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ARTICLE

Changes in prevalence and in educational inequalities in Brazilian health behaviors between 2013 and 2019

Mudanças na prevalência e nas desigualdades educacionais nos comportamentos de saúde no Brasil entre 2013 e 2019

Cambios en la prevalencia y en las desigualdades educativas en los comportamientos de salud en Brasil entre 2013 y 2019

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Abstract

Considering the relevance of health behaviors for chronic diseases prevalence and mortality and the increase in income concentration observed in the world and in Brazil, this study aimed to evaluate the changes in the prevalence and in the educational inequalities of Brazilian adult health behaviors between 2013 and 2019. We analyzed data of 49,025 and 65,803 adults (18-59 years of age) from the Brazilian National Health Survey *(PNS), 2013 and 2019. Prevalence of health behaviors (smoking, alcohol intake, diet, physical activity and sedentarism) were estimated for three educational strata, for both surveys. Prevalence ratios (PR) between year of survey and between educational strata were estimated by Poisson regression models. Significant reductions were found in the prevalence of smoking, physical inactivity, sedentarism, insufficient consumption of fruits, and the excessive consumption of sweetened beverages. However, an increase was observed in alcohol consumption and binge drinking; vegetable consumption remained stable. Contrasting the favorable change in some behaviors, inequalities among schooling strata remained very high in 2019, specially for smoking (PR = 2.82; 95%CI: 2.49-3.20), passive smoking (PR = 2.88; 95%CI: 2.56-3.23) and physical inactivity (PR = 2.02; 95%CI: 1.92-2.13). There was a significant increase in the educational inequality regarding physical inactivity (21%), insufficient intake of fruit (8%) and in the frequent consumption of sweetened beverages (32%). The persistence and enlargement of inequalities highlight the behaviors and social segments that should be special targets for policies and programs focused in promoting healthy lifestyles.*

Socioeconomic Factors; Smoking; Alcohol Drinking; Diet; Physical Activity

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Introduction

Currently, lifestyle is recognized as a determining factor for the incidence of chronic diseases and premature death. Studies conducted in different countries report high percentages of diseases and deaths that can be attributed to smoking, harmful alcohol consumption, physical inactivity, sedentarism, and poor eating habits [1,2,3,4,5].

Considering the evidence, institutions such as the World Health Organization (WHO) and governmental agencies worldwide – including Brazil – have implemented policies and actions aimed to reduce the prevalence of unhealthy behaviors [6,7,8,9,10,11,12]. The degree of success of interventions depends on the type of behavior targeted and the initiative adopted [13,14]. Monitoring trends in health behaviors is the key to evaluate the success of the measures adopted in different countries.

Despite reductions in several unhealthy behaviors, studies have suggested an increase in social inequality in the prevalence of these behaviors in many countries [15,16]. In recent decades, several developed countries have registered an increase in inequalities in mortality among socioeconomic strata [17]. An analysis of the trend in inequalities in mortality rates according to the schooling level in 15 European countries reported an increase in the relative index of inequality in 13 out of the 15 studied countries [18]. Thus, questions regarding the determinants of this expansion of social inequalities in mortality and other health indicators, and the possible role of the prevalence, and trends of unhealthy behaviors emerge.

Initiatives and actions promoting a healthier lifestyle tend to be more effective in segments of society with higher schooling and economic levels, which have access to greater knowledge and resources to change behaviors and adopt healthier practices [19,20]. This process tends to increase social inequalities in lifestyle, health status, and mortality. Even in countries with low income inequality, such as Denmark, the decrease in overall mortality from 1985 to 2009 was followed by the increase in inequality among strata with different schooling levels; moreover, 75% of this increase in inequality among men and 97% of the increase among women were associated with deaths attributed to smoking and inappropriate alcohol consumption [20]. However, some studies have questioned the relevance of health behaviors in inequalities or the increase in inequalities regarding health status and mortality [21], considering the role of economic and macrosocial policies.

As social inequalities differ in magnitude and trends depending on the analyzed behavior, some authors recommend the analysis of several behaviors to broadly understand inequalities [14]. Considering the effect of health behaviors on morbidity and mortality rates, its influence on patterns and trends of health inequalities, and the need for a more comprehensive look at behaviors, this study aims to assess changes in the frequencies of unhealthy behaviors as well as inequalities in these frequencies among different social strata based on schooling level in Brazilian adults between the first two *Brazilian National Health Surveys* (PNS) conducted in the country.

Methods

This is a cross-sectional study developed with data from the PNS conducted in Brazil in 2013 and 2019, which collected data from representative samples of the population living throughout the country. The sample was selected by three stages, including the random sampling of census tract in the first stage and the random selection of private households in the second. In the third stage, an 18-year-old (in 2013), 15-year-old (in 2019), or older resident was selected by a random draw from each of the households. Details on the sampling process, design, and contents of the 2013 and 2019 surveys can be found elsewhere [22,23]. To allow the comparison between the two editions of the PNS, the Brazilian Institute of Geography and Statistics (IBGE) recalculated the expansion factors of the 2013 edition using the Population Projection of the Federative Units by simple age and gender for the period 2010-2060, the same used in the weighting of the PNS 2019. This study used the reweighted version of the PNS 2013.

To compare estimates from both surveys (2013 and 2019), the samples from the two editions were added by the <*append datasets*> function of the Stata software (https://www.stata.com), after matching the names and categories of the variables used, generating a single database of 484,929 records.

For data analysis, each year sample was considered as a stratum, so that the primary sampling units in each survey year did not mix. The analyses were performed with the survey library from the Stata software, using the stratum variable created and the original variables of clusters and weights to define the sample design.

In this study, data from adults aged from 18 to 60 years were analyzed, including the following variables:

(1) Social and demographic variables: gender, age, self-declared skin color (white, black or brown), schooling (stratum 1: complete higher education; stratum 2: complete basic education; stratum 3: no formal schooling or incomplete basic education), household income per capita in minimum wages (MW) (< 1, 1-2, 3 and more); private health insurance (yes/no); number of household appliances, number of bathrooms, access to Internet, and having a maid (yes/no);

(2) Smoking (yes/no): current smoker, former-smoker, or passive smoker at home;

(3) Alcohol consumption: at least once per month (yes/no); binge drinking (yes/no) (considering 5 or more drinks on a single occasion in the previous 30 days for men and women in 2019, and 4 or more drinks for women in 2013). Binge drinking was estimated only among the respondents who consumed alcohol;

(4) Leisure-time physical activity: active (individuals who practiced at least 150 minutes per week of mild to moderate physical activity or 75 minutes per week of vigorous activity) or inactive (individuals who did not practice physical activity);

(5) Sedentarism: individuals who watched television 3 or more hours per day were considered sedentary;

(6) Diet: consumption of vegetables (raw or cooked) and fruit at least 5 days per week (yes/no); consumption of sweetened beverages (soft drinks or artificial juice with sugar) 4 or more days per week (yes/no).

These variables were generated based on the PNS questionnaires applied in the 2013 and 2019, and they are available on the website: https://www.pns.icict.fiocruz.br/questionarios/.

The sampling design of both PNS editions was considered in the analysis. Stata software version 15.0 in the survey module was used for statistical analysis, considering the sample weights and the design effect. Prevalence estimates and confidence intervals of health behaviors were estimated for 2013 and 2019 and for each schooling level. An equiplot graph (made with Equiplot Creator Tool – International Center for Equity in Health, Pelotas. http://www.equidade.org) illustrates the observed differences.

Prevalence ratios (PR) of the health behaviors in 2013 and 2019 adjusted by age and gender and respective 95% confidence intervals (95%CI) were estimated using Poisson regression models, considering the complex sampling design.

PR of the health behaviors of the strata with complete higher education or more and incomplete basic education with those of the strata with incomplete basic education (reference category), adjusted by age and gender, were estimated for 2013 and 2019.

The 2013 and 2019 PNS was approved by the Brazilian National Ethics Research Committee (process n. 328,159 and n. 3,529,376, respectively). All interviewees signed an informed consent form.

Results

We analyzed data from 49,025 and 65,803 adults (aged 18-59 years) interviewed in the 2013 and 2019 PNS, respectively. Between the two surveys, the proportion of adults older than 40 years (41.8% to 45%), of black or brown skin color (53.3% to 58.1%) and with complete higher education (13.4% to 17%) increased.

The analyses of the population characteristics show that, in both surveys, the schooling level is strongly associated with all demographic and socioeconomic variables analyzed (Table 1).

Between the two surveys, we found reductions in the prevalence of smoking and passive smoking at home, inactivity, sedentarism, and consumption of fruits less than 5 days per week and sweetened beverages 4 or more days per week (Table 2). However, alcohol consumption (occasional or binge drinking) significantly increased and the insufficient consumption of vegetables remained stable.

Table 1

Sample demographic and social characteristics of Brazilian adult population (18-59 years age) according to educational strata. *Brazilian National Health Survey* (PNS), 2013 and 2019.

Variables	2013			p-value	2019			p-value
	Educational strata				Educational strata			
	1	2	3		1	2	3	
Sex				< 0.0001				< 0.0001
Female	58.7	52.2	49.4		58.7	51.9	48.7	
Male	41.3	47.8	50.6		41.3	48.1	51.3	
Skin color				< 0.0001				< 0.0001
White	68.1	47.7	36.4		61.6	40.7	31.6	
Black/Brown	31.9	52.3	63.6		38.4	59.2	68.3	
Income (minimum wage)				< 0.0001				< 0.0001
< 1	14.4	48.0	71.9		14.9	55.4	75.4	
1-3	40.4	43.4	25.7		46.0	38.6	23.3	
3 or more	45.2	8.6	2.4		39.1	6.0	1.3	
Number of assets in the house				< 0.0001				< 0.0001
0-3	1.0	5.7	19.5		0.9	4.9	16.5	
4-6	7.2	22.8	38.0		8.0	26.9	41.1	
7-9	21.6	31.0	25.2		29.5	34.5	26.4	
10 or more	70.2	40.5	17.3		61.6	33.7	16.0	
Number of bathrooms in the house				< 0.0001				< 0.0001
0-1	35.2	69.7	85.2		39.7	70.7	83.8	
2	34.3	22.9	12.6		37.0	23.8	14.5	
3 or more	30.5	7.4	2.2		23.3	5.5	1.7	
Have access to Internet	87.3	58.3	26.6	< 0.0001	98.9	92.8	75.0	< 0.0001
Have a house maid	22.1	5.0	2.0	< 0.0001	15.7	3.1	1.2	< 0.0001
With private health insurance	68.6	31.6	10.4	< 0.0001	64.2	24.0	7.3	< 0.0001

Note: educational strata: 1 – complete higher education; 2 – complete basic education; 3 – no formal schooling or incomplete basic education.

The PR between schooling strata showed significant inequalities for all analyzed indicators (Table 3). The PRs between stratum 3 and 1 are generally more discrepant (far from 1) than those between stratum 2 and 1, with a clear PR gradient. The 2019 survey data showed that the prevalence of smoking and passive smoking was nearly threefold – PR = 2.82 (95%CI: 2.49-3.20) and 2.88 (95%CI: 2.56-3.23), respectively – and the prevalence of physical inactivity was twofold (PR = 2.02; 95%CI: 1.92-2.13) in the least educated segment when compared to the most. On the other hand, alcohol consumption (occasional or binge drinking) was more prevalent in the most educated stratum.

The comparison of inequalities found in 2013 and 2019, according to schooling strata (Table 3; Figure 1), showed that inequalities increased significantly in physical inactivity, insufficient fruit consumption, and excessive consumption of sweetened beverages, however, they remained stable for the others health behaviors.

Discussion

The results show a favorable trend, with decreases in most of the analyzed unhealthy behaviors, such as smoking, physical inactivity, insufficient fruit consumption, and the excessive consumption of sweetened beverages, but with an increase in alcohol consumption and the maintenance of the sedentarism and vegetable consumption level among Brazilian adults between 2013 and 2019. However, despite these favorable trends, important educational inequalities persist and the prevalence of

Table 2

Comparison of prevalence of health-related behaviors according to year of *Brazilian National Health Survey* (PNS), 2013 and 2019.

Health-related behavior	2013			2019			PR adjusted for sex and age	
	n	% (1)	95%CI	n	% (2)	95%CI	(2/1)	95%CI
Tobacco								
Smoker	7,325	15.1	14.5-15.6	8,606	12.9	12.4-13.4	0.84	0.79-0.88
Ex-smoker	6,873	48.8	47.4-50.3	14,650	63.3	62.2-64.5	1.28	1.24-1.33
Passive smoker	8,846	19.6	18.9-20.3	10,157	16.4	15.8-17.0	0.83	0.79-0.88
Alcohol								
Drinks 1 time or more per month	13,141	28.9	28.0-29.7	20,324	33.1	32.3-33.8	1.15	1.11-1.19
Binge drinking	7,629	15.7	15.1-16.3	13,455	20.2	19.6-20.7	1.30	1.24-1.36
Physical activity during leisure								
Inactive	33,982	67.5	66.7-68.3	38,536	56.6	55.8-57.4	0.83	0.81-0.84
Active	11,266	24.1	23.6-25.1	20,855	32.9	32.1-33.6	1.37	1.32-1.42
Sedentary (3 hours or more of TV)	14,125	28.2	27.4-29.0	12,796	19.6	19.0-20.2	0.69	0.66-0.72
Diet								
Vegetable intake < 5 time per week	24,505	46.9	46.1-47.7	32,921	47.1	46.3-47.8	1.01	0.99-1.03
Fruit intake < 5 time per week	30,529	61.6	60.7-62.4	38,927	58.8	58.1-59.5	0.96	0.94-0.98
Consumption of sweetened beverages > 4 time per week	10,781	23.2	22.4-24.0	11,775	21.2	20.6-21.8	0.93	0.89-0.97

95%CI: 95% confidence interval; PR: prevalence ratio.

Table 3

Comparison of prevalence ratios of health-related behaviors according to schooling and year of *Brazilian National Health Survey*, 2013 and 2019.

Health-related behavior	2013 PR (95%CI) * Educational strata		2019 PR (95%CI) * Educational strata	
	2/1	3/1	2/1	3/1
Tobacco				
Smoker	1.55 (1.32-1.82)	2.49 (2.13-2.92)	1.65 (1.45-1.87)	2.82 (2.49-3.20)
Ex-smoker	0.85 (0.78-0.93)	0.79 (0.72-0.86)	0.94 (0.89-0.98)	0.81 (0.77-0.86)
Passive smoker	1.48 (1.29-1.71)	2.40 (2.09-2.76)	1.77 (1.58-1.98)	2.88 (2.56-3.23)
Alcohol				
Drinks 1 time or more per month	0.75 (0.70-0.80)	0.68 (0.63-0.73)	0.76 (0.72-0.80)	0.64 (0.60-0.67)
Binge drinking	0.89 (0.79-0.99)	0.89 (0.80-1.00)	0.91 (0.84-0.98)	0.85 (0.78-0.93)
Physical activity during leisure				
Inactive	1.36 (1.30-1.43)	1.65 (1.58-1.73)	1.56 (1.49-1.64)	2.02 (1.92-2.13)
Active	0.63 (0.59-0.68)	0.34 (0.31-0.37)	0.63 (0.61-0.66)	0.37 (0.35-0.39)
Sedentary (3 hours or more of TV)	1.52 (1.39-1.67)	1.44 (1.31-1.59)	1.52 (1.38-1.68)	1.58 (1.43-1.74)
Diet				
Vegetable intake < 5 time per week	1.30 (1.22-1.38)	1.70 (1.59-1.81)	1.38 (1.30-1.45)	1.72 (1.62-1.82)
Fruit intake < 5 time per week	1.19 (1.13-1.25)	1.46 (1.39-1.53)	1.34 (1.28-1.39)	1.60 (1.54-1.67)
Consumption of sweetened beverages > 4 time per week	1.42 (1.27-1.58)	1.37 (1.22-1.55)	1.76 (1.59-1.95)	1.81 (1.62-2.02)

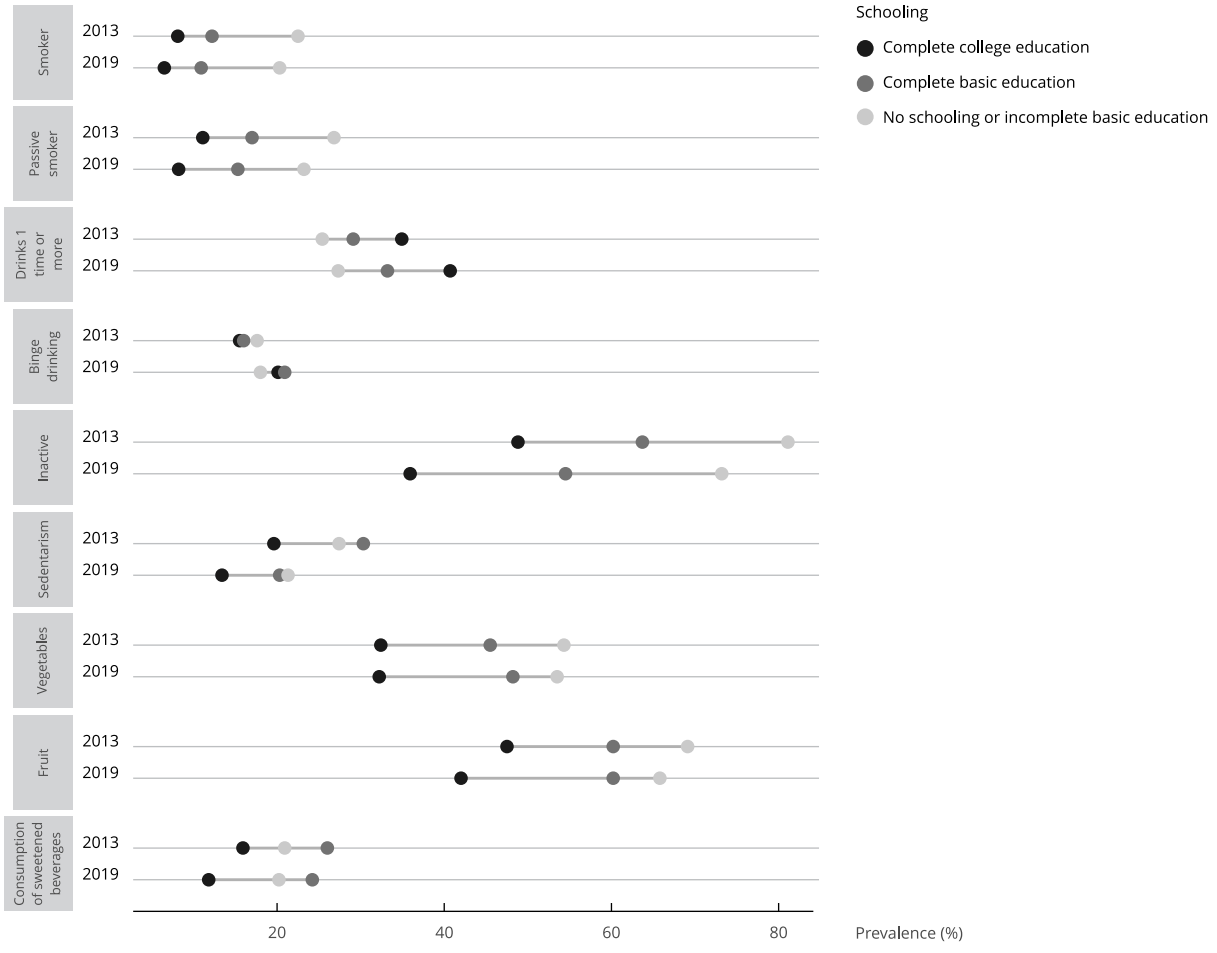
95%CI: 95% confidence interval; PR: prevalence ratio.

Note: educational strata: 1 – complete higher education; 2 – complete basic education; 3 – no formal schooling or incomplete basic education.

* PR adjusted by sex and age with reference category: "complete higher education".

Figure 1

Comparison of prevalence of health-related behaviors according to schooling and year of *Brazilian National Health Survey* (PNS), 2013 and 2019.



most unhealthy behaviors, except alcohol consumption, was higher among individuals from the less educated strata. Moreover, educational inequalities significantly increased in this short period in the prevalence of physical inactivity, insufficient fruit consumption, and the frequent consumption of sweetened beverages.

The prevalence of some behaviors that constitute risk factors for chronic disease decreased in several countries, but this decrease is often accompanied by an increase in inequalities among the social strata analyzed. The prevalence of unhealthy practices is generally higher in lower socioeconomic strata. Analyzing 27 European countries, researchers confirmed that the cluster of unhealthy behaviors are more prevalent in lower socioeconomic strata [24]. In Australia, from 2002 to 2012, the prevalence of smokers, inactivity, and insufficient vegetable consumption decreased, but, simultaneously, inequality among socioeconomic strata regarding the prevalence of smokers and vegetable consumption increased [25]. In Sweden, smoking decreased from 2006 to 2014 whereas the prevalence of physical inactivity and binge drinking remained stable, with an increase in social inequality regarding physical inactivity among men and smoking among women [15]. In Denmark, smoking and excessive alcohol consumption have been decreasing since 1970, but with an increase in inequality among schooling strata [20]. In England, social inequalities increased regarding smoking and physical

activity and decreased concerning fruit, vegetable, and alcohol consumption from 2001 to 2012 [26]. In Brazil, a study analyzing data from individuals living in capital cities presented a decrease in smoking and an increase in abusive alcohol consumption, as well as an increase in inequalities regarding heavy drinking from 2006 to 2017 [27].

Smoking

The prevalence of smoking among Brazilian adults decreased from 15.1% in 2013 to 12.9% in 2019 and the magnitude of inequality remained high and stable. A Brazilian study conducted in capital cities presented similar results: a decrease in smoking for both men and women and a persistent relative inequality among men [27]. As aforementioned, several countries presented a decrease in smoking. In the Republic of Korea, smoking decreased from 71.7% to 39.7% among men and from 6.5% to 3.3% among women from 1992 to 2016, but inequalities among social segments increased [14]. In Argentina, smoking decreased from 2005 to 2013, especially among women, but inequalities among social segments remained during this period; moreover, passive smoking in the country was more prevalent in segments with lower schooling levels [28], as found out in our study with Brazilian adults.

A study developed in Great Britain, Finland, and Japan found a broad difference among professions regarding the prevalence of smokers from 2003 to 2007, reaching relative inequality indices of 3.55 for men and 3.80 for women in Finland as well as 3.23 for men and 2.30 for women in England, but with no differences in Japan [29]. We also found high inequality in the Brazilian population in this study, with a smoking prevalence ratio of 2.82 between the more and less educated strata in 2019.

Despite the decreasing trend, smoking continues to significantly affect the incidence of diseases and mortality. In high-income countries, smoking is the main cause of premature death, corresponding to the loss of ten years of life expectancy among smokers [3]. In Sweden, alcohol consumption and smoking contribute to the increasing inequalities in life expectancy among different educational strata, the influence of alcohol being stronger among men, and the role of smoking stronger among women [2]. A study carried out in 11 European countries found that mortality from smoking according to schooling level has been increasing for both men and women [30].

Tobacco control measures have achieved different results worldwide. In England, smoking cessation campaigns have been more effective among more affluent segments [19]. A study conducted In the Republic of Korea reported the increase in social inequality regarding smoking simultaneously to the implementation of tobacco control policies [14]. The control measures implemented tend to reach more affluent segments of the population in a first step, which can lead to an increase in inequalities [13]. To reduce health inequalities, tobacco control must focus essentially on vulnerable segments of society [16].

Despite the success of tobacco control measures in Brazil, resulting in a considerable decrease in smoking, the maintenance of inequality concerning schooling level presented in this study highlights the need for a stronger return to anti-smoking campaigns especially directed at socially underprivileged segments. Besides specific tobacco control measures, studies have emphasized the need for changes in economic and macro social policies [31].

Alcohol

Our study results show that, unlike other unhealthy behaviors analyzed, the prevalence of alcohol consumption increased 15% for occasional drinking and 30% for binge drinking. In 2019, 20.2% of the Brazilian adults who consumed alcoholic beverages, reported a binge drinking episode in the previous 30 days. Alcohol consumption was the only studied unhealthy behaviors that had higher prevalence in the most educated stratum.

Alcohol consumption has been increasing in many countries. Globally, the annual consumption per capita increased from 5.9 liters in 1990 to 6.5 liters in 2017 [32]. The prevalence of binge drinking increased in almost all age groups in the United States from 2006 to 2018 [33] and the prevalence of heavy drinking increased from 15% to 20% in Ottawa (Canada), from 2000 to 2014 [34]. A Brazilian study analyzing the population living in capital cities observed, from 2006 to 2017, an increase in abusive alcohol consumption and in its educational inequalities, however, only in women [27].

The effect of alcohol on health has also been increasing. In 2016, alcohol was the seventh major cause of death and disability-adjusted life years (DALYs) worldwide. In those aged from 15 to 49 years, alcohol accounted for 12.2% of deaths among men and 3.8% among women [35]. Alcohol-related deaths in the United States increased from 2000 to 2017 in all schooling strata, with social inequalities remaining firmly [4]. In Denmark, from 1985 to 2009, 75% and 97% of the increase in inequality regarding mortality rate was related to deaths from smoking and alcohol consumption for men and women, respectively [20]. A study carried out in 17 European countries found that alcohol-related deaths correspond to 10% of the inequality in total mortality [36].

The associating of alcohol consumption with diseases and deaths depends on the amount consumed, frequency of consumption, consumption pattern, type of alcoholic beverage, and disease or cause of death analyzed [37]. Consistent evidence in several countries suggest an increase in alcohol consumption in higher socioeconomic strata, but with a greater occurrence of alcohol-related diseases and deaths in more socially vulnerable populations [36], which was called the "alcohol harm paradox". In the United States, a low socioeconomic status has been associated with low alcohol consumption but with heavier drinking [38].

Several studies presented lower mortality rate for individuals with moderate alcohol consumption [39] but these results have been questioned by some authors [35] and Minzer et al. [40] indicate the lack of a safe limit of alcohol consumption as a difficulty regarding its control.

The increase in the alcohol consumption and binge drinking among Brazilian adults reported in this study underscores the urgent need for new public policies aiming to control alcohol consumption. Advertisements and regulations have been partially hindering the control, since the regulation considers alcoholic beverages only those with alcohol content higher than 13%, thus excluding beers and wines [41]. Brazil could use other countries experiences to employ effective strategies, such as establishing a period of time to sale alcoholic beverages, requiring liquor licenses to sell such beverages, and providing effective programs in healthcare services to treat individuals with alcohol dependence or harmful alcohol use.

Diet

In this study, we found an increase in fruit consumption, a decrease in excessive consumption of sweetened beverages, and no change in vegetable consumption. Different trends have been reported. For adults living in Brazilian capitals, a study using data from telephone survey found an increase in the consumption of fruits and vegetables from 2008 to 2016 [42]. In the United States, a study showed fruit consumption decreasing and a stable consumption of vegetable from 1999/2000 to 2017/2018 [43]. In Australia, insufficient vegetable consumption decreased from 2002 to 2012 [25]. Studies conducted in Brazil [44] and other countries [45] showed a decrease in the consumption of sweetened beverages, as observed in this study. Although the favorable trend in relation to fruits and sweetened beverages consumption, the results showed that in 2019 nearly half of Brazilian adults had insufficient consumption of fruits and two thirds of vegetables.

We found social inequalities for the three diet indicators analyzed, with higher prevalence of inadequate consumption in the less educated stratum. These results are similar to those from other studies conducted in Brazil [42,44,46] and other countries [5,25,26,47]. Furthermore, inequalities increased regarding fruits and sweetened beverage consumption between the two Brazilian PNS, but they remained stable for the consumption of vegetables. Studies carried out in other countries showed a decrease in inequalities related to vegetables in Australia [25] and to fruits and vegetables in Republic of Korea [48] and England [26]. A previous Brazilian study also presented a higher decrease in relation to sweetened beverages for the more educated stratum [44].

The advances in the Brazilian diet quality results from policies implemented in the country [7], including the new *Dietary Guidelines for the Brazilian Population*, which strongly recommends the consumption of fresh food, such as fruit and vegetables [12]. The increasing prevalence of obesity have also produced a broadly recommendations about health diets.

The increasing inequalities regarding fruits and sweetened beverage consumption, also observed in other countries, may result from the early adherence to health and nutrition recommendations by higher socioeconomic strata, which have broader access to information and more resources to obtain

healthy foods, although the presence of ultra-processed foods in the diet is not an exclusive practice of underprivileged social segments [49]. In Brazil, social inequalities increase regarding healthy food consumption can be partially attributed to the austerity policies implemented after 2016, as well as the lack of investments in regulatory policies and the promotion of healthy eating habits [50]. In order to promote equitable access to healthy foods for the Brazilian population, this current scenario must be reversed, implementing intersectoral public policies concerning food and nutritional security [51], including incentives and support to reduce fruit and vegetable prices and implement taxes and advertising regulation for sweetened beverages [10].

Physical activity and sedentarism

We found that the practice of leisure-time physical activity increased from 24.1% in 2013 to 32.9% in 2019. A study conducted in Brazilian capitals also reported an increase from 44% in 2006 to 53.6% in 2016 [52]. In Norway, the practice of physical activity has been increasing steadily since 1994/1995 [53] and in Poland, it increased by 43% from 2014 to 2018 [54]. The worldwide prevalence of sedentarism decreased from 2013 to 2019. However, this trend cannot be observed in the United States, as the adult population watched TV for 2 hours or more from 2001 to 2016 [55].

Schooling level has been a significant determinant of physical activity and sedentary behavior. In our study, the percentage of inactive and sedentary individuals was higher in the least educated individuals. Previous studies also found these associations with socioeconomic levels [56,57,58]. The systematic review developed by Beeneckers et al. [56] showed that the direction of socioeconomic inequalities regarding physical activity depends on the activity domain, but those performed in leisure time are more prevalent in the higher socioeconomic stratum. A study performed with the Brazilian population found that aquatic, weight-lifting, and gymnastic exercises were fourfold more prevalent among the wealthiest segments [57].

The influence of schooling on leisure-time physical activity may result from the understanding of its health and well-being benefits [56], a greater knowledge in types of exercises, and more access to such activities. Moreover, considering the tendency of lower income among less educated individuals, economic constraints may lead to restrictions due to the lack of resources for engaging in paid activities.

Although the prevalence of physical inactivity decreased, the gap between the highest and the lowest socioeconomic level increased by 21% from 2013 to 2019. Studies performed in the Netherlands [59] and Brazil [52] presented an increase in the prevalence of leisure-time physical activity in higher socioeconomic strata.

Unemployment rate in Brazil increased from 6.8% in 2014 to 12.8% in 2017, affecting specially the poorest strata of the population. Informal work also increased, with an estimated 38 million autonomous or informal workers [60]. Low income and work conditions may make it difficult for the poorest to dedicate time or resources to practice leisure-time physical activity.

Outdoor gyms with free access have been installed in some municipalities in Brazil, but little is known about the effectiveness of this strategy in reducing leisure-time physical activity inequalities [61]. The Health Academy Program created by the Brazilian Ministry of Health for the promotion of educational programs in health behaviors was another strategy aimed to increase the level of physical activity [11]. However, due to austerity policies, such programs have been receiving less investment and funding since 2016 [50].

This study has some limitations. The health behaviors are self-reported and, therefore there is a social expectation on what would be a good answer, they are subjected to memory biases and under or overestimation. Moreover, the comparison of prevalence between the two surveys may be influenced by differences in the questions. The definition of binge drinking for women differ between the surveys, as aforementioned, the PNS 2013 applied two questions about vegetables (raw and cooked) while the PNS 2019 applied only one, and the leisure-time physical activity level was assessed considering the previous 3 months in 2013 and the previous 12 months in 2019. We analyzed inequalities according to the schooling level, which proved to be strongly associated with several socioeconomic indicators and which is broadly used as proxy of socioeconomic level [18,27,30]. On the other hand, the study has advantages. Firstly, it isa population-based study with representative sample of the entire Brazilian population. Our study provides significant information about changes in health

behaviors and their educational inequalities, which is crucial for the control of chronic noncommunicable diseases.

The analyses of the results must consider political and economic changes occurred in Brazil between the two surveys. Since 2015, political and economic crises and the implementation of an ultra-neoliberal program increased unemployment, poverty, loss of workers' rights, and inequality. Moreover, a 2016 Constitutional Amendment prohibited for 20 years the increase in resources for health and education, affecting directly the public health system [50,60]. According to a study carried out in 21 European countries, the reduction in social inequalities regarding health and mortality depends on the decrease in low income and unemployment as well as specific measures focused on the prevention and control of unhealthy behaviors and diseases [31].

Conclusion

The results of this study show that the prevalence of several unhealthy behaviors decreased, but alcohol consumption increased and the prevalence of insufficient vegetable consumption remained stable. Despite the overall improvement, strong educational inequalities persist in the prevalence of these behaviors, and inequalities even increased in relation to physical inactivity and fruits and sweetened beverages consumption.

Policies aiming at the prevention of chronic noncommunicable diseases and the decrease in health inequalities, besides the decrease in income concentrations and unemployment, should specially focus on the most challenging unhealthy behaviors and the most socially vulnerable segments of the Brazilian population.

Contributors

M. B. A. Barros defined the proposal and the objectives of the study, carried out a bibliographic review, prepared the writing of the introduction, general discussion, conclusion and the specific discussion on alcohol and tobacco, and the general review of the manuscript. L. P. B. Medina prepared the analyses, writing the results, methods and specific discussion about food. M. G. Lima collaborated in the literature review, writing the specific discussion on physical activity and sedentary lifestyle and general review of the manuscript. N. F. S. Sousa collaborated in the literature review and critical review of the study. D. C. Malta collaborated in the literature review and in the critical review and final correction of the manuscript. All authors contributed with multiple revisions of the article and approved the final version of the manuscript.

Additional informations

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Resumo

Dada a relevância dos comportamentos de saúde para a prevalência de doenças crônicas, a mortalidade devida a elas e o aumento da concentração de renda no mundo e no Brasil, este estudo procurou avaliar as mudanças na prevalência dos comportamentos de saúde e sua relação com desigualdades educacionais em adultos brasileiros entre 2013 e 2019. Foram analisados dados de 49.025 e 65.803 adultos (18-59 anos) em Pesquisa Nacional de Saúde *(PNS), 2013 e 2019. A prevalência de comportamentos de saúde (tabagismo, ingestão de álcool, dieta, atividade física e sedentarismo) foi estimada para três estratos educacionais em ambas as PNS. As razões de prevalência (RP) entre os anos da pesquisa e os estratos educacionais foram estimadas pelos modelos de regressão de Poisson. Foram encontradas reduções expressivas na prevalência de tabagismo, inatividade física, sedentarismo, consumo insuficiente de frutas e ingestão excessiva de bebidas adoçadas. Observou-se um aumento no consumo de álcool (incluindo o excessivo), ao passo que o consumo de vegetais se manteve estável. Em contraste com a mudança favorável em alguns comportamentos, as desigualdades entre os estratos de escolaridade permaneceram muito altas em 2019, especialmente para tabagismo (RP = 2,82; IC95%: 2,49-3,20), fumo passivo (PR = 2,88; IC95%: 2,56-3,23) e inatividade física (RP = 2,02; IC95%: 1,92-2,13). Houve um aumento expressivo da desigualdade entre os estratos de escolaridade em relação à inatividade física (21%), à ingestão insuficiente de frutas (8%) e ao consumo frequente de bebidas adoçadas (32%). A persistência e o ampliação das desigualdades destacam os comportamentos e segmentos sociais que devem ser alvos especiais de políticas e programas focados na promoção de estilos de vida saudáveis.*

Fatores Socieconômicos; Fumar; Consumo de Bebidas Alcoólicas; Dieta; Atividade Física

Resumen

Teniendo en cuenta la relevancia de los comportamientos de salud para la prevalencia de enfermedades crónicas, la mortalidad por ellas y el aumento de la concentración de la renta en el mundo y en Brasil, este estudio buscó evaluar los cambios en la prevalencia de comportamientos de salud y su relación con las desigualdades educativas en adultos brasileños en el periodo entre 2013 y 2019. Se analizaron 49.025 y 65.803 datos de adultos (18-59 años) de la Encuesta Nacional de Salud *(PNS), 2013 y 2019. Se estimó la prevalencia de comportamientos de salud (tabaquismo, consumo de alcohol, dieta, actividad física y sedentarismo) para tres estratos educativos en ambas encuestas. Las razones de prevalencia (RP) entre el año de la encuesta y los estratos educativos se estimaron mediante modelos de regresión de Poisson. Se encontraron reducciones significativas en la prevalencia de tabaquismo, inactividad física, sedentarismo, consumo insuficiente de frutas y consumo excesivo de bebidas azucaradas. Se observó un mayor consumo de alcohol (incluido con exceso), mientras que el consumo de vegetales se mantuvo estable. En contraste con el cambio favorable en algunos comportamientos, las desigualdades entre estratos escolares se mantuvieron muy altas en 2019, especialmente para el tabaquismo (RP = 2,82; IC95%: 2,49-3,20), fumo passivo (RP = 2,88; IC95%: 2,56-3,23), y la inactividad física (RP = 2,02; IC95%: 1,92-2,13). Hubo un aumento significativo de la desigualdad en cuanto a la inactividad física (21%), la ingesta insuficiente de frutas (8%) y el consumo frecuente de bebidas azucaradas (32%). La persistencia y ampliación de las desigualdades ponen de manifiesto comportamientos y segmentos sociales que deben ser destinatarios especiales de políticas y programas orientadas hacia la promoción de estilos de vida saludables.*

Factores Socioeconómicos; Fumar; Consumo de Bebidas Alcohólicas; Dieta; Actividad Física

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