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Evaluation of the Brazilian population's intake of antioxidant nutrients and their relation with the nutritional status

Avaliação da ingestão de nutrientes antioxidantes pela população brasileira e sua relação com o estado nutricional

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ABSTRACT: ***Introduction***: The study of dietary antioxidants has gained prominence owing to the elucidation of the deleterious effects of oxidative stress to the human body. ***Objective***: To evaluate the Brazilian population's intake of antioxidant nutrients and their association with the nutritional status. ***Methods***: A cross-sectional study was carried out including secondary data on food consumption of 33,459 individuals from both sexes, aged 10 years or older, from all Brazilian regions based on microdata of the "2008–2009 Household Budget Survey, Brazilian Dairy Survey." The content of vitamins E, A, and C; zinc; manganese; copper; and selenium from 188 food items, divided into 12 groups, according to the habitual consumption form was analyzed. The means of antioxidant nutrient intake according to the nutritional status were compared using Bonferroni's t-test. ***Results***: Higher percentages of insufficient intake of vitamins than antioxidant minerals were seen. A significant difference in the intake of vitamin E as to the nutritional status was noticed, wherein the intake in overweight individuals was lower than in those with proper weight. Participants with low weight presented lower intake of almost all antioxidant minerals, except for copper, in which the intake of participants with low weight was equal to those with normal weight. ***Conclusion***: High percentages of insufficient intake of antioxidant nutrients were observed in the studied population, especially vitamins. It was also found that the intake of antioxidant nutrients varied based on nutritional status, gender, and life stage.

Keywords: Vitamins. Minerals. Antioxidants. Food consumption. Nutritional status. Diet.

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RESUMO: ***Introdução:*** O estudo dos antioxidantes dietéticos tem ganhado destaque em função da elucidação dos efeitos deletérios do estresse oxidativo ao organismo. ***Objetivo*:** Avaliar a ingestão de nutrientes antioxidantes pela população brasileira e sua relação com o estado nutricional. ***Métodos*:** Realizou-se um estudo transversal com coleta de dados secundários do consumo alimentar de 33.459 indivíduos de ambos os sexos, de 10 ou mais anos, de todas as regiões do Brasil, a partir dos microdados da Pesquisa de Orçamentos Familiares (2008 – 2009), Inquérito Nacional de Alimentação. Foram analisados os teores das vitaminas E, A e C, zinco, manganês, cobre e selênio de 188 itens alimentares, divididos em 12 grupos, conforme a forma habitual de consumo. As médias de ingestão dos nutrientes antioxidantes de acordo com o estado nutricional foram comparadas por meio do teste *t* de Bonferroni. ***Resultados*:** Foram observados maiores percentuais de ingestão insuficiente para as vitaminas do que para os minerais antioxidantes. Notou-se diferença significativa na ingestão da vitamina E em relação ao estado nutricional, sendo que a ingestão por indivíduos com excesso de peso foi inferior em relação aos com peso adequado. Verificou-se que os indivíduos com baixo peso apresentaram menor ingestão de quase todos os minerais antioxidantes, exceto o cobre, em que a ingestão por indivíduos com baixo peso foi igual à ingestão por aqueles com peso adequado. ***Conclusão*:** Elevados percentuais de ingestão insuficiente de nutrientes antioxidantes foram observados na população estudada, especialmente para as vitaminas. Além disso, a ingestão de nutrientes antioxidantes variou conforme o estado nutricional, o sexo e o estágio de vida.

Palavras-chave: Vitaminas. Minerais. Antioxidantes. Consumo alimentar. Estado nutricional. Dieta.

INTRODUCTION

Certain nutrients and food components have been prominent in their antioxidant activity, with the ability to transform and diminish action of oxidation of free radicals, preventing their harmful effects on the body[1]. The imbalance in the production of free radicals and in their removal by the antioxidant defenses, defined as oxidative stress, can cause cellular damage by attacking membranes, nucleic acids, proteins, and polysaccharides, leading to functional alterations and the development of several diseases[2].

Although the body possesses effective endogenous antioxidant defenses to fight excess free radicals, such as enzymes superoxide dismutase, peroxidase, catalase, and glutathione peroxidase[3], they are believed to be not infallible. Therefore, there is a constant formation of free radicals[4]. Thus, antioxidants obtained through a diet are indispensable for proper defense against oxidation, and therefore play an important role in maintaining health. Among the diet's nutrients with antioxidant action, there are vitamins E, A, and C and minerals zinc, manganese, copper, and selenium[5,1].

The demographic, epidemiological, and, especially, nutritional transitions that have developed in Brazil since the 20th century, characterized by the reduction in the prevalence of malnutrition and the increase of obesity, have resulted in a profile of health risk in the population[6]. The increasing prevalence of obesity causes clinical complications, such as hypertension, diabetes, cardiovascular diseases, and osteoarthritis, leading to

an increase in various comorbidities, decreasing quality of life and leading to the premature death of several people[5].

Several factors are believed to be related to the development of comorbidities in obese individuals, including mechanisms that cause the excess of oxidative lesions in the human organism. Among these, it is highlighted that lipid peroxidation is a chain reaction of the fatty acids from cell membranes, capable of generating free radicals that cause damage to cells and which is increased in obesity. In addition, the decrease of cytoprotective enzymes with obesity has also been related to cellular damage and, consequently, to the development of chronic non-transmissible diseases, such as cancer, atherosclerosis, hypertension, among others[7].

However, it is noteworthy that, recently, evidence has emerged showing that not only insufficient or excessive food consumption, but the quality of the diet, is related to the definition of health status[8], as well as nutritional status[9]. Therefore, considering that dietary antioxidants are essential for the maintenance of health and taking into account the increase in the prevalence of overweight in the population, the relation of oxidative stress with chronic non-communicable diseases, the emergence of the concept of hidden hunger, as well as the importance of dietary antioxidants and the scarcity of data on their intake make studies on the ingestion of antioxidants and their relation with the nutritional status of the Brazilian population relevant. In this sense, this study aimed at evaluating the intake of antioxidant nutrients by the Brazilian population and its relationship with nutritional status.

METHODS

RESEARCH CHARACTERIZATION AND POPULATION

This is a cross-sectional study with secondary data collection, based on microdata from the National Food Inquiry (INA), which was a module of the Family Budget Research (POF) 2008–2009, developed by the Brazilian Institute of Geography and Statistics (IBGE). It is worth mentioning that the data contain detailed information on one day of food consumption from 33,459 individuals aged 10 years or more, of both sexes and all regions of Brazil.

FOOD CONSUMPTION

Data on the food consumption of the individuals interviewed by POF were collected on two consecutive days of feeding data registration. However, owing to the quality of the information obtained, the POF considered the first day of registration to estimate the average food consumption of the individuals.

Among the 1,121 food items described by the research participants, which are described in Annex 1 of POF 2008 – 2009[10], the contents of 188 of these food items were evaluated, corresponding to 16.8%.

The criteria for the evaluation of only 188 food items were to have more than one nominal designation for several foods; lack of information on the antioxidant nutrient content of light, diet, and organic foods.

When categories in the POF classification (2008 – 2009) were described as "[specific ingredient]-based preparations," only the main food was considered, as in "rice-based preparations," using only rice. For categories called "other," only foods with a higher prevalence of consumption were taken into account.

The selection and characterization of foods were performed based on the preparation method by which foods are usually consumed. Therefore, the food groups were studied as follows:

1. cereals (cooked), flour, pasta (cooked), baked goods, biscuits, snacks (fried and roasted) and sandwiches;
2. pulses (cooked);
3. vegetables (raw)/vegetables (cooked);
4. roots and tubers (cooked);
5. fruits (raw);
6. oil seeds (raw);
7. meat and eggs (cooked);
8. dairy products;
9. sweets;
10. oils and fats;
11. beverages; and
12. soups, broths, sauces, and condiments.

INTAKE OF ANTIOXIDANT NUTRIENTS

Quantification of the levels of antioxidant vitamins (E, A, and C) and minerals (zinc, manganese, copper, and selenium) of the selected foods was carried out using national and international food composition tables[11-14].

For each food, the data of at least two references were used to facilitate the calculation of the average content, with one information being preferentially obtained from the Brazilian Food Composition Table[11], since it is a Brazilian table with important use in academic and scientific circles, as well as for presenting the composition of the foods grown in the country, according to climatic and soil conditions.

The contents of the antioxidants obtained per 100 g of food were converted according to the average portion consumed *per capita*. The total daily *per capita* intake of each antioxidant nutrient was calculated by the sum of the content of each food, with the total daily *per capita* intake being quantified according to each classification of nutritional status.

NUTRITIONAL STATUS

The evaluation of the nutritional status of the individuals was carried out by calculating the body mass index (BMI), defined as the relationship between body weight and height squared, and the weight and height data of each individual were already in the database provided by POF. For adolescents, the BMI/age indicator was used, which was assessed using the reference standard and the WHO classification criteria[15]. For adults and the elderly, the classification criteria of WHO (1998)[16] and Lipschitz[17], respectively, were used.

STATISTICAL ANALYSIS

The intake of antioxidant nutrients from individuals evaluated according to the life stage, sex, and nutritional status was compared with the recommendations of the Dietary Reference Intakes (DRIs)[18,19], established for each age group and sex. For adolescents, considering that there are different nutritional recommendations for this age group, the average between the recommendations defined by DRIs for adolescents aged 9 – 13 years and for adolescents aged 14 – 18 years old was calculated.

The percentage of individuals with insufficient and excessive intake was calculated. A value lower than that recommended by DRIs was found to be below the estimated average requirements (EAR) or adequate intake (AI), whereas values between EAR or AI and tolerable upper intake levels (UL) were adequate, and those above the recommended values were higher than UL.

The data were organized and analyzed using Microsoft Excel 2010 and the statistical software Sisvar®, being expressed as mean and standard deviation of the antioxidant nutrients content, according to each nutritional status. The Kolmogorov–Smirnov data normality test was applied, and the comparisons between the data were performed by the Bonferroni *t*-test, with 5% significance.

RESULTS

The evaluated population consisted of 33,459 individuals, mostly adults (64.7%), with normal weight (54.7%), followed by those overweight (40.1%). The mean total intake of antioxidant nutrients and the characteristics of the analyzed population can be observed in Table 1.

The estimate of the average daily intake of antioxidant vitamins according to the nutritional status of the Brazilian population showed that there was a significant difference only in vitamin E intake ($p < 0.05$). Ingestion in overweight individuals was lower than those with normal weight (Table 2).

Table 1. Characteristics of the studied population regarding life stage, gender, nutritional status, and intake of antioxidant nutrients, Brazil, 2008 – 2009.

Variable	n	%
Life stage		
Adolescents	7,512	22.4
Adults	21,640	64.7
Elderly	4,307	12.9
Sex		
Female	17,851	53.3
Male	15,608	46.6
Nutritional status		
Low weight	1,718	5.1
Normal weight	18,315	54.7
Overweight	13,426	40.1
Average intake of antioxidant nutrients		
Nutrient	Mean	Standard deviation
Vitamin E (mg/day)	8.48	11.68
Vitamin A (µg/day)	331.12	766.44
Vitamin C (mg/day)	64.66	124.10
Zinc (mg/day)	11.70	7.25
Manganese (mg/day)	2.22	1.41
Copper (mg/day)	1.23	1.09
Selenium (µg/day)	102.34	87.42

Table 2. Average intake of antioxidant vitamins and minerals according to the nutritional status of the Brazilian population, 2008 – 2009.

Antioxidant nutrient	Low weight	Adequate weight	Overweight
Vitamin E (mg/day)	8.35 ± 11.79[a,b]	8.76 ± 11.85[b]	8.11 ± 11.43[a]
Vitamin A (µg/day)	333.93 ± 788.63	328.36 ± 776.63	334.53 ± 749.42
Vitamin C (mg/day)	62.33 ± 123.26	63.71 ± 127.71	66.25 ± 119.09
Zinc (mg/day)	10.67 ± 6.92[a]	11.59 ± 7.09[b]	11.99 ± 7.50[c]
Manganese (mg/day)	2.04 ± 1.27[a]	2.17 ± 1.39[b]	2.18 ± 1.46[b]
Copper (mg/day)	1.18 ± 1.06[a]	1.22 ± 1.06[a,b]	1.26 ± 1.13[b]
Selenium (µg/day)	87.14 ± 75.53[a]	103.04 ± 89.77[b]	103.34 ± 85.40[b]

[a,b,c]These indicate if there is a significant difference ($p < 0.05$) in the intake of antioxidant nutrients among the variables low weight, adequate weight, and overweight. When the letters are different, it shows that the values are statistically different from each other, according to the Bonferroni *t*-test.

Comparison of vitamin E intake with DRI recommendations indicated an average daily intake lower than that recommended for all stages of life, sexes, and nutritional status ratings. Approximately 83.0% of the individuals had inadequate intake of this vitamin. The highest percentages of inadequacy were observed in overweight individuals, except for elderly women with low weight, who presented lower intakes than those with normal weight ($p < 0.05$), according to Table 3. No individual had vitamin E intake above the recommended amount (data not shown).

Table 3. Average daily intake and inadequate percentage of antioxidant vitamins intake according to life stage, gender, and nutritional status, Brazil, 2008 – 2009.

Variable	Vitamin E		Vitamin A		Vitamin C	
	Mean (mg/day)	Insufficient (%)	Mean (µg/day)	Insufficient (%)	Mean (mg/day)	Insufficient (%)
Adolescents – male	9.33	78.5	316.25	90.8	58.94	72.7
Low weight	10.01	76.0	289.12	89.6	72.84	70.4
Normal weight	9.41	77.8	318.30	90.9	58.25	73.1
Overweight	8.93	81.2	313.32	90.6	59.14	71.8
Adolescents – female	7.83	83.1	301.10	88.8	60.92	69.2
Low weight	7.78	80.3	288.41	91.3	70.25	64.6
Normal weight	8.11	82.3	304.11	88.4	61.11	69.6
Overweight	6.82	86.2	292.15	89.9	58.72	68.6
Adults – male	9.75	82.0	356.43	91.3	62.06	78.1
Low weight	10.26	76.3	404.27	93.1	49.79	81.5
Normal weight	10.35	80.1	366.67	91.4	62.22	78.8
Overweight	9.10	84.3	344.13	91.1	62.34	77.3
Adults – female	7.52	86.0	320.46	89.6	66.21	70.9
Low weight	8.06	83.8	393.63[a]	88.3	66.38	71.7
Normal weight	7.53	86.0	315.37[b]	88.9	65.31	70.8
Overweight	7.45	86.1	319.95[b]	88.2	67.17	75.2
Elderly – male	8.84	83.3	327.71	91.9	72.32	74.7
Low weight	9.17	82.8	254.44[a]	95.0	49.15[a]	82.1
Normal weight	8.68	83.4	321.56[a.b]	91.8	76.05[b]	73.6
Overweight	8.83	83.7	390.55[b]	90.0	83.45[b]	70.8
Elderly – female	7.30	86.2	352.75	85.3	76.65	66.4
Low weight	6.64[a]	86.9	353.09	82.8	71.88	69.5
Normal weight	8.10[b]	84.3	318.08	87.8	73.94	67.3
Overweight	6.86[a.b]	87.5	383.54	84.0	80.99	64.3
Total population	8.62	82.8	330.55	89.6	65.59	72.2

[a,b,c]These indicate if there is a significant difference ($p < 0.05$) in the intake of antioxidant nutrients among the variables low weight, normal weight and overweight, according to the life stages (adolescent, adults, and elderly) and sex. When the letters are different, it shows that the values are statistically different from each other, according to the Bonferroni *t*-test.

The mean intake of vitamin A by the total population did not differ statistically according to nutritional status (Table 2). However, adult women with adequate weight and overweight had lower intake than those with low weight, differently from the elderly with low weight, who presented lower intake than those overweight ($p < 0.05$), according to Table 3.

It was also verified that the average daily intake of vitamin A was inferior to that recommended in all stages of life, sexes, and nutritional status ratings. The percentage of individuals who did not reach the recommendations was high and ranged from 83.0 to 95.0% (Table 3), and the adults and the elderly with low weight presented the highest percentage of inadequacy. Only 1.4% of participants had an intake higher than recommended (data not shown).

Regarding the mean intake of vitamin C, the elderly with low weight had the lowest intake of this vitamin in relation to the other nutritional status classifications ($p < 0.05$), as well as the higher percentage of inadequacy in comparison to those recommended by DRIs (82.0%), followed by adults with 81.5% (Table 3).

Insufficient intake of vitamin C was observed in approximately 72.0% of the individuals evaluated. Among adolescents of both sexes, with adequate weight, and adult women, those overweight women presented the highest percentage of inadequacy. Vitamin C intake above the recommended value was observed in 0.4% of participants (data not shown).

In relation to the antioxidant minerals, the estimate of the average daily intake of the total population showed that the individuals with low weight had inferior intake of all the minerals in comparison with the other classifications of the nutritional state ($p < 0.05$), according to Table 2. For copper alone, the intake of low-weight individuals did not differ from those with normal weight.

The percentages of insufficient intake found for the intake of antioxidant minerals were lower than those found for antioxidant vitamins. Approximately 35.0, 51.0, 24.0, and 19.0% of individuals had insufficient intake of zinc, manganese, copper, and selenium, respectively.

The mean daily intake of antioxidant minerals at all stages of life, sexes, and nutritional status was within the recommended range, except for manganese in adults and the elderly with low weight.

Concerning zinc, the highest percentages of insufficient intake were observed in low-weight individuals, except for adolescents and adult and elderly women in whom no significant difference was observed between the nutritional status ratings ($p < 0.05$), as shown in Table 4.

Regarding manganese, among adolescents of both sexes, the highest percentages of inadequacy were found in overweight individuals. However, in adult males and elderly of both sexes, the highest percentages of inadequacy were observed in individuals with low weight, and, for adult women, in those of adequate weight.

With regard to copper, the highest percentages of insufficient intake were found among the elderly of both sexes and among adults with low weight. For adolescents and adults, the highest percentages of inadequacy were observed in individuals with normal weight and overweight.

Table 4. Average daily intake and inadequate percentage of antioxidant minerals intake according to life stage, gender, and nutritional status, Brazil, 2008 – 2009.

Variable	Zinc		Manganese		Copper		Selenium	
	Mean (mg/day)	Insufficient (%)	Mean (mg/day)	Insufficient (%)	Mean (mg/day)	Insufficient (%)	Mean (µg/day)	Insufficient (%)
Adolescents – male	12.13	30.5	2.32	49.9	1.24	17.9	110.66	12.7
Low weight	12.16	27.2	2.34	40.0	1.23	16.0	111.25	12.8
Adequate weight	11.90	31.5	2.33	50.0	1.25	18.2	110.37	13.0
Overweight	12.92	27.6	2.29	50.9	1.22	16.9	111.58	11.8
Adolescents – female	10.42	34.1	2.02	40.2	1.09	22.4	94.42	15.0
Low weight	10.66	33.1	2.02	37.0	1.15	15.0	88.61	21.3
Adequate weight	10.39	34.1	2.04	39.2	1.10	22.5	94.09	14.9
Overweight	10.49	34.4	1.94	44.0	1.07	23.1	96.57	14.2
Adults – male	13.95	32.1	2.52	51.2	1.40	17.8	120.96	12.2
Low weight	11.75[a]	48.0	2.26[a]	59.0	1.28	20.2	98.47[a]	20.2
Adequate weight	13.82[b]	32.3	2.54[b]	50.4	1.40	17.3	122.29[b]	13.0
Overweight	14.17[b]	31.2	2.50[b]	51.8	1.39	18.2	120.41[b]	11.0
Adults – female	10.43	30.3	2.03	51.0	1.14	30.3	90.77	20.8
Low weight	10.36	31.0	2.03	49.4	1.20	26.3	82.54[a]	23.4
Adequate weight	10.38	30.5	2.03	51.1	1.13	30.6	91.49[b]	20.1
Overweight	10.50	30.1	2.03	51.0	1.16	30.3	90.66[b]	21.3
Elderly – male	12.31	42.1	2.36	57.8	1.34	22.4	102.90	18.8
Low weight	11.64[a]	46.6	2.2[a]	59.5	1.23[a]	25.8	93.92[a]	21.5
Adequate weight	12.18[a.b]	43.5	2.31[a]	59.0	1.3[a]	24.0	102.62[a.b]	20.7
Overweight	12.99[b]	36.7	2.54[b]	54.5	1.5[b]	17.3	109.86[b]	14.7
Elderly – female	9.43	36.4	1.94	55.1	1.12	32.1	80.55	28.0
Low weight	9.03	40.4	1.78[a]	57.6	1.06	39.2	72.1[a]	36.7
Adequate weight	9.41	35.2	1.92[a.b]	54.9	1.08	31.9	78.66[a.b]	27.7
Overweight	9.60	35.8	2.02[b]	54.2	1.19	29.5	85.62[b]	24.8
Total population	10.91	34.8	2.15	50.8	1.20	23.6	101.06	18.8

[a,b,c]These indicate if there is a significant difference ($p < 0.05$) in the intake of antioxidant nutrients among the variables low weight, normal weight, and overweight, according to the life stages (adolescent, adults, and elderly) and sex. When the letters are different, it shows that the values are statistically different from each other, according to the Bonferroni *t*-test.

For selenium, the highest percentages of insufficient intake were found in individuals with low weight, especially in the elderly.

Intake of antioxidant minerals above the recommended value was observed in 0.2, 0.4, 1.4, and 1.9% of the individuals for manganese, copper, zinc, and selenium, respectively (data not shown).

DISCUSSION

This study addresses a subject that has not yet been explored in the country, since it is one of the first to evaluate the nutritional status of antioxidant nutrients. Nevertheless, these estimates still have limitations, such as cross-sectional data, the use of a single food record and the adjustment according to the amount of energy consumed. Therefore, prospective studies of food consumption assessment in Brazilians are necessary to verify their relationship with the ingestion of antioxidant nutrients.

In previous studies, such as Fernandes et al.[20] and Rodrigues et al.[21], in adults and elderly people with metabolic syndrome, respectively, high percentages of inadequate intake of antioxidant vitamins by Brazilians were also observed. In the first study mentioned, the inadequacy of the intake of vitamins E and A was 100.0%, whereas that of vitamin C was 93.0%. In the second, inadequacy in vitamin E intake was 72.0%; of vitamin A, 92.0% and vitamin C, 88.0%, similar to the results found in this study.

The highest percentage of the insufficient intake of antioxidant vitamins in comparison to the antioxidant minerals observed in this study can be explained by the dietary sources of these nutrients. Food sources of antioxidant vitamins include, among other foods, fruits, vegetables, and oilseeds, whereas sources of antioxidant minerals include meat, cereals, coffee, and tea[22], which are foods of high prevalence of consumption in Brazil[10].

Thus, considering the lower presence of fruits and vegetables in the Brazilian diet, since, according to the analyses of POF 2008 – 2009[10], less than 10.0% of the Brazilian population reaches the recommended consumption for these foods, which is 400 g/day, it is likely that the low intake of vitamin C in the population is due to insufficient consumption of these foods.

As for vitamin E, the high percentage of insufficient intake of this vitamin can be explained by the reduced consumption of oilseeds, wheat germ, seeds, and whole grains. These foods have an important vitamin E content, but their presence in food is low, especially in relation to whole foods[10,23,24].

In relation to vitamin A, it is observed that the Brazilian population frequently consumes meats, the source food of this vitamin, but poorly consumes fruits and vegetables, which are sources especially of carotenoids that are precursors to this vitamin, as well as of viscera, milks, and dairy, which may possibly explain the high percentages of inadequate intake. According to Souza et al.[25], milk was cited by 12.9% of adolescents, 11.6% of adults, and 15.8% of the elderly surveyed by POF 2008 – 2009.

As for antioxidant minerals, the most frequently mentioned foods by the Brazilian population in POF 2008 – 2009 were rice (84.0%), coffee (79.0%), beans (72.8%), bread (63.0%), and beef (48.7%), which are food sources of these minerals[25].

However, it is important to emphasize that although it has been verified that most of the daily intake averages of the antioxidant minerals of the Brazilian population are in agreement with the recommendations of the DRIs, the percentages of inadequacy suggest concern with the compromising of the action of the antioxidant minerals in the antioxidant defense, as it relates to the development of various diseases such as inflammatory bowel diseases[26], infertility[27], degenerative diseases such as Alzheimer's and Parkinson[28], cancer and inflammatory diseases[29], lung diseases[30], diabetes[31], and cardiovascular diseases[32].

The low intake of antioxidant nutrients among the elderly with low weight is possibly due to the smaller volume of food ingested by these individuals. This condition can be explained by the very characteristic of the aging process, since morphological, biochemical, physiological, behavioral, and biopsychosocial changes occur, which result in a progressive loss of adaptability to the environment, as well as a deterioration in the act of feeding, which leads to malnutrition and pathological processes[33].

According to Moreira, Boas and Ferreira[34], there is a relationship between oxidative stress and the nutritional status of the elderly, including both malnutrition and overweight. Thus, the authors emphasize the importance of encouraging the ingestion of antioxidant foods, such as fruits and vegetables, as well as maintaining weight within the normal range.

The highest percentages of insufficient intake of antioxidant nutrients in both people with adequate weight and overweight individuals, as observed for vitamin E in the total population, for vitamins A and C and copper in adult women and for vitamin C, manganese and copper in adolescents of both sexes, can be attributed possibly to the food choices of these individuals.

According to IBGE[10], food consumption in Brazil is mainly composed of food with a high energy and low nutrient content, which constitutes a risk for deficits in important nutrients, obesity, and many chronic non-transmissible diseases, which are characteristic of the nutritional transition. Thus, the importance of changes in Brazilian food habits, including the replacement of high-calorie and low-nutrient foods by fruits, vegetables, legumes, milk, whole grains, oilseeds, viscera, fish, all produced in Brazil.

In this context, many people with low weight can present greater intake of antioxidant vitamins and minerals in comparison to eutrophic and overweight people. This is due to the fact that although these may consume a greater amount of food, the intake of antioxidant nutrients seems to be related to the quality of the diet.

In addition, it should be noted that the mean BMI of the underweight individuals in this study was 18.31 kg/m^2, which is close to the lower limit for the nutritional diagnosis of eutrophy. This may indicate that, in addition to malnourished people, those who are constitutionally thinner or overly concerned about their physical appearance are included in this group.

CONCLUSIONS

High percentages of insufficient intake of antioxidant nutrients were observed in the evaluated population, especially in relation to vitamins. In addition, differences in the intake

of antioxidant nutrients in the Brazilian population according to their nutritional status, life stage, and sex were found. The highest percentages of insufficient intake of antioxidant vitamins were observed in overweight individuals, especially in women, and with the exception of the elderly. Also, with respect to minerals, there was a predominance of inadequacy in people with low weight. Finally, it was possible to verify that the intake of antioxidant nutrients seems to be related to the quality of the diet of the population.

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