

Correspondence between overweight and socioeconomic and demographic indicators in the adult Brazilian population

Correspondência entre excesso de peso e indicadores socioeconômicos e demográficos na população adulta brasileira

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ABSTRACT: *Objective:* To verify the correlation between overweight and socioeconomic and demographic indicators among Brazilian adults, using data from the Brazilian Household Budget Survey from 2008/2009. *Methods:* We analyzed the joint relationships between overweight and socioeconomic and demographic indicators in the Brazilian adult population (99,532,672 individuals), through the multiple correspondence analysis technique. *Results:* The featured profile of the Brazilian adult population with regard to overweight was correlated with ages from 30 years of the most developed and economically social geographic regions of Brazil; however between genders, the correlation was in the opposite direction in the variables income, education, and subjective issues about life conditions related to food and nutrition security. *Conclusion:* By the joint relationship between overweight and selected demographic and socioeconomic indicators, the urgency of the development of strategies and/or preventive public health programs of health problems with overweight in the Brazilian adult population is suggested.

Keywords: Adult. Cross-sectional studies. Epidemiology. Overweight. Socioeconomic factors. Food security.

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RESUMO: *Objetivo:* Verificar a correspondência entre excesso de peso e indicadores socioeconômicos e demográficos em adultos no Brasil, por meio dos dados da Pesquisa de Orçamentos Familiares do período de 2008/2009. *Métodos:* Foram investigadas as relações conjuntas entre excesso de peso e indicadores socioeconômicos e demográficos na população adulta brasileira (99.532.672 indivíduos), por meio da técnica de análise de correspondência múltipla. *Resultados:* O perfil caracterizado da população adulta brasileira no que se refere ao excesso de peso foi correlacionado com idades a partir de 30 anos, das regiões geográficas mais desenvolvidas social e economicamente do Brasil, mas entre os sexos a correlação foi em direção oposta nas variáveis renda, escolaridade e das questões subjetivas sobre as condições de vida referentes à segurança alimentar e nutricional. *Conclusão:* Por meio das relações conjuntas entre excesso de peso e indicadores socioeconômicos e demográficos selecionadas, sugere-se a urgência do desenvolvimento de estratégias e/ou programas preventivos de saúde pública dos agravos à saúde ao excesso de peso à população de adultos brasileiros.

Palavras-chave: Adulto. Estudos transversais. Epidemiologia. Sobrepeso. Fatores socioeconômicos. Segurança alimentar e nutricional.

INTRODUCTION

The recente behavioral changes that took place in many societies around the world, especially regarding dietary patterns and physical activities, have been a significant contribution to the increasing rates of overweight¹, which now affects 30% of the adults², with 5 million estimated deaths a year until 2020³. Population-based surveys ratify the epidemic progress of overweight rates in the world and in Brazil, in the adult population⁴⁻⁷. Other studies show the association between socioeconomic and demographic indicators and the reported outcome^{7,8-10}. However, most studies analyzing the prevalence of overweight rates and associated factors used association analyses, by simple and multiple linear regressions¹⁰, as well as logistic and Poisson regressions⁷⁻⁹.

In this context, few studies used the correspondence analysis. Even though this methodology is considered to be a descriptive and exploratory technique, which simplifies complex data and produces exhaustive analyses of information that supports conclusions about it¹¹, in this case it allows identifying how the variables are related and which the profile and cluster of specific variables are. Besides, the graphic illustration of the correspondence analysis enables the understanding of inter-related factors addressed to health administrators, who have little contact with the complex regression analyses.

Therefore, this study aimed at verifying the correspondence between overweight and socioeconomic and demographic indicators among adults aged from 20 to 59 years old,

of both genders in Brazil, by a global analysis with sampling design structured to provide results with external validity.

METHODS

This study was based on secondary and public domain data, coming from the Household Budget Survey (POF) from 2008/2009¹². Data regarding the sampling procedure of the survey were previously described at a specific publication¹². However, shortly, it is informed that the effective size of the sample in POF 2008/2009 was of 4,696 sectors, corresponding to 55,970 interviewed households. The number of interviewed households per sector was established according to the research area as 12 households in the urban sectors and 16 in rural ones¹².

In this investigation, a population of adults aged 20 to 59 years old was selected, of both genders, in the five regions of the Brazilian national territory. Individuals with incomplete data, pregnant women and infants were excluded from the analysis, comprising 99,532,672 individuals. Collections and records of the information were performed directly in each of the selected households, with the residents, by assisted interview recurring to the memory of the informer, for a period of nine consecutive days.

Overweight was verified by the body mass index [BMI = body mass (kg)/height (m²)] and classified as ≥ 25.00 kg/m²¹³. Body mass and height were measured in a portable electronic balance for adults (brand not specified by the Brazilian Institute of Geography and Statistics – IBGE), with minimum sensitivity of 100 g, maximum capacity of 150 kg and portable stadiometer for adults, by KaWe PERSON-CHECK® (KaWe, Germany), accuracy of 0.1 cm and extension of up to 200 cm, respectively, according to the recommendations in the Manual of the Research Agent¹².

The demographic and socioeconomic information of this study, extracted from the questionnaires of POF 2008/2009 (POF 1; POF 5 and POF 6)¹², were: age group (20 to 29; 30 to 39; 40 to 49 and 50 to 59 years old); sex (male and female); color/ethnicity (white and nonwhite); major regions (North, Northeast, Southeast, South and Center-West); schooling (0 to 5; 6 to 9; 10 to 12 and ≥ 13 schooling years); income ($1/2 \leq MW$; $1/2 > MW < 2$; $\geq 2 MW$) referring to the federal minimum wage (MW) that was current at the time of POF 2008/2009 (R\$ 415.00) and life conditions (amount of consumed food: it is usually not sufficient; sometimes it is not sufficient; it is always sufficient; type of consumed food: always the wanted type; not always the wanted type; rarely the wanted type).

The bivariate description of socioeconomic and demographic indicators in the studied population was conducted according to BMI ≥ 25.00 kg/m², and proportions were compared by the χ^2 test, considering a 5% significance level. The analysis of joint relationships between socioeconomic and demographic indicators and BMI ≥ 25.00 kg/m²

was conducted by the multiple correspondence analysis (MCA), which is a multivariate analysis to explore categorical data, similar to the analysis, but mainly used for the graphic verification of the relationships between variable categories. In this methodology, the studied variable categories are visually represented by perceptual maps, and their correspondence is assessed according to the proximity of these categories (the closer they are, the higher the chances of being associated)¹¹. This study also used the symmetric normalization method, applied to know the differences or similarities between the two variables¹⁴.

The MCA becomes an extension of the correspondence analysis, thus enabling to study the relationship of more than two nominal variables, representing them in a few dimensions, usually two or three. In this study, two dimensions were chosen by the principle of parsimony, since they explained most of the variance in each analysis¹¹. MCA transforms qualitative data by associating optimal quantities to them (scores), which allow not only their graphic representation, but also the separation between categories. The measures of discrimination inform about the variables that mostly contribute with the definition of each one of the dimensions, being the most relevant ones in terms of graphic interpretation. However, theory can lead variables with poor discriminatory power to be interpreted in a specific dimension, and it is also possible to consider another variable in a different dimension in comparison to the more discriminatory one. Therefore, variables which not only contribute more to the expected dimension, but that are also simultaneously away from the origin in the graph¹⁴, are privileged.

The MCA does not define a selection procedure for the variables to compose the final model of the multivariate analysis, such as the automatic selection procedures for multiple regression models. Selection is often conducted based on the subjectivity of the researcher, and also on the theoretical knowledge about the analyzed subject¹⁴. Therefore, the idea was to identify a combination of variables and categories presenting more stability when represented in the multidimensional space (graph of factors), explaining the higher percentage of variability in the set of data. The closer two variables would be in the graph, the more common would be its joint occurrence. The graph representing two dimensions generates four quadrants. Both dimensions, together, separate the characteristics placed in the upper left quadrant from those in the lower right quadrant, and the ones in the upper right quadrant from those in the lower left quadrant, thus characterizing groups with extremely opposite profiles. The method does not establish the statistical significance of the associations nor assesses the independent effect of each characteristic; however, it combines the advantages of non-linear and multidimensional methods¹¹.

The study was approved by the Research Ethics Committee of the Public Health National School, at Fundação Oswaldo Cruz, protocol n. 13/2013. Data were processed and analyzed, stratified by gender with the statistical software *Statistical Package for the Social Sciences* (SPSS), version 20.0^{TM15}.

RESULTS

The distribution of socioeconomic and demographic conditions of individuals for both analyzed genders according to $BMI \geq 25.00 \text{ kg/m}^2$ is presented in Table 1.

By the MCA, the two first dimensions with self-values higher than 1.3 and 1.4, explaining 48.4 and 48.5% of the variance, were used, being: 31.5 and 30.3% in the first and 16.8 and 18.1% in the second dimension, for male and female genders, respectively. The dimension values were stored for subsequent analyses. The choice of two dimensions was provided by the principle of parsimony, since they explained most of the variance in each analysis. The analyses showed there was a higher percentage in the contribution in each variable and in the composition of the first dimension, more influence regarding income, schooling, color/ethnicity and life conditions for both genders. In the second dimension, influence was more related to age, schooling (for both genders) and BMI (only for female participants).

To build the odels, the measures of discrimination of the variables were used (Table 2). Therefore, the models only had the variables whose measures of discrimination were close to or higher than the values of inertia of the dimension. These refer to the variance explained by the dimension; therefore, there is 0.315 and 0.303 of inertia in the first and 0.168 and 0.181 of inertia in the second dimension, for male and female genders, respectively.

The quantification of variable categories in the dimensions of the models occurred by the values of their centroid coordinates (Table 2), which allow the construction of typologies organized by dimension and positive (signals) and negative loads of the centroid coordinates of each category.

The correlations between variable categories and the formation of clusters can be assessed by analyzing the proximity between points, as presented in Figures 1 and 2, or by the pattern of relationships between these characteristics. Overweight, being the object of this study, located in the upper right quadrant, in both genders, influences the lower right quadrant, for men, and the upper left, for women. In the end, it provided a description with a general profile for individuals aged 30 years old or more, with self-declared white color, from the most socially and economically developed regions of the country. However, between genders, the correlation was in the opposite direction for the variables income, schooling and subjective issues of life conditions regarding food and nutritional safety (SAN).

DISCUSSION

This study aimed at correlating the socioeconomic and demographic characteristics and overweight rates, in a population-based sample, referring to Brazilian adults aged 30 to 59 years old, by using data from POF 2008/2009, considering that these may have favored

Table 1. Frequency (%) of overweight (body mass index ≥ 25.00) according to socioeconomic and demographic characteristics in adults, by sex, Brazil (2008 to 2009).

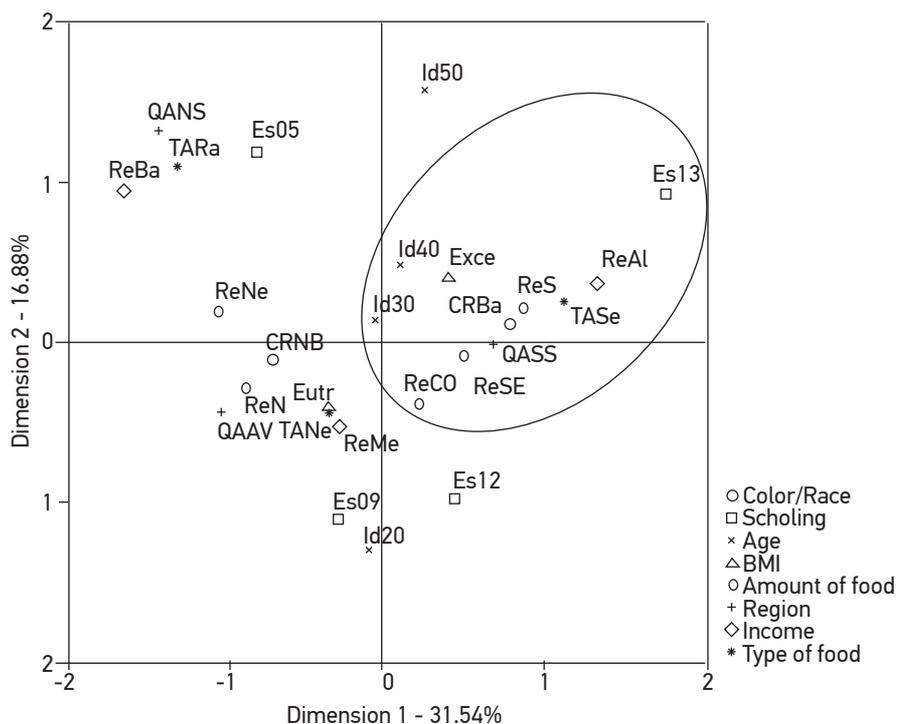
Variables*	Sex			
	Male		Female	
	n	%	n	%
Age				
20 to 29 years old	5,751,012	36.3	4,333,888	28.9
30 to 39 years old	6,935,217	54.1	6,228,876	45.0
40 to 49 years old	6,517,687	56.9	7,023,425	54.7
50 to 59 years old	4,975,331	59.2	5,749,315	61.4
Income				
$\leq 1/2$ MW	2,848,931	35.3	3,824,633	44.0
$1/2 > MW < 2$	11,910,202	48.0	12,462,016	47.4
≥ 2 MW	9,420,113	60.2	7,048,854	43.9
Schooling				
0 to 5 years	7,975,184	46.6	9,125,910	54.5
6 to 9 years	4,390,420	47.5	4,133,005	46.5
10 to 12 years	8,485,515	52.0	7,347,130	40.9
≥ 13 years	3,328,128	57.3	2,729,459	36.9
Color/ethnicity				
White	12,830,730	54.9	11,535,971	45.3
Nonwhite	11,348,516	45.1	11,799,532	46.2
Region				
North	1,751,036	47.6	1,646,005	45.3
Northeast	5,530,203	42.7	6,043,682	44.1
Southeast	10,999,303	52.3	10,300,284	46.0
South	4,068,768	56.2	3,650,980	48.7
Center-West	1,829,937	50.8	1,694,552	44.3
Amount of consumed food				
Usually not sufficient	1,769,752	38.9	2,202,225	46.1
Sometimes not sufficient	5,986,079	44.8	6,574,419	46.7
Always sufficient	16,423,416	53.7	14,558,860	45.3
Type of consumed food				
Always the wanted kind	9,209,284	56.3	7,642,011	45.1
Not always the wanted kind	12,354,274	48.0	12,477,381	45.6
Rarely the wanted kind	2,615,689	40.8	3,216,111	48.0

*all of them were significant with $p < 0.001$. MW: federal minimum wage at the time of the date of 2008/2009 HBS (BRL 415.00).

Table 2. Measures of discrimination of variables and quantification of categories, centroid coordinates, in the dimensions (1 and 2) of the model, for adults, by sex, Brazil (2008 to 2009).

Variables	Sex							
	Male				Female			
	MD		CC		MD		CC	
	Dimensions							
	1	2	1	2	1	2	1	2
Age	0.009	0.433			0.003	0.597		
20 to 29 years old			-0.120	-1.305			0.015	-1.568
30 to 39 years old			-0.070	0.139			0.100	-0.122
40 to 49 years old			0.079	0.483			-0.033	0.704
50 to 59 years old			0.226	1.589			-0.127	1.730
Income	0.594	0.141			0.601	0.011		
≤ 1/2 MW			-1.653	0.961			1.695	0.072
1/2 > MW < 2			-0.293	-0.539			0.258	-0.151
≥ 2 MW			1.317	0.360			1.341	0.209
Schooling	0.381	0.479			0.378	0.393		
0 to 5 years			-0.817	1.203			0.812	1.294
6 to 9 years			-0.316	-1.106			0.470	-1.646
10 to 12 years			0.414	-0.969			-0.306	-0.919
≥ 13 years			1.749	0.938			-1.658	0.082
Color/ethnicity	0.304	0.005			0.299	0.014		
White			0.764	0.112			-0.737	0.183
Nonwhite			-0.710	-0.104			0.736	-0.183
Region	0.317	0.017			0.284	0.047		
North			0.886	-0.285			0.872	-0.734
Northeast			-1.053	0.218			1.000	-0.191
Southeast			0.478	-0.092			-0.450	0.101
South			0.848	0.214			-0.837	0.577
Center-West			0.191	-0.384			-0.141	-0.340
Amount of consumed food	0.434	0.089			0.438	0.033		
Usually not sufficient			-1.427	1.327			1.508	0.715
Sometimes not sufficient			-1.045	-0.436			1.032	-0.318
Always sufficient			0.668	-0.007			-0.676	0.033
Type of consumed food	0.405	0.118			0.423	0.035		
Always the wanted kind			1.107	0.261			-1.145	0.118
Not always the wanted kind			-0.373	-0.441			0.362	-0.225
Rarely the wanted kind			-1.329	1.101			1.414	0.621
Body mass index	0.079	0.069			0.003	0.323		
Eutrophic			-0.373	-0.409			-0.072	-0.799
Overweight			0.375	0.411			0.085	0.948

MW: federal minimum wage. MD: measures of discrimination. CC: coordinates of centroids. Values in bold refer to the variables (and therefore the categories) whose measures of discrimination were close to or higher than the values of dimension inertia.

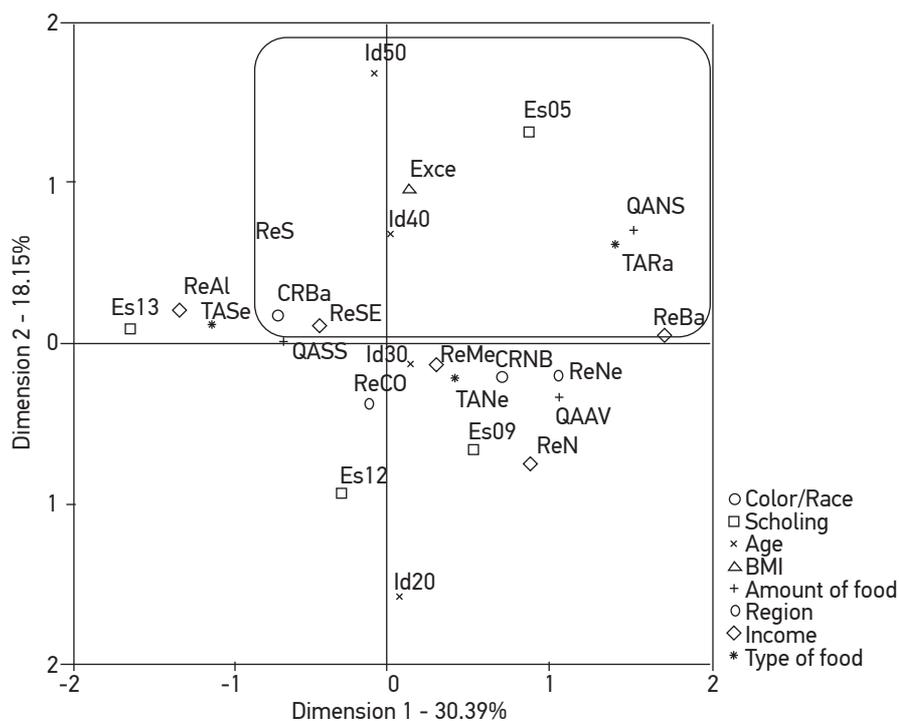


CAPTION	
Abbreviation	Categoria da variável
Age	
Id20	20 to 29 years old
Id30	30 to 39 years old
Id40	40 to 49 years old
Id50	50 to 59 years old
Income	
ReBa	≤ 1/2 MW
ReMe	1/2 > MW < 2
ReAl	≥ 2 MW
Scholing	
Es05	0 to 5 years
Es09	6 to 9 years
Es12	10 to 12 years
Es13	≥ 13 years
Color/ethnicity	
CRBa	White
CRNB	Nonwhite

CAPTION	
Abbreviation	Categoria da variável
Region	
ReN	North
ReNE	Northeast
ReSE	Southeast
ReS	South
ReCO	Center-West
Amount of consumed food	
QANS	Usually not sufficient
QAAV	Sometimes not sufficient
QASS	Always sufficient
Type of consumed food	
TASE	Always the wanted kind
TANe	Not always the wanted kind
TARa	Rarely the wanted kind
Body Mass Index	
Eutr	Eutrophic
Exce	Overweight

BMI: body mass index.

Figure 1. Visualization of socioeconomic and demographic characteristics of the Brazilian adult male population through the graph set generated by multiple correspondence analysis between dimensions 1 and 2 (Brazil, 2008/2009).



CAPTION	
Abbreviation	Categoria da variável
Age	
Id20	20 to 29 years old
Id30	30 to 39 years old
Id40	40 to 49 years old
Id50	50 to 59 years old
Income	
ReBa	≤ 1/2 MW
ReMe	1/2 > MW < 2
ReAl	≥ 2 MW
Schooling	
Es05	0 to 5 years
Es09	6 to 9 years
Es12	10 to 12 years
Es13	≥ 13 years
Color/ethnicity	
CRBa	White
CRNB	Nonwhite

CAPTION	
Abbreviation	Categoria da variável
Region	
ReN	North
ReNE	Northeast
ReSE	Southeast
ReS	South
ReCO	Center-West
Amount of consumed food	
QANS	Usually not sufficient
QAAV	Sometimes not sufficient
QASS	Always sufficient
Type of consumed food	
TASe	Always the wanted kind
TANe	Not always the wanted kind
TARa	Rarely the wanted kind
Body Mass Index	
Eutr	Eutrophic
Exce	Overweight

BMI: body mass index.

Figure 2. Visualization of socioeconomic and demographic characteristics of the Brazilian adult female population through the graph set generated by multiple correspondence analysis between dimensions 1 and 2 (Brazil, 2008/2009).

the effectiveness of MCA for the standardized and similar distribution of these indicators, or reduced the possibility of selection bias, therefore improving the representativeness of the sample. The proposed method based on MCA distinguished the relationship of the groups placed in separated quadrants, with different characteristics.

This analysis revealed a worrisome scenario, mainly illustrated by the condition that, in practically all of the categories of the analyzed age groups, there was correspondence with overweight, thus implying potential over-risk of morbidity and mortality of the possible associations with overweight in a significant contingent of the Brazilian adult population. These results are consistent and in agreement with data from the Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL)¹⁶, in frequencies of overweight and obesity in Brazil. A possible justification for such finding is related to the common aging process, which affects physiological aspects associated with the accumulation of body fat, like, for instance, the reduced metabolism and hormonal changes that can contribute with the increasing levels of body fat¹³.

In this sense, facing the epidemic progress of overweight rates in these age groups in Brazil is a major challenge for administrators, professionals and researchers in the field of nutritional epidemiology, thus translating a process of intense changes in proximal factors, in the causal network of the several problems experienced in the past few years in Brazil, reported by changes in dietary habits and practice of physical activity, besides more distal factors regarding socioeconomic status. This implies the need for further investigations and understanding in this dynamic and current stage of the nutritional transition in the country, in order to amplify and integrate actions from several sectors in the national scenario to face overweight control, as well as to maintain the control over the nutritional status of the Brazilian adult population aged more than 20 years old.

In Brazil, the nutritional transition is taking place at the same time as the sequels of nutritional deficiencies. In general, the relationship between rates of overweight and social stratum is inverse: the poorest residents are characterized as the most vulnerable to such a process, due to low schooling, precarious purchasing power to buy healthy foods and less availability of places and time for physical activities¹⁷. This would lead to increasing prevalence of chronic non-communicable diseases in the world¹ and overweight, which, in the country, is different between genders: it is more common among men from all income levels and among women with higher levels¹².

The negative aspects of dietary habits, especially in Brazil, in the end of the first decade of the 21st century, indicate the need to prioritize public policies promoting a healthy diet¹⁸, including efforts to solve problems of SAN, which can influence overweight rates¹⁹. In this study, based on information referring to SAN, on subjective matters of life conditions based on studies from the World Bank about this specific field²⁰, which are useful to establish limits and criteria to measure or establish poverty lines of populations²¹, a correlation between genders, in the opposite direction, was presented, regarding sufficiency (among) – sufficient, as usual; and usually not sufficient, and

satisfaction (quality) — always the wanted type; and rarely the wanted type of consumed foods for men and women, respectively.

The aforementioned data, proposed as being good predictors of the real perception of individuals about essential factors for the quality of life of people²², may favor the increasing approaches of studies regarding life conditions, which complemente other technical and scientific evaluations addressed to analyzing nutritional patterns or other subjects. These can increase the possibilities of explanations related to health problems in adult populations referring to nutritional status^{12,16,21}, especially concerning chronic diseases in adult populations, thus helping to understand the qualitative aspects of the diet, influenced by nutritional transition, thus implying the increasing prevalence of overweight, which is growing together with physical inactivity and morbimortality of chronic non-communicable diseases²³⁻²⁶.

The correspondence of overweight was demonstrated both in individuals with low and high schooling in thi study. Schooling is considered to be a proxy of economic status, and is constantly reported in studies about inequalities in health²⁷. Besides, studies indicate that people with low schooling are more prone to the reflexes of overweight⁷, and more vulnerable to dietary restrictions. Then, children coming from environments of food insecurity tend to present sequels of protein-energy malnutrition, with reflexes in adulthood¹². Because of that, it is assumed that measures related to providing access to all, regardless of schooling and purchasing power, to information about the determinants and consequences of overweight, must be seen as possible strategies to prevent and control the disease²⁸. These measures include public policies about the human right to adequate food addressed to people who cannot access it easily.

By assessing the quadrants, the results of this investigation indicated the correlation of overweight with the geographic regions South, Southeast and Center-West, which are the most developed ones in the country in social and economic terms, thus corroborating findings in literature^{7,16}. In mid-income countries, like Brazil, economic development is associated with some characteristics considered to be obesigenic, such as sedentary lifestyle, in general, allied to the insufficient practice of physical exercises, daily stress, inadequate dietary habits and more access to food²⁹.

Ethnic and racial disparities in health found in many countries, including Brazil, can be explained by socioeconomic issues that have been present for many generations^{30,31}. These disparities create groups that are especially exposed to risks, but their dynamics is complex, therefore, it is also necessary to promote debates in the Brazilian public health field³².

In this contexto, it is relevant to analyze and interpret data regarding color/ethnicity, which are scarce in the national epidemiological literature; in other countries, like the USA and England, however, this variable has been important in the study of health matters³³. In this study, it was possible to verify that white individuals were in the same overweight quadrant. A possible justification for that can be focused on socioeconomic level, because in Brazil white people compose the part of population with more financial resources in the different geographic regions³⁴. It is also possible to speculate that white adults have more

access to electronic devices, such as television and computer, which increases the chances of adopting sedentary lifestyles; therefore, the chances of overweight rates increase²⁹.

One of the limitations of this study was the use of secondary data, which are prone to problems regarding the record of information. However, the team that performed data collection and record of information was trained by specialized technicians to decrease the chances of error. Besides, the cross-sectional design of the study does not allow establishing cause-and-effect relationships between independent and dependent variables. However, cross-sectional studies are relevant for estimating measures that are useful to assess the weight of the disease in the community. They are valuable for the planning of the health service³⁵. However, using the information in POF enables to subsidize public policies in the social field to improve the conditions of the population, including thematic public policies in the fields of nutrition, dietary guidance and public health nationally¹².

CONCLUSION

The joint relationships between overweight and socioeconomic and demographic conditions, observed by the MCA technique — which was adequate to identify the overweight profile in the Brazilian adult population aged from 20 to 59 years old, of both genders —, suggest an alarming situation. Correlations were presented in almost all of the age groups, in the most socially and economically developed regions of the country, among white people, those with low income (women) and high income (men), and, finally, among the respondents to subjective questions regarding life conditions in terms of SAN. These questions were related to sufficiency and satisfaction of the consumed foods in terms of quantity; sufficient, as usual (men); and usually not sufficient (women); and always the wanted type (men) and rarely the wanted type (women) regarding the quality of the food, respectively. In this sense, the development of public health strategies and/or programs to prevent health problems related to overweight among Brazilian adults is suggested.

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