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The Prevalence of Risk and Protective Factors for Noncommunicable Diseases (NCDs) among Brazilian Adults with Pre-Obesity and Obesity

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Abstract: The present study aimed to identify the prevalence of risk and protective factors for noncommunicable disease (NCDs) among Brazilian adults with pre-obesity and obesity and compare it to that of non-overweight adults in the country. Data from the National Health Survey (NHS) 2013 (n = 40,942) and 2019 (n = 87,678) were used. Nutritional status was described for 2013 and 2019 according to sociodemographic characteristics, health conditions, and risk and protective factors for NCDs. Poisson regression models were used to analyze the crude and adjusted prevalence of risk and protective factors for NCDs with nutritional status in both years. Adults with pre-obesity and obesity were more likely to perform risk factors related to sedentary behavior (prolonged screen time) and less leisure-time physical activity (among adults with obesity) and active commuting (among adults with pre-obesity and obesity) and alcohol abuse. However, among adults with pre-obesity and obesity, a lower prevalence was observed in relation to the regular consumption of sweets and smoking. The identified risk and protective factors had a similar prevalence between 2013 and 2019. Brazilian adults with pre-obesity and obesity presented worrisome scenarios regarding risk and protective factor for NCDs.

Keywords: obesity; public health; food consumption; physical activity; multivariate analysis

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1. Introduction

Obesity is considered a non-communicable disease (NCDs) and a risk factor for other diseases [1–3]. Overweight (including obesity) is also one of the leading causes of death globally, accounting for about 8.8% of total deaths in 2019 [4]. Currently, obesity is considered a major health problem, being defined as a global scale epidemic and one of the biggest public health challenges [5,6]. The prevalence of obesity has tripled worldwide and, in 2016, 1.9 billion adults were overweight and more than 650 million presented obesity [7]. In Brazil, the prevalence of obesity was 27.0% in 2019 [8]. Estimates for 2030 indicate that about 1 billion people worldwide will present obesity [9]. For the Brazilian population, estimates suggest a prevalence of 29.6% in 2030 [10].

The obesity is a multifactorial condition defined by excess weight from the accumulation of body fat, characterized by a body mass index (BMI) equal to or above 30. When associated with other risk factors, behavioral and modifiable (unhealthy diet, physical inactivity, smoking, alcohol abuse, and sleep disorders), it can be aggravated or even lead to a worse prognosis in the individual's chronic diseases [11,12]. Evidence has shown that high BMI is related to an expressive set of NCDs including high blood pressure and high blood cholesterol levels, cardiovascular disease, diabetes mellitus, osteoarthritis, and cancers [2,13,14].

Obesity is a relevant problem for health systems, with high management and treatment costs, impacting about 2.8% of the global gross domestic product (GDP) [15]. In Brazil, the scenario is similar: about 11% of the total expenditures of the *Sistema Único de Saúde* (SUS) are for obesity (without considering the expenses related to other NCDs attributable to obesity) [16]. Additionally, obesity-caused changes in metabolism may be associated with other negative health outcomes [17–20]. Considering the relevance of obesity control and management, understanding which risk and protective factors for health may be related to the presence of obesity allows a better design of strategies for the control of obesity and its aggravation for other NCDs.

The use of nationally representative health surveys enables risk monitoring and protective factors for health. Since 2013, Brazil has relied on the National Health Survey (NHS) for such an end [21]. In this context, the present study aimed to identify the prevalence of risk and protective factors for NCDs among Brazilian adults with pre-obesity and obesity and compare it to that of non-overweight adults in the country.

2. Methods

This study relies on the two editions of the Brazilian NHS, 2013 and 2019. The NHS is a nationally representative household survey (cross-sectional) conducted by a partnership between the Brazilian Ministry of Health (BMoH) and the *Instituto Brasileiro de Geografia e Estatística* (IBGE) [8].

The NHS was carried out for the first time in 2013 and its second edition in 2019. The sample is composed of permanent residents in Brazilian households. A cluster sampling strategy (in three stages) was employed. The census tracts (organized in geographic and economic strata) were the primary sampling units. Households were second-stage units and residents aged 18 and over were defined as third-stage units for the NHS 2013 [8] and aged 15 and over in the third stage of the NHS 2019. More details on the methodology are available in specific publications [8,22].

The present study used a subsample of NHS 2013 and 2019 data composed exclusively of adult individuals ($\geq$18 years of age) and who answered questions about their BMI (weight and height). Information on weight and height was not available for the entire 2013 sample; however, in the 2019 sample, for those who did not respond about weight and height, imputations were used in these variables, which allowed the use of the database in almost its entirety [8,22]. Information about weight and height were available for about 64% (n = 40,942) of the NHS 2013 sample and over 99% (n = 87,678) of the NHS 2019 sample.

Considering the objective of the present study, the main information of interest was the indicators of risk and protective factor for NCDs (already recognized in the literature) and anthropometric data (self-reported weight and height) used to define the nutritional status (BMI). Protective factors included were regular consumption of fruits and vegetables ($\geq$5 days/week), leisure-time physical activity ($\geq$150 min/week), active commuting ($\geq$150 min/week). Risk factors included were regular consumption of sweetened beverages ($\geq$5 days/week), regular consumption of sweets ($\geq$5 days/week), excessive screen time ($\geq$3 h/day), alcohol abuse, smoking and sleep disorders.

Regular consumption of fruits and vegetables involved consuming fruit and vegetables on five or more days/week. The sufficient leisure-time physical activity involved a minimum of 150 min of moderate-intensity physical activity or 75 min of vigorous activity per week. Active commuting involved spending a minimum of 150 min of moderate-intensity activity per week (commuting to work or school). The regular consumption of sweetened beverages, as well as cookies and sweets, involved consuming these products on five or more days/week. Excessive screen time involved watching television for $\geq$3 h/day. Those who reported smoking daily, regardless of the number of cigarettes, frequency, and duration of smoking, were identified as smokers. Those who reported drinking in the last 30 days, 5 (for men) or 4 (for women)—or more doses of alcoholic beverage on a single occasion were considered to have been abusive of alcoholic beverages in 2013 and in 2019, considered 5 or more doses for men and women. Sleep disorders involved reporting sleep

problems in the last two weeks, such as difficulty falling asleep, waking up frequently at night or sleeping more than usual on more than half the days or almost every day.

Nutritional status was based on BMI [body weight (kg) divided by the square of height (m) (kg/m^2)]. Cut-off points were defined as BMI < 25 kg/m^2 (no overweight), BMI 25 to <30 kg/m^2 (pre-obesity) and BMI ≥30 kg/m^2 (obesity) [6].

Sociodemographic characteristics and health conditions of the adults complemented the analyses: sex (man and woman), age groups (18 to 34, 35 to 59 and ≥ 60 years), schooling (0 to 4, 5 to 8, 9 to 11 and ≥ 12 years), presence of one or more NCDs (hypertension, diabetes, high cholesterol, back pain, or depression) and poor self-rated health (adults who self-rated their health as poor or very poor). Further details on the construction of indicators can be found in the original NHS report for 2013 [22] and 2019 [8].

Statistical Analysis

The study population was described for the years 2013 and 2019 by nutritional status (no overweight, pre-obesity, obesity) according to sociodemographic characteristics (sex, age groups, schooling), health conditions (presence of NCDs, poor self-rated health) and risk and protective factors (regular consumption of fruits and vegetables, leisure-time physical activity, active commuting, regular consumption of sweetened beverages, regular consumption of sweets, excessive screen time, alcohol abuse, smoking, sleep disorders). Poisson regression models were used to analyze the crude and adjusted (sex, age groups, schooling, presence of NCDs and poor self-rated health) prevalence of risk and protective factors for NCDs with nutritional status for both years.

Data were organized and analyzed using Stata® software, version 16.1. (College Station, TX, USA; StataCorp LLC, 2019). The NHS was authorized by the Brazilian Committee on Ethics in Research with Human Beings, Ministry of Health.

3. Results

For this study, data from 40,942 adults interviewed in 2013 and 87,678 adults in 2019 were used. Among adults interviewed in 2013, about 45.9% were eutrophic (non-overweight), 35.5% presented pre-obesity and 18.7% obesity. For the year 2019, the prevalence of non-overweight adults reduced to 41.8%, while the prevalence of pre-obesity increased to 37.0% and of obesity to 21.2% (Table 1). Prevalence of overweight (considering pre-obesity and obesity) increased from 2013 to 2019 among women, but not among men. Both, pre-obesity, and obesity, tended to be more frequent in those aged 35 to 50 and with 9–11 years of schooling. We highlight the increase in the prevalence of negative self-rated health and chronic diseases among those overweight between the years (Table 1).

Regarding protective factors, eutrophic adults (non-overweight) have a lower prevalence of regular consumption of fruits and vegetables and a higher prevalence of leisure time physical activity and active commuting compared to adults with obesity (Table 2). Among the risk factors, the prevalence of regular consumption of sweetened beverages and sweets and excessive screen time, reduced for all groups between 2013 and 2019. For risk factors related to abusive alcohol and sleep disorders, there was an increase in prevalence between 2013 and 2019 for all groups (Table 2). No clear pattern was observed in the comparison of risk factors among the groups, except for adults with obesity presenting the highest prevalence of excessive screen time (32.7% in 2013 and 25.4% in 2019).

Table 1. Distribution (%) of the Brazilian adult, according to nutritional status and sociodemographic characteristics and health conditions. National Health Survey (NHS), 2013 (n = 40,942) and NHS, 2019 (n = 87,678).

Variables	NHS 2013				NHS 2019			
	%	CI 95%			%	CI 95%		
Eutrophic (non-overweight)								
Sex								
Men	48.1	46.9	-	49.4	46.0	45.1	-	47.0
Women	51.9	50.6	-	53.1	54.0	53.0	-	54.9
Age group (years)								
18 to 34	47.3	46.0	-	48.6	39.8	38.8	-	40.8
35 to 59	38.6	37.4	-	39.8	39.2	38.3	-	40.1
≥60 years	14.1	13.1	-	15.1	21.0	20.3	-	21.7
Schooling (years)								
0 to 4	29.0	27.8	-	30.3	34.3	33.4	-	35.3
5 to 8	16.4	15.4	-	17.4	14.8	14.1	-	15.5
9 to 11	38.4	37.1	-	39.7	35.3	34.4	-	36.3
≥12 years	16.2	15.1	-	17.3	15.5	14.7	-	16.4
Poor self-rated health	3.8	3.3	-	4.2	5.0	4.6	-	5.3
Chronic disease	35.2	33.9	-	36.5	43.1	42.2	-	44.1
Total	45.9	44.9	-	46.8	41.8	41.1	-	42.4
Pre-obesity								
Sex								
Men	56.0	54.6	-	57.4	51.3	50.4	-	52.3
Women	44.0	42.6	-	45.4	48.7	47.7	-	49.6
Age group (years)								
18 to 34	32.1	30.8	-	33.4	26.7	25.7	-	27.6
35 to 59	50.9	49.4	-	52.4	50.4	49.4	-	51.4
≥60 years	17.0	15.9	-	18.2	22.9	22.2	-	23.7
Schooling (years)								
0 to 4	30.4	29.0	-	31.8	34.7	33.7	-	35.6
5 to 8	15.0	13.9	-	16.1	14.0	13.4	-	14.7
9 to 11	37.7	36.4	-	39.1	34.7	33.7	-	35.7
≥12 years	16.9	15.5	-	18.3	16.6	15.8	-	17.5
Poor self-rated health	3.7	3.3	-	4.2	5.4	5.0	-	5.8
Chronic disease	48.2	46.7	-	49.8	53.1	52.1	-	54.1
Total	35.5	34.6	-	36.3	37.0	36.4	-	37.6
Obesity								
Sex								
Men	45.7	43.5	-	47.8	42.8	41.6	-	44.1
Women	54.3	52.2	-	56.5	57.2	55.9	-	58.4
Age group (years)								
18 to 34	26.4	24.6	-	28.3	23.8	22.6	-	25.0
35 to 59	56.6	54.5	-	58.7	54.7	53.4	-	56.0
≥60 years	17.0	15.5	-	18.6	21.5	20.3	-	22.7
Schooling (years)								
0 to 4	34.1	32.1	-	36.1	36.4	35.0	-	37.8
5 to 8	15.8	14.5	-	17.3	14.3	13.5	-	15.3
9 to 11	35.3	33.3	-	37.4	34.2	32.9	-	35.7
≥12 years	14.7	13.2	-	16.4	15.0	14.0	-	16.1
Poor self-rated health	7.8	6.8	-	8.9	8.3	7.6	-	9.0
Chronic disease	61.1	59.1	-	63.2	64.4	63.0	-	65.7
Total	18.7	17.9	-	19.4	21.2	20.6	-	22.0

CI 95%: Confidence Interval of 95%.

Table 2. Distribution (%) of risk and protective factors according to nutritional status of Brazilian adults. National Health Survey (NHS), 2013 (n = 40,942) and NHS, 2019 (n = 87,678).

Risk and Protective Factors	NHS 2013				NHS 2019			
	%	CI 95%			%	CI 95%		
Eutrophic (non-overweight)								
Protective factors								
Regular consumption of fruits and vegetables	30.3	29.0	-	31.7	31.0	30.1	-	32.0
Leisure-time physical activity	60.6	58.5	-	62.7	61.7	60.3	-	63.1
Active commuting	15.1	14.2	-	16.0	14.9	14.1	-	15.7
Risk factors								
Regular consumption of sweetened beverages	25.1	23.9	-	26.3	21.8	20.9	-	22.7
Regular consumption of sweets	25.9	24.7	-	27.1	16.2	15.5	-	17.0
Excessive screen time	26.3	25.1	-	27.5	20.0	19.3	-	20.8
Smoking	16.5	15.6	-	17.5	15.2	14.5	-	15.9
Alcohol abuse	14.4	13.5	-	15.4	16.7	15.9	-	17.5
Sleep disorders	13.5	12.6	-	14.3	17.0	16.3	-	17.8
Pre-obesity								
Protective factors								
Regular consumption of fruits and vegetables	33.8	32.4	-	35.2	33.1	32.2	-	34.0
Leisure-time physical activity	63.3	60.9	-	65.7	63.5	62.1	-	64.9
Active commuting	13.2	12.2	-	14.2	13.2	12.5	-	13.9
Risk factors								
Regular consumption of sweetened beverages	21.7	20.4	-	22.9	19.4	18.7	-	20.2
Regular consumption of sweets	20.9	19.7	-	22.1	14.1	13.4	-	14.8
Excessive screen time	28.6	27.3	-	29.9	21.5	20.6	-	22.3
Smoking	12.4	11.4	-	13.5	11.0	10.4	-	11.6
Alcohol abuse	15.3	14.3	-	16.3	17.4	16.7	-	18.1
Sleep disorders	14.7	13.7	-	15.7	18.5	17.8	-	19.3
Obesity								
Protective factors								
Regular consumption of fruits and vegetables	35.1	33.1	-	37.1	33.6	32.4	-	34.9
Leisure-time physical activity	58.3	54.7	-	61.9	57.3	55.1	-	59.5
Active commuting	11.9	10.6	-	13.1	12.4	11.5	-	13.3
Risk factors								
Regular consumption of sweetened beverages	25.0	23.3	-	26.8	20.3	19.3	-	21.4
Regular consumption of sweets	20.4	18.7	-	22.1	13.2	12.0	-	14.3
Excessive screen time	32.7	30.7	-	34.7	25.4	24.3	-	26.5
Smoking	10.5	9.3	-	11.8	10.4	9.6	-	11.1
Alcohol abuse	13.9	12.4	-	15.4	17.7	16.8	-	18.7
Sleep disorders	18.2	16.7	-	19.7	21.8	20.7	-	22.9

CI 95%: Confidence Interval of 95%.

A similar association pattern was observed between 2013 and 2019. In general, when compared to eutrophic (non-overweight) individuals (comparisons adjusted by sex, age, schooling, chronic disease, poor self-rated health), individuals with pre-obesity and obesity tend to present lower prevalence of active commuting and higher prevalence of excessive screen time. They also presented higher prevalence of regular consumption of fruits and vegetables and lower prevalence of regular consumption of sweets. Finally, they also presented lower prevalence of smoking (Table 3). The prevalence of leisure-time physical activity was higher among individuals with pre-obesity in comparison to eutrophic ones; an opposite scenario to that observed in the case of obesity (significant only in 2019). The prevalence of regular consumption of sweetened beverages and of fruits and vegetables

presented no clear behavior between the years and the nutritional status groups, similar to what was observed regarding the prevalence of alcohol abuse (Table 3).

Table 3. Association coefficients (crude and adjusted) obtained in Poisson regression models to investigate the association of risk and protective factors according to nutritional status of Brazilian adult. National Health Survey (NHS), 2013 (n = 40,942) and NHS, 2019 (n = 87,678).

Risk and Protective Factors	NHS 2013				NHS 2019			
	CPR	CI 95%	APR	CI95%	CPR	CI 95%	APR	CI95%
Pre-obesity								
Protective factors								
Regular consumption of fruits and vegetables	**1.11**	1.05;1.18	**1.06**	1.00;1.12	**1.07**	1.03;1.11	1.01	0.97; 1.05
Leisure-time physical activity	1.04	0.99;1.10	**1.07**	1.02;1.13	1.03	1.00;1.06	**1.04**	1.01;1.07
Active commuting	**0.88**	0.80;0.96	**0.88**	0.80;097	**0.89**	0.83;0.95	**0.91**	0.85;0.97
Risk factors								
Regular consumption of sweetened beverages	**0.86**	0.81;0.93	**0.92**	0.86;0.98	**0.89**	0.84;0.94	0.95	0.90;1.01
Regular consumption of sweets	**0.81**	0.75;0.87	**0.85**	0.79;0.91	**0.87**	0.81;0.93	**0.91**	0.85;0.98
Excessive screen time	**1.09**	1.02;1.15	**1.11**	1.04;1.18	**1.07**	1.02;1.13	**1.07**	1.01;1.13
Smoking	**0.75**	0.68;0.83	**0.69**	0.63;0.77	**0.72**	0.67;0.78	**0.70**	0.64;0.75
Alcohol abuse	1.06	0.97;1.16	1.03	0.95;1.12	1.04	0.99;1.11	1.04	0.98;1.10
Sleep disorders	1.09	0.99;1.20	0.99	0.90;1.10	**1.09**	1.30; 1.15	1.02	0.96;1.07
Obesity								
Protective factors								
Regular consumption of fruits and vegetables	**1.16**	1.08;1.24	1.06	0.99;1.13	**1.08**	1.03;1.14	1.01	0.96; 1.06
Leisure-time physical activity	0.96	0.90;1.03	0.99	0.92;1.06	**0.93**	0.89;0.97	**0.94**	0.90;0.99
Active commuting	**0.79**	0.70;0.89	**0.77**	0.68;0.88	**0.83**	0.76;0.91	**0.85**	0.78;0.92
Risk factors								
Regular consumption of sweetened beverages	1.00	0.92;1.09	**1.12**	1.03;1.23	**0.93**	0.87;1.00	1.03	0.96;1.09
Regular consumption of sweets	**0.79**	0.72;0.87	**0.84**	0.77;0.93	**0.81**	0.73;0.89	**0.86**	0.78;0.95
Excessive screen time	**1.24**	1.15;1.34	**1.24**	1.15;1.34	**1.28**	1.20;1.33	**1.24**	1.18;1.31
Smoking	**0.64**	0.56;0.73	**0.57**	0.51;0.65	**0.68**	0.63;0.74	**0.67**	0.61;0.72
Alcohol abuse	0.96	0.85;1.09	1.07	0.95;1.21	1.06	0.99;1.14	**1.15**	1.07;1.24
Sleep disorders	**1.35**	1.22;1.50	1.02	0.92;1.13	**1.28**	1.20;1.36	1.03	0.97;1.09

Reference: Eutrophic (non-overweight). CI 95%: Confidence Interval of 95%. CPR: crude prevalence ratio. APR: adjusted prevalence ratio by sex, age, schooling, chronic disease, poor self-rated health. Bold values: $p < 0.05$.

4. Discussion

Based on nationally representative health surveys carried out in 2013 and 2019, it was possible to analyze the prevalence of risk and protective factors for NCDs among Brazilian adults with pre-obesity and obesity. We identified a mixed scenario for the prevalence of these factors in this population, with some factor in more favorable conditions than that observed for eutrophic individuals and others in a more adverse one. Adults with pre-obesity and obesity were more likely to present risk factors related to sedentary behavior (prolonged screen time) and insufficient physical activity. However, lower prevalence of regular consumption of sweets and smoking was observed among these individuals. The identified risk and protective factors had a similar prevalence between 2013 and 2019.

This, in no way, represents a favorable scenario for overweight individuals in Brazil. The practice of regular physical activity is recognized as an important source of energy expenditure, being a strategy adopted for the prevention and treatment of obesity [23] and other diseases [24]. Along with the excessive screen time, a risk factor independent of total physical activity, this represents a relevant burden of risk for these individuals regarding conditions well related to obesity, such as cardiovascular diseases and metabolic diseases [24]. Furthermore, excessive time watching television is also associated with

higher consumption of unhealthy foods such as snacks and fast foods, reinforcing this poor health cycle [25,26].

We also observed that the prevalence of consumption of sweetened beverages and regular consumption of sweets were lower among individuals with pre-obesity and obesity. Although the consumption of sweetened beverages and sweets is recognized as a risk factor for excessive weight gain [27], ceasing or reducing this behavior may lead to an increase in diet quality [28]. However, one should keep in mind that the quantity of sweetened beverages and sweets consumed was not evaluated, only the weekly frequency, which might bias the evaluation of these indicators.

Alcohol abuse was more prevalent among individuals with obesity when compared to non-overweight (significant only for 2019). Among the public health concerns of this association are the facts that energy from alcohol appears to be an additive to energy from other sources (ultimately facilitating weight gain) [29] and that individuals who frequently consume alcohol are also more likely to engage in other unhealthy behaviors such as inadequate diet [30].

Our results can support the development of actions and policies to improve obesity care by identifying other key risk behaviors in this population group. The multifactorial nature of obesity makes the control and management of obesity extremely complex. The use of strategies based simultaneously in collective and individual approaches in the scope of primary care can be effective [31,32]. Following the goals established in the "Global Action Plan for prevention and control of noncommunicable diseases—2013–2020" of the World Health Organization, the BMoH updated the plan for coping with NCDs in Brazil (Strategic Action Plan for Tackling Chronic Diseases and Noncommunicable Diseases in Brazil 2021–2030), with the objective of stopping the growth of obesity in adults through intersectoral strategies and universal health care [33]. Additional strategies such as Primary Health Care (PHC) service, considered the entrance of the health system, guarantee longitudinal and multidisciplinary treatment for the individuals [32,33]. Furthermore, materials and the collective approach instruction for the management of obesity in the SUS allow for an expansion and qualification of the health professional's performance in the care of the person with obesity [33]. However, up to the conclusion of the present study, little progress has been made in such actions and all evidence suggests that obesity prevalence is still on the rise in the adult population [10].

Environments that favor physical activity and promote healthy eating are essential to prevent obesity and improve the prognosis of individuals with obesity [7]. PHC plays an important role in this sense. Education and referral programs for physical activity should be integrated into the activities of this system and in the neighborhood environments [33,34]. Initiatives aiming at the increase of parks, squares and spaces for walking and cycling also encourage lifestyles and should be considered [7,34]. As for food, the fiscal policies, in addition to marketing regulation and adequate nutritional labelling, aiming at the reduction in consumption of ultra-processed foods, should be considered for an adequate food environment [31,34,35]. Added to this is the need to direct policies to encourage the production, marketing, and access to unprocessed or minimally processed foods, such as fruits and vegetables [31].

Our study presents some limitations that must be addressed. The self-reported data about risk and protective factors may result in information bias. Such bias is especially relevant among individuals with obesity, who tend to underreport their body weight [36] and food consumption [37]. Although no studies aiming to investigate the validity of NHS indicators were conducted, similar indicators in other surveys have proven good validity and reliability [38,39].

In addition, our study is the first to investigate the prevalence of risk and protective factors for NCDs among Brazilian adults with pre-obesity and obesity. Conducting this investigation through population-based surveys is very important for the advancement of knowledge and improvements in health policies. The use of two surveys reinforces the results as coherence of associations is a good indicator of its quality. And evaluating

the change in time in relation to the prevalence of the factors studied makes it possible to understand the advances in obesity management policies and their gaps.

5. Conclusions

The present study identified the prevalence of risk and protective factors for NCDs among Brazilian adults with pre-obesity and obesity and compared it to that of non-overweight individuals. Higher prevalence of excessive screen time and alcohol abuse and lower prevalence of leisure-time physical activity, active commuting, regular consumption of sweets and smoking were observed among those with obesity. The identification of the most common risk behaviors among adults with obesity is essential for the design of more effective public policies to manage and reduce the worsening of obesity.

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