CI] lowest quartile: 26.9% [23.6%–30.6%] vs. 16.2% [15.8%–16.7%]).

Figures 2 and 3 illustrate the headache disability sample's socio-demographic distribution across household income strata as income quartiles. Both female (mean [95% CI] 20.49% [16.7%–24.6%]) and male (mean [95% CI] 20.49% [16.7%–24.6%]) showed the highest proportion in the third income quartile, followed by the lowest income quartile (female: mean [95% CI] 19.0% [16.1%–22.2%]; male: 7.9% [6.0%–10.3%]; Figure 1A). Regarding the distribution of age groups, adults aged <50 years (18–34 years: mean [95% CI] 9.6% [7.6%–12.2%]; 35–49 years: 9.6% [7.6%–12.2%]) predominated the lower income quartile (Figure 2B). There was a higher proportion of participants living in urban areas across all income levels, with urban (mean [95% CI] 20.49% [16.7%–24.6%]) and rural (mean [95% CI] 20.49% [16.7%–24.6%]) housing areas presenting the highest proportion in the third and the lowest income quartiles, respectively (Figure 2C). The Northeast region (mean [95% CI] 15.4% [12.8%–18.4%]) predominated the lower income quartile (Figure 2D).

Brown people represented the greatest proportion in the lowest income quartile (mean [95% CI] 17.5% [14.7%–20.7%]; Figure 3A). Conversely, while being a minority in the headache disability sample, White people represented the greatest proportion in the highest income quartile (mean [95% CI] 10.6% [8.1%–13.6%]; Figure 3A). The lowest education level predominated the lowest (mean [95% CI] 13.6% [11.3%–16.2%]) and third (mean [95% CI] 15.7% [12.4%–19.8%]) income quartiles (Figure 3B). People inside the labor force (Figure 3C) and employed (Figure 3D) predominated, and showed a seemingly stable distribution across income levels, while people

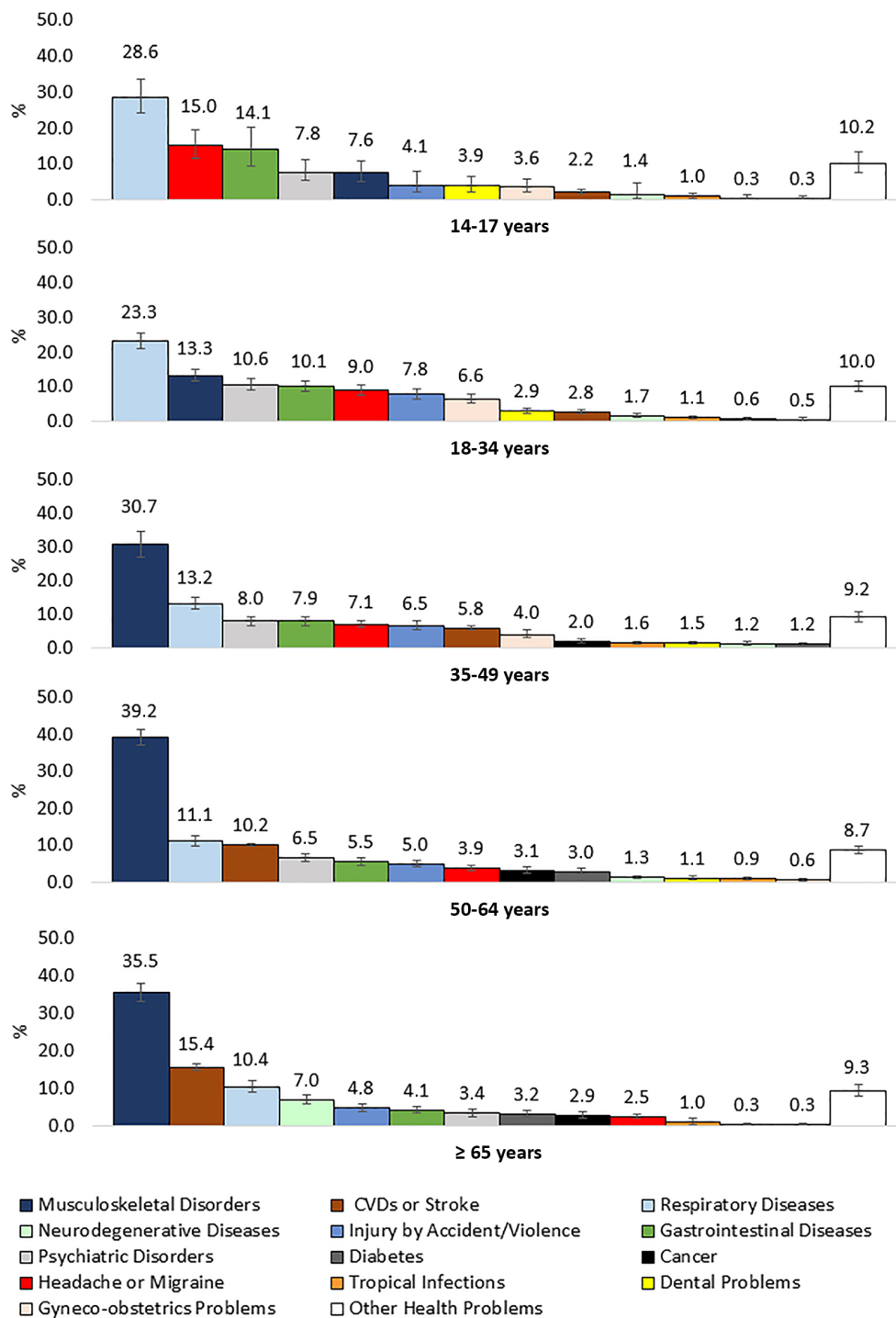


FIGURE 1 Distribution of disease-related disabilities in the past 2 weeks ($n = 18,321$) in the Pesquisa Nacional de Saúde (PNS) 2019 survey. Data are expressed as weighted percentages. CVDs, cardiovascular diseases. [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

outside the labor force and unemployed showed an increasing proportion as income levels decreased.

In the headache disability sample, we compared the number of days lost between sociodemographic categories (Figure 4). The post hoc Bonferroni test from one-way ANOVAs showed that Black people had more days lost than White people (mean [95% CI] 4.1 [3.5–4.6] vs. 3.1 [2.8–3.4] days, $p = 0.008$; Figure 4A) and people from the North region had more days lost than people in the Southeast

region (mean [95% CI] 3.8 [3.4–4.2] vs. 2.8 [2.4–3.3] days, $p = 0.022$; Figure 4B). Independent t -test showed that people outside the labor force had more days lost than people inside the labor force (mean [95% CI] 3.8 [3.5–4.1] vs. 3.2 [3.0–3.4], $t(1.2) = -2.8$, $p = 0.004$; Figure 4E). No significant differences between other categories, or in the other sociodemographic variables were found.

Based on the weighted linear contrasts values, both income quartiles (p -trend = 0.034) and education levels (p -trend <0.001)

TABLE 2 Weighted distribution of socioeconomic and demographic variables among headache disability and total samples in the Pesquisa Nacional de Saúde (PNS) 2019 survey

Variable	Headache disability sample (n = 1228)		Total sample (n = 225,563)	
	n	% (95% CI)	n	% (95% CI)
Region				
Southeast	176	29.6 (25.0–34.7)	47,197	43.0 (42.2–43.8)
South	88	9.5 (7.4–12.2)	26,228	14.6 (14.2–15.0)
Central West	122	8.6 (6.9–10.7)	25,028	7.5 (7.3–7.8)
Northeast	547	40.4 (36.3–44.6)	80,095	26.7 (26.2–27.3)
North	295	11.7 (9.9–13.8)	47,015	8.0 (7.8–8.3)
Housing place				
Urban	901	81.0 (77.7–83.9)	173,675	86.0 (85.6–86.3)
Rural	327	19.0 (16.1–22.3)	51,888	14.0 (13.7–14.4)
Sex				
Female	880	72.4 (68.5–75.9)	118,419	52.9 (52.6–53.1)
Male	348	27.6 (24.1–31.5)	107,144	47.1 (46.9–47.4)
Age group, years				
14–17	110	11.3 (8.6–14.7)	17,718	7.2 (7.0–7.4)
18–34	361	29.5 (25.8–33.5)	70,431	30.4 (30.0–30.7)
35–49	381	31.5 (27.7–35.5)	59,990	26.8 (26.4–27.2)
50–64	243	18.5 (15.3–22.1)	47,237	21.7 (21.4–22.1)
≥65	133	9.1 (7.2–11.5)	30,187	13.9 (13.5–14.2)
Skin color				
White	360	33.0 (29.0–37.3)	80,955	43.9 (43.2–44.5)
Black	173	13.4 (10.6–16.7)	24,442	11.0 (10.7–11.3)
Brown	678	51.7 (47.2–6.2)	117,046	43.8 (43.2–44.3)
Others (Asian, Indigenous)	17	1.9 (0.98–3.6)	3120	1.3 (1.2–1.5)
Marital status				
Single	650	49.5 (45.4–53.7)	116,872	48.0 (47.6–48.5)
Married	428	37.1 (33.1–41.3)	83,312	39.5 (39.0–40.0)
Separated/divorced	75	7.5 (5.3–10.6)	12,820	6.4 (6.2–6.6)
Widower	75	5.7 (4.2–7.7)	12,559	6.0 (5.8–6.2)
Schooling				
No formal/incomplete primary	538	42.3 (38.2–46.4)	85,353	35.4 (34.8–35.9)
Complete primary	206	15.6 (12.9–18.7)	38,522	17.2 (16.9–17.5)
Complete high school	347	30.3 (26.5–34.4)	71,042	32.8 (32.4–33.2)
Complete college	137	11.8 (9.1–15.2)	30,646	14.6 (14.1–15.2)
Household Income (per capita)^{a,b}				
Q4 income (lowest)	375	26.9 (23.6–30.6)	47,253	16.2 (15.8–16.7)
Q3 income	348	29.2 (25.2–33.7)	54,833	22.5 (21.9–23.0)
Q2 income	285	23.5 (20.1–27.2)	60,446	28.7 (28.1–29.2)
Q1 income (highest)	220	20.4 (17.1–24.1)	62,870	32.6 (31.8–33.4)
Labor force status^c				
Inside the labor force	721	59.6 (55.4–63.7)	136,595	62.6 (62.2–63.1)
Outside the labor force	507	40.4 (36.3–44.6)	88,968	37.4 (36.9–37.8)

(Continues)

TABLE 2 (Continued)

Variable	Headache disability sample (n = 1228)		Total sample (n = 225,563)	
	n	% (95% CI)	n	% (95% CI)
Employment status				
Employed	646	89.4 (85.6–92.4)	124,399	90.9 (90.6–91.2)
Unemployed	75	10.6 (7.64–14.4)	12,196	9.06 (8.77–9.36)

Note: Data are presented as unweighted frequencies (n) and weighted proportions.

^aThere are 161 respondents with missing data on household income in the total sample. Q4–1: Quartiles of household income (per capita). Quartile income values in International Dollars (Int\$): Q4 = Int\$ < 169.00, Q3 = Int\$ 169–322.00, Q2 = Int\$ 323.00–591.00, and Q1 = Int\$ > 591.00, based on exchange rate of 2.36:1 (as for 2020, according to World Economic Bank) (<https://www.data.worldbank.org/indicator/PA.NUS.PPP?end=2020>, accessed 02/01/2022).

^bExcluding income from the pension.

^cPeople inside the labor force: working-aged people employed or unemployed and outside the labor force. People outside the labor force: working-aged people not classed as employed or unemployed.³⁵

showed a significant linear trend for more days lost as income and education levels decreased (Figure 5). Likewise, people in the “No formal instruction/Incomplete Primary” education level had more days lost compared to “Complete College” level (mean [95% CI] 3.9 [3.6–4.2] vs. 2.8 [2.3–3.3] days, $p = 0.005$).

DISCUSSION

In this representative sample of the Brazilian population, we found that headache disorders are a major cause of recent disability, leaving nearly 1 million Brazilians unable to perform their customary daily activities in the past 2 weeks. Headache disability disproportionately affects working-aged Brazilian adolescents and adults aged <50 years, mostly females, of non-White color, with lower income and education levels, and from underserved regions in terms of healthcare services and economic indicators (North/Northeast regions and rural areas). Moreover, higher disability levels (days lost) were observed in Black people, underserved regions, and people outside the labor force. Finally, the lower the income and education levels, the more days lost due to headache disability.

In the previous edition of the survey (PNS2013), headache disability ranked fourth among the most common disease-related disabilities among Brazilian adults.²⁶ The drop from fourth to the sixth position results from different settings of disease groups between surveys. Some highly prevalent disease options in the PNS2013 survey (23 disease options) were pooled together in the PNS2019 survey (14 disease options), such as cardiovascular diseases and stroke, arthritis, rheumatoid disease, limb pain, and back and neck pain.²⁶ Yet, headache disability remained a top five cause of disability among adults aged <50 years, and only below disability related to respiratory diseases in adolescents (Figure 1).

Of note, the position of headache disability in the ranking of disabilities for adolescents and adults aged <50 years in the PNS2019 survey matches the position of headache disorders for the same age groups in the most recent estimates of disability-adjusted life-years of the Global Burden of Diseases Study.²⁷ This indicates consistency

between headache disorders prevalence and disability in Brazil and worldwide.

Along with other prevalence population surveys in low-, middle-, and high-income countries,^{3–5} including Brazil,⁴ the findings in the PNS2019 survey concur with the social causation hypothesis, indicating that, besides the evidence of socioeconomic factors related to headache disorders prevalence, there are also socioeconomic inequalities in headache disability.¹³

The greater proportion of adolescents with low SES within the population with headache disability agrees with other observational and population studies in Brazil.^{28,29} Okamura et al. (2020)²⁸ recently found a high prevalence of headache disorders associated with low education levels among 539 adolescents (aged 15–19 years) living in São Paulo city. Lima et al. (2014)²⁹ found a high prevalence of headache disorders and an association of higher headache pain intensity with school absenteeism, interference in activities of daily living, medication use, and medical consultation, among 204 female adolescents from a public school in the city of Petrolina, in the Northeast region of Brazil. These findings agree with the greater proportion of females, with lower SES and from the Northeast region found in people with headache disability in the PNS2019 survey.

The predominance of headache disability in the Northeast and North regions (recognizably underserved regions), non-White color, plus the higher mean days lost in people from the North region, Black color, and lower SES and education levels, are likely due to less access to healthcare services and private insurance coverage, which limit the diagnosis and appropriate treatment of headache disorders.³⁰

Importantly, this is the first study to show racial/ethnic disparity in headache disability in Brazil, with more days lost in Black people. This finding could indicate an impact of racial/ethnic discrimination or segregation in headache disorders, as evidenced by other studies in the US.^{16,19} By constituting a pervasive stressor in society, structural racism and discrimination may compromise health by inducing unhealthy lifestyle behaviors,³¹ or by undermining headache treatment access and adequate care.^{16,19}

Notwithstanding racial/ethnic disparities, socioeconomic and geographic inequalities may be associated with poorer health

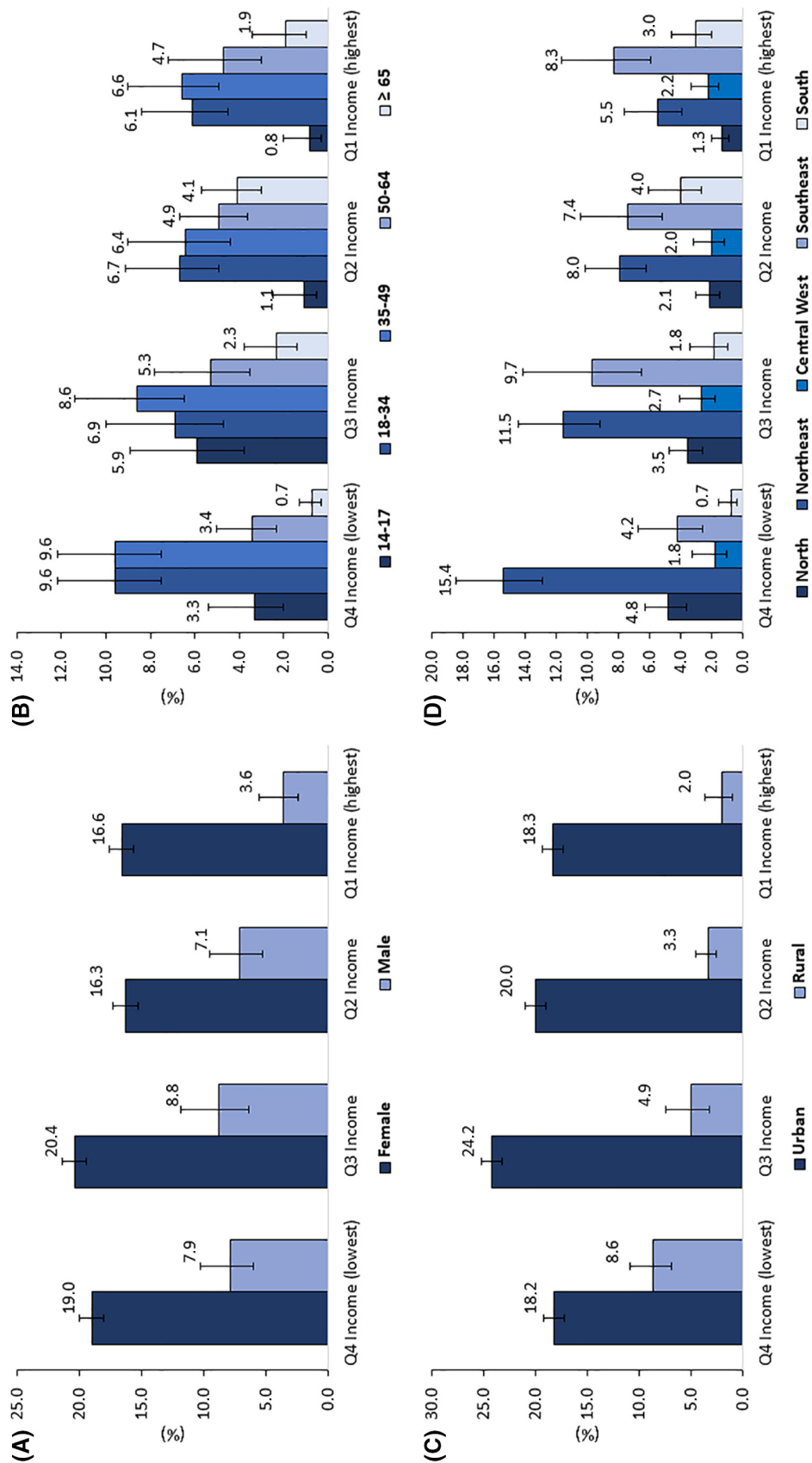


FIGURE 2 Distribution of headache disability across (A) sex, (B) age groups, (C) region, and (D) housing place by household income quartiles in the Pesquisa Nacional de Saúde (PNS) 2019 survey. Data are expressed as weighted proportions. [Color figure can be viewed at wileyonlinelibrary.com]

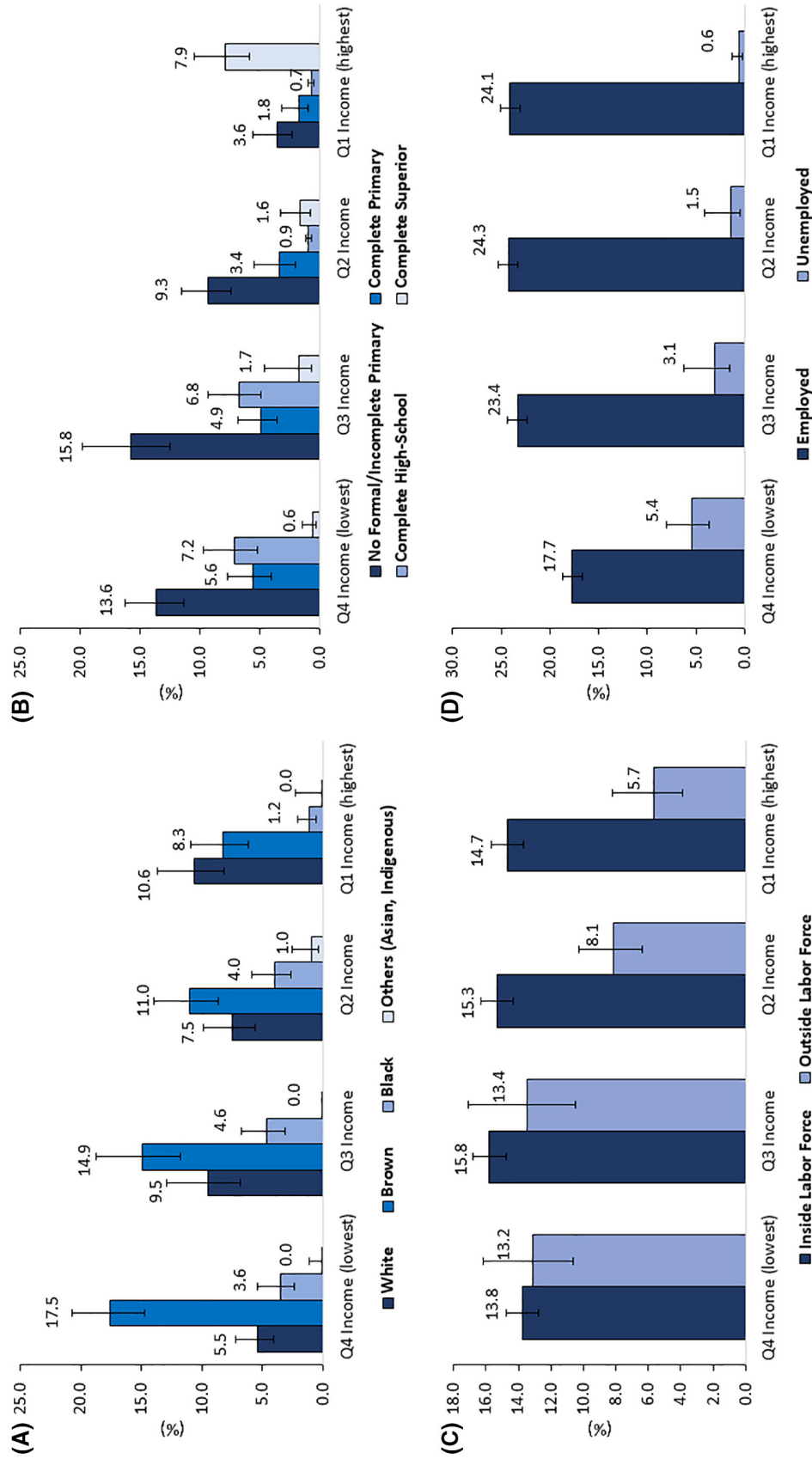


FIGURE 3 Distribution of headache disability across, (A) skin color, (B) education levels, (C) labor force, and (D) employment status by household income quartiles in the Pesquisa Nacional de Saúde (PNS) 2019 survey. Data are expressed as weighted proportions. [Color figure can be viewed at wileyonlinelibrary.com]

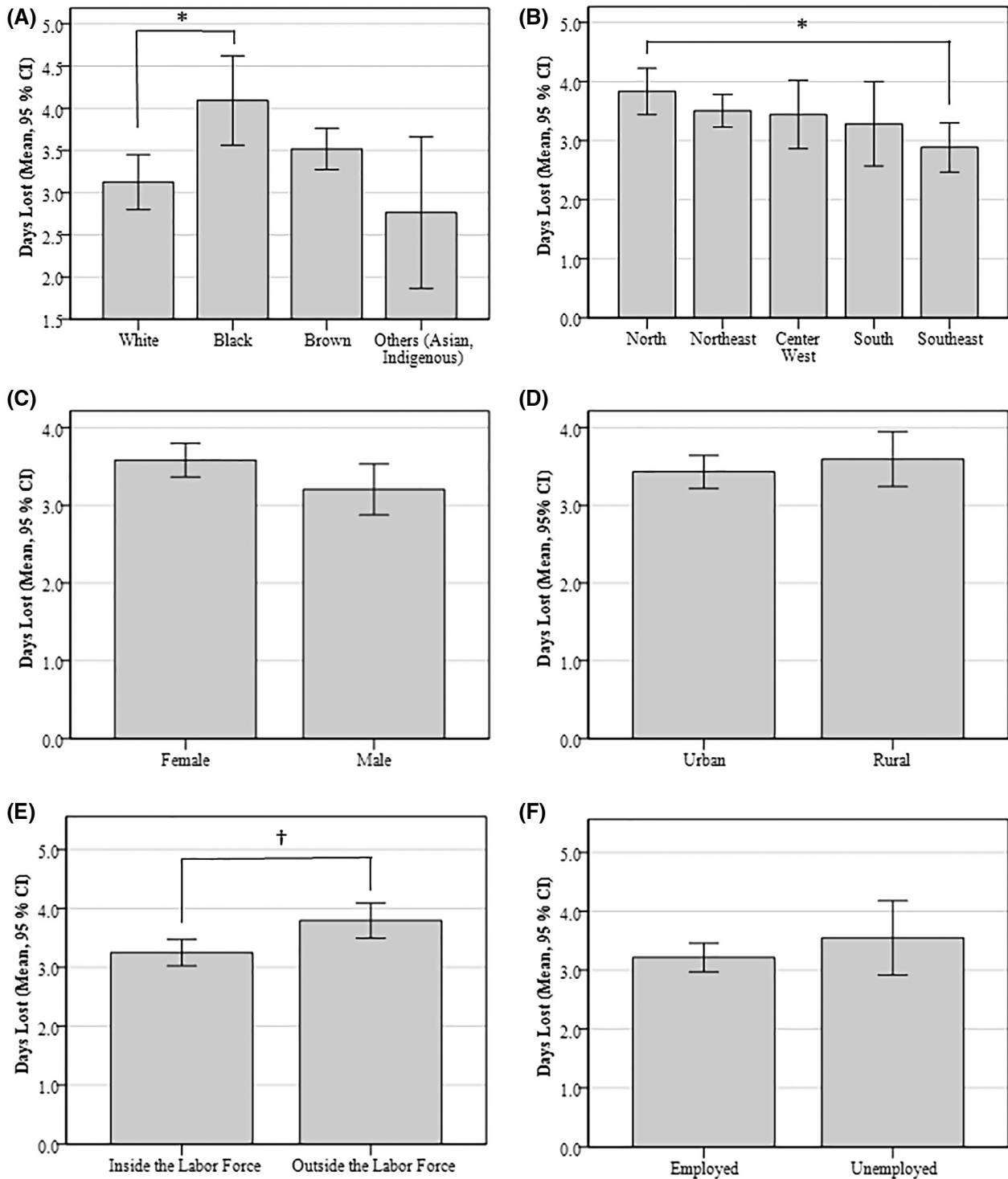


FIGURE 4 Number of days lost between socioeconomic, color, and geographic categories in people with headache disability in the Pesquisa Nacional de Saúde (PNS) 2019 survey ($n = 1228$). Data are shown as unweighted mean (95% confidence interval [CI]). * $p < 0.05$, pairwise comparisons of one-way analysis of variance with Bonferroni's adjustments. † $p < 0.05$, independent t -test.

behaviors and other stressful lifestyle factors.^{6,13,26} In the PNS2013 survey, we found that headache disability carried along with mental health problems, as well as was associated with physical inactivity and poorer health self-perception.²⁶ As such, a comprehensive and multidisciplinary approach at regional and national levels, providing

access to headache treatment and focusing on psychoeducation, and lifestyle changes are needed to reduce the headache burden. For example, a pilot study showed reduced headache burden in a low-income community in the North region of Brazil through a program based on lifestyle changes.³²

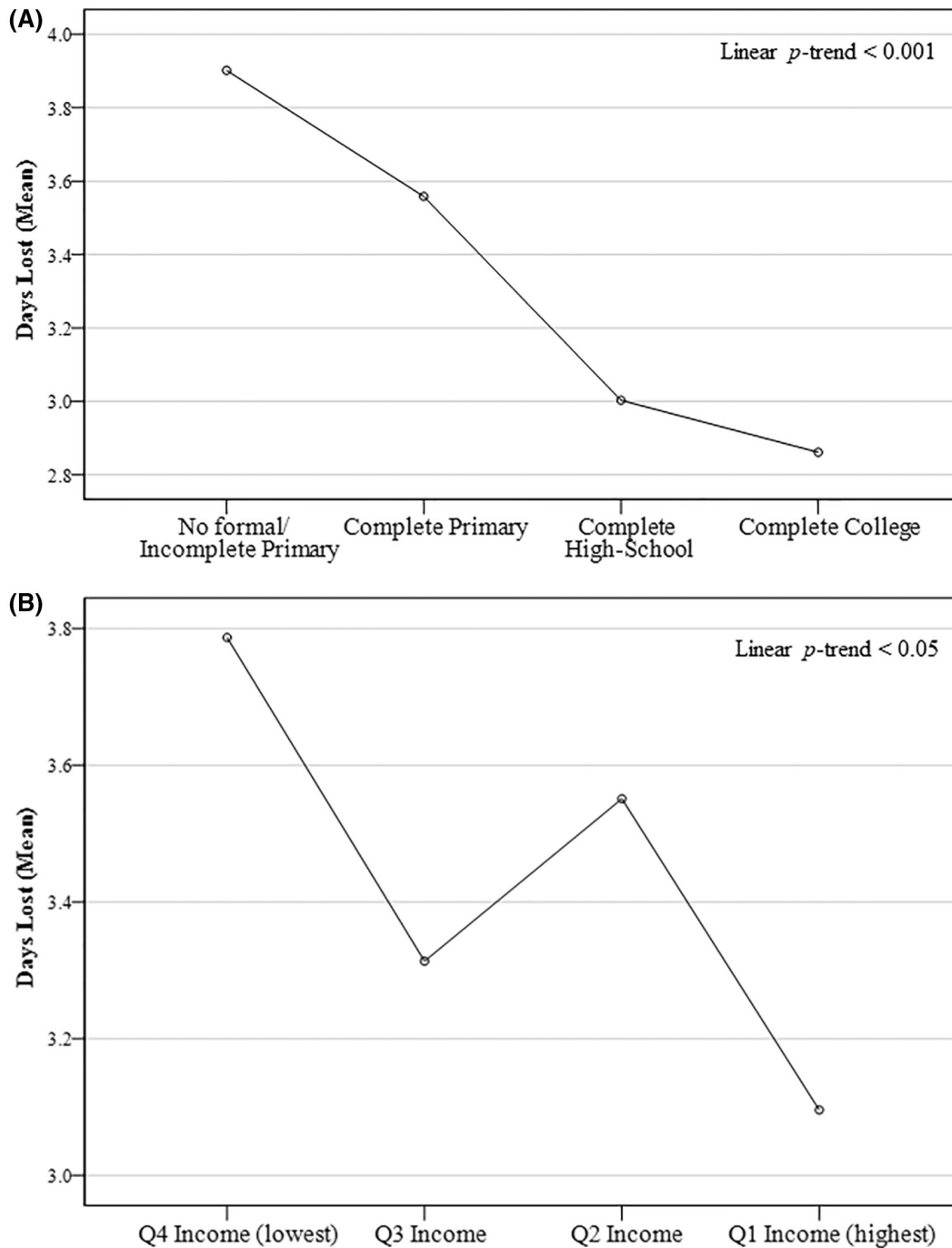


FIGURE 5 Means plot and linear trend analysis between education and household income levels and days lost due to headache disability in the Pesquisa Nacional de Saúde (PNS) 2019 survey ($n = 1228$). Data are shown as unweighted mean. Q4-1: Quartiles of household income (per capita). Quartile income values in International Dollars (Int\$): Q4 = Int\$ < 169.00, Q3 = Int\$ 169–322.00, Q2 = Int\$ 323.00–591.00, and Q1 = Int\$ < 591.00, based on exchange rate of 2.36:1 (as for 2020, according to World Economic Bank) (<https://www.data.worldbank.org/indicator/PA.NUS.PPP?end=2020>, accessed 02/01/2022).

Headache disability was evenly distributed across income levels in employed people, indicating that this disability may represent a substantial economic burden related to work absenteeism/presenteeism throughout all income strata. A recent analysis of a nationwide database estimated that headache disorders, mostly migraine, may cost up to Int\$ 33.5 billion (Brazilian R\$ 67.6 billion) in terms of indirect costs due to work absenteeism/presenteeism yearly.³³

While representing a minor proportion, people outside the labor force had more headache disability than people inside the labor force. This could represent more vulnerable populations such as people depending exclusively on social welfare programs or retired due to other disabilities. Further studies are needed to investigate how these populations contribute to the socioeconomic burden of headaches and how to address this issue.

Despite being an enormous public health issue affecting adolescents and adults in their most productive years, headache disorders have received negligible attention from policymakers and public health authorities.²⁷ Strategies to reduce inequalities in headache disability and provide adequate diagnosis and treatment at regional and national levels should target several areas. Potential strategies include, (i) Expanding the primary healthcare system in key underserved regions, (ii) implementing headache medicine training for primary care professionals in key underserved regions, (iii) improving headache disorder surveillance, including more specific questions regarding headache subtypes, frequency, and disability in the National Health Survey, (iv) including headache disorders as a noncommunicable disease (NCD) in the list of NCDs in the Ministry of Health's *Strategic Action Plan for Coping with Chronic Diseases*, and (v) establishing a nationwide headache management protocol.^{2,21,34}

The strength of this study is that it is based on a representative sample of the Brazilian population, with data collected following a complex sampling design. As such, the estimates of prevalence, distribution, and projections of the sample with recent headache disability are robust and generalizable to the Brazilian population.

An obvious and important limitation in the PNS2019 is that it does not investigate headache prevalence, neither did it utilize a more specific headache-related instrument assessing headache disability for a longer period (e.g., Migraine Disability Assessment), nor does it provide detailed information on which daily activities are affected most, and what is the share of absenteeism and presenteeism in headache disability. In other surveys and datasets, presenteeism-related disability is estimated to represent the largest share of headache disability.^{14,35–37} Also, headache disability is much broader than absenteeism or presenteeism and may involve several cognitive,³⁸ affective,^{39,40} and behavioral⁴¹ dysregulations with large social and personal impact.

Furthermore, because the PNS2019 does not specify headache subtypes, the subtype that generates the highest burden is undetermined. Nonetheless, estimates of headache prevalence in general and observational studies in primary care units rank migraine as the most disabling, most common in emergency rooms, and the costliest subtype in Brazil.^{33,42–44}

Other factors related to misreporting of headaches could have influenced the responses, causing both under- and overrating reporting. For example, for cultural reasons, men usually underrate headaches. Conversely, headache disability could be overrated because disability was inquired using a single-choice question with a list of diseases, thus, other diseases (e.g., infectious diseases) that were not included in the list in which headache may be present as a secondary symptom could be selected instead.

Finally, the short time window enquired (2 weeks) may result in the underestimated prevalence of disability. As headache disorders are paroxysmal neurological conditions, a greater time window of observation would certainly yield a higher prevalence of headache disability.^{13,44} On the other hand, this short period assessed used in the PNS2019 minimizes recall bias.

CONCLUSIONS

In summary, headache disorders remain a leading cause of disability in Brazil and there are socioeconomic, ethnic, and geographical inequalities in headache disability. This study can help public health authorities and stakeholders to establish priorities for headache policies considering these inequalities in Brazil.

AUTHOR CONTRIBUTIONS

Study concept and design: Arão Oliveira, Mario Peres. *Acquisition of data:* Arão Oliveira. *Analysis and interpretation of data:* Arão Oliveira, Juliane Mercante, Alessandra Goulart, Isabela Bensenor, Mario Peres. *Drafting of the manuscript:* Arão Oliveira, Alessandra Goulart, Mario Peres. *Revising it for intellectual content:* Arão Oliveira, Juliane Mercante, Alessandra Goulart, Isabela Bensenor, Mario Peres. *Final approval of the completed manuscript:* Arão Oliveira, Juliane Mercante, Alessandra Goulart, Isabela Bensenor, Mario Peres.

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The nomenclature regarding the race categories “Black” and “Brown” is of commonplace use in Brazil and is not used in demographic/epidemiology information in a pejorative sense or with the intention of discriminating against any of the ethnic-racial groups.

CONFLICT OF INTEREST

Arão Oliveira, Isabela Bensenor, Alessandra Goulart, Juliane Mercante, and Mario Peres have no conflict of interest to declare.

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