

Overweight and obesity prevalence trend in Espírito Santo, Brazil: an ecological study, 2009-2018*


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Abstract

Objective: To analyze trends in the prevalence of overweight and obesity in the state of Espírito Santo, Brazil, between 2009 and 2018. **Methods:** This was an ecological study, with data from the Food and Nutritional Surveillance System (SISVAN). Overweight and obesity were classified as recommended by the World Health Organization. Prais-Winsten regression was used to estimate the trend of the prevalence. **Results:** There was an increasing trend of overweight (5.5 to 8.6%) and obesity (4.4 to 8.3%), in both sexes and in different regions of the state. In the stratified analysis, there was an increase in overweight and obesity in children, adolescents and adult women (4.2 to 8.6%; $p < 0.05$). Obesity increased among male adolescents, in the south, central and north regions of the state, while in the south region, in all age groups (5.1% growth; $p = 0.01$). **Conclusion:** There was an increase in overweight and obesity in Espírito Santo, from 2009 to 2018.

Keywords: Obesity; Overweight; Nutritional Status; Nutritional Surveillance; Space-Time Analysis.

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Introduction

Obesity is considered a global health problem. According to the World Health Organization (WHO), overweight has nearly tripled since 1975 and, in 2016, over 340 million children and adolescents, and more than 1.9 billion adults were overweight or obese.¹

Obesity is considered a global health problem. According to the World Health Organization (WHO), overweight has nearly tripled since 1975 and, in 2016, over 340 million children and adolescents, and more than 1.9 billion adults were overweight or obese.

In 2018, 56% of the population of Brazilian state capitals were overweight and 20% obese; overweight in adult population ranged from 47% (São Luís, state of Maranhão) to 61% (Cuiabá, state of Mato Grosso).² Vitória, state capital of Espírito Santo, also presented a high prevalence, about 52% of overweight and 18% of obesity.²

Obesity is related to several chronic non-communicable diseases (NCDs), such as hypertension, diabetes *mellitus*, cancer, and cardiovascular diseases. Therefore, it has a negative impact on health and life expectancy of the population.^{3,4} Studies conducted in Brazil (2015) and the United States (2016) indicate that the costs related to obesity and associated diseases are significant and showed an increasing trend, directly reflecting on the quality of health services provided.^{5,6}

The Food and Nutrition Surveillance System (SISVAN) is one of the data sources used to estimate the prevalence of overweight and obesity in Brazil. It has a rich database, with information on the nutritional status of the population assisted in Primary Health Care, provided by the Brazilian National Health System (SUS). In addition to enabling the expansion of knowledge about the nutritional status of the Brazilian population, the information generated by SISVAN can support planning, management and evaluation of food and nutrition.⁷

Studies of historical series conducted in Brazil aimed to understand the outcome evolution over time, especially in children and women. They identified an

increase in the prevalence of overweight and obesity over time.⁸⁻¹⁰ Taking into consideration the potential contribution of these findings to specific populations, the objective of this study was to analyze trends in the prevalence of overweight and obesity in the state of Espírito Santo, between 2009 and 2018.

Methods

This was an ecological study with temporal trend analysis of overweight and obesity prevalence in the population of the state of Espírito Santo, between 2009 and 2018.

The study was conducted with data from the SISVAN Web, a tool that gathers data on the Food and Nutrition Surveillance (VAN) of individuals assisted in Primary Health Care, provided by the SUS, such as anthropometric and food consumption information.⁷

In 2020, Espírito Santo had an estimated population of 4,064,052 inhabitants. The metropolitan region of Vitória, its capital, was the most populous with 2,277,458 inhabitants; the north region of the state had 434,485, the central region 669,534 and the south region 682,396 inhabitants. The nominal monthly household income *per capita* in the state is BRL 1,477.00 and the Basic Education Development Index at the beginning of high school in public schools is 5.7.¹¹ In 2009, Espírito Santo had 649 primary healthcare centers (PHC) registered with the National Registry of Health Establishments (CNES) (Department of Primary Care/Ministry of Health [DAB/MS]: December/2009 (reference); in 2018, there were 715 PHCs in Espírito Santos registered with CNES (DAB/MS): December/2018 (reference).

The nutritional status of individuals recorded and grouped by the state of Espírito Santo between 2009 and 2018, was analyzed through SISVAN-Web, Family Income Transfer Program Management System and/or e-SUS Primary Care. All information on coverage regions such as, sex, stages of life (except for pregnant women), race/skin color, people and communities, and schooling was considered.¹²

Classification of nutritional status was performed according to WHO recommendations. For adults and the elderly, the body mass index (BMI) was used, and for children (<10 years old) and adolescents (10-19 years old), BMI-for-age. BMI was obtained by calculating weight (kg)/height (m), whose data were

measured by health service teams during the actions carried out by the VAN.^{2,13}

The cutoff points for each age group, used to determine overweight or obesity,¹⁴ were established as recommended by the WHO:

- a) Children up to 5 years old
 - Overweight: > z-score +2 and ≤ z-score +3
 - Obesity: > z-score +3
- b) Children from 5 to 10 years old
 - Overweight: > z-score +1 and ≤ z-score +2
 - Obesity: > z-score +2 and ≤ z-score +3; severe obesity > z-score +3
- c) Adolescents - 10 to 19 years old
 - Overweight: ≥ z-score +1 and < z-score +2
 - Obesity: ≥ z-score +2 and ≤ z-score +3; severe obesity > z-score +3
- d) Adults - 20 to 59 years old
 - Overweight: BMI between 25 and 29.9kg/m²
 - Obesity: BMI ≥ 30kg/m²
- e) The elderly - 60 years of age or older
 - Overweight: IBM ≥ 27kg/m²

The outcomes evaluated were overweight and obesity prevalence. The operationalization of outcomes was based on total values (grouped data) of overweight and obese individuals. These values were subsequently used to calculate prevalence (number of cases/number of people recorded x 100). The independent variables used were: phases of life, divided into four age categories (in years: 0 to 9; 10 to 19; 20 to 59; 60 or older) and in a total sample; gender (male; female); regions of Espírito Santo state (north; central; metropolitan; south); and time variables (by year, in the period from 2009 to 2018).

In trend analysis, logarithmic transformation of the values of time series was performed to measure the line variation rate that adjusts the points of the time series, in addition to reducing the heterogeneity of residual variance of linear regression analysis.¹⁵

To identify the existence of autocorrelation between residuals in a time series at two successive points in time (first-order autocorrelation), the Durbin-Watson test was used. Generalized linear regression was performed to infer the rate of change, using the Prais-Winsten regression, in which random errors include a first-order serial autocorrelation structure. From this, the annual percentage change (APC) was calculated to estimate quantitative trend and

determine the 95% confidence interval (95%CI), using the following equations, respectively:

$$APC = [-1 + 10b_1] * 100\%$$

$$95\%IC = [-1 + 10(b_1 \pm t * SE)] * 100\%$$

where: b_1 is the beta coefficient; t is the tabulated value of the Student's t-distribution; SE is the standard error.¹⁵

The rate of positive APC shows an increasing trend; negative APC, a decreasing trend; and stationary, when there is no statistical difference.¹⁵

The analyses were stratified by sex, state region and age; and the total sample, by sex and region. Statistical significance level was considered when p-value < 0.05. Data tabulation, descriptive analysis and prevalence rate calculation were performed using Microsoft Office Excel 2016[®]; and for trend analysis the Statistical Package for the Social Sciences (SPSS) version 20.0 was used.

The study project was approved by the Human Research Ethics Committee of the University of Vila Velha (CEP/UVV): Opinion No. 3,730,617, issued on November 27, 2019; Certificate of Submission for Ethical Appraisal (CAAE) No. 21450719.0.3001.5064.

Results

A lower number of men was found on the SISVAN (between 26.2 and 31.0%) and those aged 60 years or older (between 1.0 and 5.0%). Most people recorded on the system, from 2009 to 2018, were female. The age group with the highest proportional participation was that aged 10 to 19 years (Table 1), when compared to other groups.

In 2018, 12.5% of the population had information on the system. Similar results were found by health region, with the highest quantity on the north region system (18.9%) and the lowest quantitative in the metropolitan region (10.1%) (data not shown in table). At the same time, in the north region, Primary Health Care coverage reached about 91.0%; and in the metropolitan region, 56.8% (data not shown in table). However, more than half of the population was concentrated in the metropolitan region, 55.9% (data not shown in table).

There was an increase in the occurrence of obesity and overweight in both sexes and in all regions of

Table 1 – Characteristics of people registered in the Food and Nutrition Surveillance System, in the state of Espírito Santo, Brazil, 2009-2018

Variable	2009-2010	2011-2012	2013-2014	2015-2016	2017-2018
Sex					
Female	228,580 (69.0)	271,154 (71.7)	340,227 (73.8)	350,494 (72.6)	335,298 (72.8)
Male	102,653 (31.0)	106,793 (28.3)	120,746 (26.2)	132,517 (27.4)	125,463 (27.2)
Region					
North	51,270 (15.5)	68,352 (18.1)	83,240 (18.0)	85,829 (17.8)	76,469 (16.6)
Central	77,631 (23.4)	78,272 (20.7)	91,585 (19.9)	90,798 (18.8)	76,433 (16.6)
Metropolitan	124,444 (37.6)	137,895 (36.5)	181,633 (39.4)	195,415 (40.4)	206,218 (44.7)
South	77,888 (23.5)	93,427 (24.7)	104,514 (22.7)	110,970 (23.0)	101,642 (22.1)
Age (years)					
0-9	92,814 (28.0)	103,250 (27.4)	123,709 (26.8)	120,599 (25.0)	115,118 (25.0)
10-19	131,058 (39.6)	150,123 (39.7)	186,908 (40.5)	182,320 (37.7)	171,073 (37.2)
20-59	103,637 (31.3)	120,335 (31.8)	145,924 (31.7)	159,528 (33.0)	151,173 (32.8)
≥60	3,723 (1.1)	4,238 (1.1)	4,431 (1.0)	20,565 (4.3)	23,397 (5.0)

Note: Values are average numbers of people registered in the Food and Nutrition Surveillance System (SISVAN).

Espírito Santo (Figure 1). The highest increase in the prevalence of obesity occurred in females, with rates ranging from 6.7% in the southern region to 7.6% in the central region. Regarding the prevalence of overweight, there was a 5.8% increase among women in the south region in the last decade.

It could be seen a statistically significant increasing trend of overweight (Table 2) and obesity (Table 3) in both sexes and in all regions of the state, in the period. Among female children and adolescents, there was a general increasing trend of overweight (Table 2) in all regions, with 8% APC (95%CI 7.3;8.7) in children up to 9 years of age in the south region. In male adolescents, there was an increasing trend with statistical difference in those living in the north, metropolitan and southern regions. It has been noted an increasing trend of overweight among adult men (20 to 59 years old) from the north and south regions and adult women (20 to 59 years old) from all regions of the state, with emphasis on a 7.3% APC (95%CI 7.2;7.4) in those living in the metropolitan region.

When analyzing obesity trend (Table 3), it could be seen an increasing trend in females of all age groups and from all the regions of the state, in the period analyzed (APC>5.5%). In males, the south region with an increasing trend of obesity in all age groups stands out; in adolescent men (10 to 19 years old), especially,

a significant increase was found in the north, central and southern regions. In the metropolitan region of Vitória, although there was a stationary trend in male obesity, regardless of age group, in the verification of the total sample, an increasing trend of obesity was also found: 4% APC – 95%CI 4.2;4.7.

Discussion

This study showed an increasing trend of overweight and obesity between 2008 and 2018 in all regions of the state of Espírito Santo. A study conducted in 2016 described the trend of indicators with impact on the occurrence of NCDs, in Brazilian adult population, using data from the Surveillance System of Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel) (2006-2011), and showed that, in Vitória, the prevalence of overweight was 46.7%, in 2011, requiring a reduction of approximately 0.3% per year in order to reach stabilization goals by 2022. The same study showed that the prevalence of obesity was 14.5%, therefore a reduction of 0.1% per year to reach the recommended stabilization goal, is required.⁸ According to this study, in 2011, the prevalence of obesity was 14 to 15% for women, and 13 to 16% for men, considering all regions of the state.

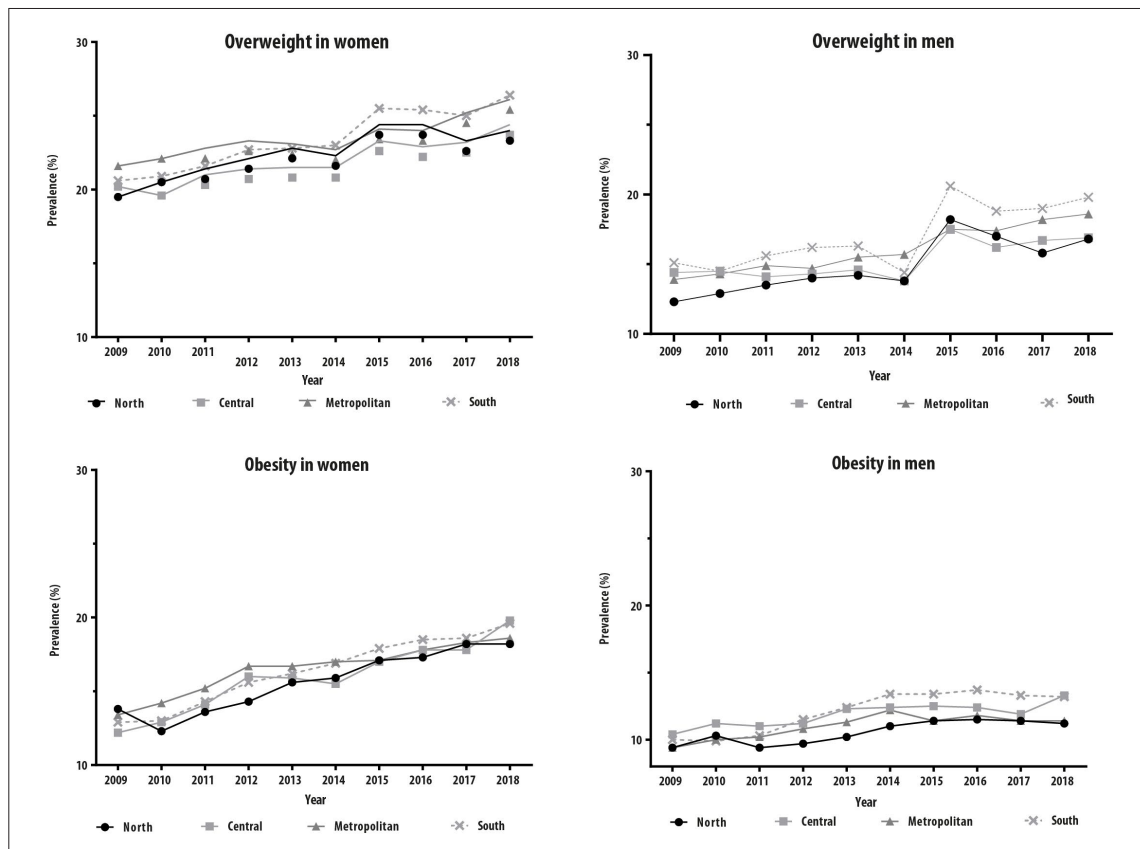


Figure 1 – Historical series of the prevalence of overweight and obesity among regions, for sex, in the state of Espírito Santo, Brazil, 2009-2018

It is important to point out, as a limitation of the study, the relatively low coverage of SISVAN in Espírito Santo, in addition to the fact that its data are often related to individuals benefited from the Family Income Transfer Program – food-insecure households. Although the Family Income Transfer Program provides financial support for the acquisition of food, this does not imply a better quality of the diet,¹⁶ therefore the analysis of the results should be carried out sparingly, and may present underestimated data, most of them predominantly from a population subgroup whose sample is not representative of the general population. Moreover, it is not possible to attest the quality of the collected information because it is based on secondary data, which could lead to information bias and measurement of cases of overweight and obesity in the sample. The effects of bias resulting from the evaluation of weight and height measurements, as well as the insertion of data into a system (when there is a typo), are inherent to the routine of health units

and information systems in general; nevertheless, they may have consequences on the proper classification of nutritional status and quality of records. Thus, studies on the nutritional status of the population can help the municipalities reflect about this situation and provide permanent education actions, aiming to improve the standardization and quality of data collection.

However, SISVAN is a tool that provides data on the nutritional status of populations, enabling observations over time, given the continuous generation of information about primary health care users. However, the results of this study reflect only the reality of the state of Espírito Santo and should not be extrapolated to other locations in the country.

An increasing trend of overweight and obesity was found in female adolescents from all regions of the state, and in male adolescents from at least three regions. A similar trend was observed in a study with children and adolescents (7 to 14 years old) taking part in the Brazil Sport Project (PROESP-Br).

Table 2 – Trend and annual percentage change of overweight by gender, according to region and age, in the state of Espírito Santo, Brazil, 2009-2018

Variable	APC ^a	95%IC ^b	p-value ^c	Trend
Male				
North region				
0-9 years old	2.4	2.3; 2.5	0.139	Stationary
10-19 years old	4.3	4.1; 4.5	0.028	Increasing
20-59 years old	4.4	4.2; 4.7	0.024	Increasing
≥60 years old	-0.1	-0.1; -0.1	0.881	Stationary
Total	6.6	6.0; 7.3	0.002	Increasing
Central region				
0-9 years old	2.2	2.2; 2.3	0.164	Stationary
10-19 years old	1.1	1.1; 1.1	0.910	Stationary
20-59 years old	1.2	1.2; 1.3	0.361	Stationary
≥60 years old	0.7	0.6; 0.8	0.539	Stationary
Total	5.5	5.2; 5.9	0.007	Increasing
Metropolitan region				
0-9 years old	3.4	3.2; 3.5	0.062	Stationary
10-19 years old	5.8	5.6; 6.1	0.005	Increasing
20-59 years old	2.6	2.6; 2.7	0.115	Stationary
≥60 years old	4.3	4.1; 4.6	0.026	Increasing
Total	8.6	7.7; 9.5	<0.001	Increasing
South region				
0-9 years old	2.5	2.4; 2.7	0.126	Stationary
10-19 years old	6.3	6.0; 6.5	0.003	Increasing
20-59 years old	6.5	6.2; 6.8	0.002	Increasing
≥60 years old	1.1	1.1; 1.1	0.384	Stationary
Total	7.4	6.7; 8.1	<0.001	Increasing
Female				
North region				
0-9 years old	7.3	6.8; 8.0	<0.001	Increasing
10-19 years old	6.1	5.8; 6.5	0.03	Increasing
20-59 years old	4.2	4.0; 4.4	0.03	Increasing
≥60 years old	3.9	3.7; 4.2	0.038	Increasing
Total	6.7	6.3; 7.1	0.001	Increasing
Central region				
0-9 years old	7.3	6.8; 7.8	<0.001	Increasing
10-19 years old	7.7	7.3; 8.2	<0.001	Increasing
20-59 years old	6.5	6.3; 6.7	0.002	Increasing
≥60 years old	3.2	3.0; 3.4	0.074	Stationary
Total	8.6	8.0; 9.2	<0.001	Increasing

To be continue

Continuation

Table 2 – Trend and annual percentage change of overweight by gender, according to region and age, in the state of Espírito Santo, Brazil, 2009-2018

Variable	APC ^a	95%IC ^b	p-value ^c	Trend
Metropolitan region				
0-9 years old	7.0	6.4; 7.6	0.001	Increasing
10-19 years old	6.5	6.1; 6.9	0.002	Increasing
20-59 years old	7.3	7.2; 7.4	<0.001	Increasing
≥60 years old	0.5	0.5; 0.5	0.630	Stationary
Total	7.4	7.0; 7.8	<0.001	Increasing
South region				
0-9 years old	8.0	7.3; 8.7	<0.001	Increasing
10-19 years old	7.0	6.6; 7.5	0.001	Increasing
20-59 years old	5.5	5.4; 5.7	0.007	Increasing
≥60 years old	1.3	1.3; 1.4	0.327	Stationary
Total	8.5	8.0; 9.0	<0.001	Increasing

a) APC: annual percentage change; b) 95%CI: 95% confidence interval; c) Linear regression - Prais-Winsten regression.

Table 3 – Trend and annual percentage change of obesity by gender, according to the region and age, in the state of Espírito Santo, Brazil, 2009-2018

Variable	APC ^a	95%IC ^b	p-value ^c	Trend
Male				
North region				
0-9 years old	4.3	4.1; 4.5	0.027	Increasing
10-19 years old	7.3	6.8; 7.7	0.001	Increasing
20-59 years old	-0.2	-0.2; -0.2	0.818	Stationary
Total	5.9	5.6; 6.4	0.004	Increasing
Central region				
0-9 years old	2.7	2.6; 2.9	0.106	Stationary
10-19 years old	7.2	6.9; 7.6	0.001	Increasing
20-59 years old	4.2	3.7; 4.8	0.03	Increasing
Total	6.5	6.2; 6.9	0.002	Increasing
Metropolitan region				
0-9 years old	1.9	1.8; 2.0	0.206	Stationary
10-19 years old	3.5	3.3; 3.7	0.057	Stationary
20-59 years old	0.3	0.3; 0.4	0.741	Stationary
Total	4.4	4.2; 4.7	0.023	Increasing
South region				
0-9 years old	4.1	3.7; 4.5	0.033	Increasing
10-19 years old	4.9	4.4; 5.3	0.016	Increasing
20-59 years old	7.0	5.7; 8.6	0.001	Increasing
Total	5.1	4.6; 5.6	0.012	Increasing

To be continue

Continuation

Table 3 – Trend and annual percentage change of obesity by gender, according to the region and age, in the state of Espírito Santo, Brazil, 2009-2018

Variable	APC ^a	95%IC ^b	p-value ^c	Trend
Female				
North region				
0-9 years old	7.6	6.8; 8.5	<0.001	Increasing
10-19 years old	8.5	7.7; 9.4	<0.001	Increasing
20-59 years old	8.2	6.9; 9.0	<0.001	Increasing
Total	8.3	7.5; 9.3	<0.001	Increasing
Central region				
0-9 years old	5,8	5,2; 6,5	0,005	Increasing
10-19 years old	7,0	6,4; 7,6	0,001	Increasing
20-59 years old	8,6	7,4; 10,0	<0,001	Increasing
Total	8,0	7,0; 9,1	<0,001	Increasing
Metropolitan region				
0-9 years old	5.5	5.0; 6.0	0.008	Increasing
10-19 years old	6.7	6.0; 7.5	0.001	Increasing
20-59 years old	8.4	7.5; 9.4	<0.001	Increasing
Total	7.3	6.6; 8.1	<0.001	Increasing
South region				
0-9 years old	7.2	6.4; 8.2	0.001	Increasing
10-19 years old	7.0	6.1; 8.0	0.001	Increasing
20-59 years old	8.5	7.5; 9.6	<0.001	Increasing
Total	8.3	7.3; 9.5	<0.001	Increasing

a) APC: annual percentage change; b) 95%CI: 95% confidence interval; c) Linear regression - Prais-Winsten regression.

In this study, the increase in the percentage of obesity, during a period of only two years, was 2.7% in male children (7 to 10 years old) and 3% in girls.¹⁷ A study conducted in 2016, using data from the Study of Cardiovascular Risk in Adolescents (12 to 17 years old), showed that the prevalence of obesity was 8.6% (95%CI 7.8;9.5) in the South region of Brazil, and approximately 10% in Vitória.¹⁸

A study conducted in 2016, with adults in the 26 Brazilian state capitals and the Federal District, between 2006 and 2013, showed that the increase in the prevalence of overweight was 7.4%, and the increase in the prevalence of obesity – classes I, II and III – was 47.1% and, specifically, class III obesity, was 36.4%. The authors also observed increased obesity in both sexes, in all regions of the country and age groups (≥18 years old).¹⁹ These data corroborate those of the present

study about Espírito Santo, where in adults (19 to 59 years old), there was an upward trend, in the historical series, of overweight and obesity: in women, the upward trend of overweight and obesity was observed in all regions of the state, while in men, there was an increasing trend of overweight in the north and south regions, and obesity in the central and south regions.

A study conducted with elderly people in the city of Vitória, aiming at describing the nutritional profile of these individuals and also based on data from SISVAN-Web, showed a high prevalence of overweight (69.2%) in 2012, and an increase in overweight prevalence (15.6%) between 2009 and 2012.²⁰ This study identified an increase in the trend of overweight in individuals aged 60 years or older, although, in the metropolitan region, only in males, and in the north region of the state, in females.

Vigitel data, released in 2020, showed that the prevalence of overweight was 49.1% ($BMI \geq 25 \text{ kg/m}^2$) among adults (≥ 18 years) from Vitória, 50.6% in men and 47.8% in women; and the prevalence of obesity was 17.6% ($BMI \geq 30 \text{ kg/m}^2$) among adults, with the age group 45-54 accounting for the highest percentage (24.5%).²¹

Studies have shown that the advance in the prevalence of overweight and obesity in the Brazilian population, in both sexes and all age groups, in different territories, has had a negative impact on the health of a large proportion of society.^{2,7,18-22} This scenario is confirmed by recent data from the Ministry of Health: the prevalence of obesity in the country was 28.5%, affecting approximately 4 million people in 2019.²³

Obesity has a multifactorial character and has, as main determinants for its occurrence, inadequate food intake and physical inactivity.²⁴ Data from the National Health Survey (PNS) 2019, showed that only 13% of Brazilian adults (≥ 18 years old) consumed the recommended amount of fruit and vegetable. When analyzing the consumption of ultra-processed foods, it could be seen that 14.3% of adults reported the consumption of five or more of this food group on the day before the interview.²⁵ In 2020, the Household Budget Survey (POF), conducted by the Brazilian Institute of Geography and Statistics (IBGE), released estimates of energy intake and macronutrients, between 2008-2009 and 2017-2018 surveys, which provided conclusive evidence of a reduction of dietary fiber intake and a higher average daily consumption of added sugar, in both sexes and in all age groups analyzed (10 to 18, 19 to 59 and 60 years of age or older), indicative of a worsening in the quality of food consumed by Brazilian population.²⁶ A cross-sectional study conducted with civil servants from Brazilian institutions, aged between 35 and 74 years, showed that the high consumption of ultra-processed foods

has contributed to the increase in obesity.²⁷ Regarding physical activity, the 2019 PNS showed that only 30.1% of adults practiced the recommended level of physical activity in their free time, that is, 150 minutes per week of moderate-intensity aerobic activity, or 75 minutes of vigorous aerobic activity.²⁵

Taking these results, it can be concluded that there was an increase in the prevalence of overweight and obesity between 2009 and 2018, in both sexes and in all regions of the state of Espírito Santo, especially among adolescents and adults. The findings point to the need to develop intersectoral strategies aiming to control obesity in the population of Espírito Santo, by promoting food and nutritional education at primary health care centers and collective spaces, establishing partnerships with existing programs, supporting the participation of a multidisciplinary team, actions to encourage self-care, in addition to broadening the discussion on the subject, aiming to reverse this trend and mitigate damage to the health of the population due to these problems.

Authors' contribution

Aprelini CMO and Martinez OGE collaborated with the conception and design of the study, data analysis and interpretation, and drafting of the manuscript. Reis EC collaborated with the conception and design of the study, data interpretation, drafting and critical reviewing of the manuscript intellectual content. Jesus TR collaborated with data processing and analysis and drafting of preliminary versions of the manuscript. Molina MCB collaborated with the conception and design of the study, data interpretation and critical reviewing of the manuscript intellectual content. All authors have approved the final version of the manuscript and have declared themselves to be responsible for all aspects of the work, including ensuring its accuracy and integrity.

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