DOI: https://doi.org/10.17921/2447-8938.2020v22n2p164-170

Dietary fat Intake Had a Different Influence on Body Mass Index in Active and Inactive Subjects: a Cross-Sectional Study

O Consumo de gordura Alimentar Influenciou Diferentemente no Índice de Massa Corporal de Indivíduos Ativos e Inativos: um Estudo Transversal

Ana Gabriella Pereira Alves*[a]; Mário Flávio Cardoso de Lima[a]; Maria Sebastiana Silva[a]

[a]Federal University of Goiás, Faculty of Physical Education and Dance, Laboratory of Physiology, Nutrition and Health. GO, Brasil.
*E-mail: anagabriela_alves@hotmail
Recebido em: 31/03/2020
Aprovado em: 03/07/2020

Abstract

The understanding of cardiovascular disease (CVD) risk factors and their association with food and physical activity is not yet completely clear. This study aimed to evaluate the association between CVD risk factors with dietary intake, according to the physical activity level. A cross-sectional study was conducted with Brazilian individuals attended by the Public Health System. Demographic, blood pressure, physical activity practice, anthropometry and food intake data were collected and evaluated. Of the 83 participants, 61.4% were active. No difference were observed in the frequency of CVD risk factors, anthropometric data, blood pressure, estimated energy requirement, energy and nutrient intake between the active and inactive subjects ($p \geq .05$). There was also no difference in the frequency of energy and nutrient intake adequacy between groups ($p \geq .05$). Among the inactive subjects, it was found that the consumption of total (OR: 1.021, p = .035) and saturated (OR: 1.060, p = .033) fat was predictor of being overweight, with no relationship between food intake and the risk factors for CVD when the total participants or active individuals were considered ($p \geq .05$). No difference was observed in the frequency of CVD risk factors between active and inactive individuals, however, total and saturated fat consumption increased the chance of being overweight among the inactive individuals.
Keywords: Cardiovascular Diseases. Food Consumption. Exercise. Body Weight. Health Systems.

Resumo

O conhecimento da associação entre os fatores de risco para doenças cardiovasculares com a alimentação e atividade física ainda não está totalmente elucidada. Este estudo teve como objetivo avaliar a associação entre os fatores de risco cardiovascular e o consumo alimentar, segundo o nível de atividade física. Foi realizado um estudo transversal com individuos brasileiros atendidos pelo Sistema Único de Saúde. Foram coletados e avaliados dados demográficos, pressão arterial, prática de atividade física, antropometría e consumo alimentar. Dos 83 participantes, 61,4% eram ativos. Não foi observado diferença na frequência dos fatores de risco cardiovascular, dados antropométricos, pressão arterial, estimativa da necessidade energética, consumo de energía e nutrientes entre os individuos ativos e inativos ($p \geq 0,05$). Também não houve diferença na frequência de adequação no consumo de energia e nutrientes entre os grupos ($p \geq 0,05$). Entre os participantes inativos, observou-se que o consumo de gordura total (OR: 1,021; p = 0,035) e saturada (OR: 1,060; p = 0,033) foram preditores do sobrepeso, sem relação entre o consumo alimentar e os fatores de risco cardiovascular quando se considerou todos os participantes ou apenas os indivíduos ativos ($p \geq 0,05$). Não foi observado diferença na frequência dos fatores de risco cardiovascular entre os sujeitos ativos e inativos, entretanto o consumo de gordura total e saturada aumentou a chance de sobrepeso entre os indivíduos inativos.
Palavras-chave: Doenças Cardiovasculares. Consumo de Alimentos. Exercício Físico. Peso Corporal. Sistemas de Saúde.

1 Introduction

This work stands out for assessing the frequency of risk factors for cardiovascular disease (CVD) in active and inactive people and associating them with food intake, since this approach in literature is scarce.[1]

Non-communicable chronic diseases (NCDs), especially CVD, are the leading cause of death worldwide, and also responsible for public health care spending growth, especially in low- and middle-income countries.[2] In Brazil, CVDs have been identified as the main cause of death since the 1990s, and the risk factors with the highest attributable risk are hypertension, overweight, physical inactivity and dietary factors.[3]

With regards to being overweight, this increases the risk of heart disease, diabetes mellitus and hypertension.[4] In Brazil, according to body mass index (BMI), one in two adults is overweight and 24.1% of individuals over 18 years old are hypertensive.[5]

Despite the BMI being widely used to assess the body weight of a population, the assessment of body fat percentage (BF%) and waist circumference (WC) are necessary to improve the diagnosis made through the BMI.[6]

An inappropriate nutrition increases the chance of being overweight and hypertensive.[7] Specifically considering the consumption of fat, a higher mortality rate for coronary artery disease were found among individuals who ingested excessive amounts of total and saturated fat.[8]

Physical inactivity increases the prevalence of CVD and their risk factors, such as hypertension and overweight. Conversely, the benefits of physical activity include the reduction of fat in the abdominal area and improvements regarding respiratory capacity, lipid profile and insulin sensitivity.[9]

There is no scientific evidence that food inadequacy influences less on the development of a CVD risk factor in active when compared to inactive individuals.

Therefore, the hypothesis of this study was that an inadequate food intake influences more on the development of CVD risk factors in inactive than active people, and the aim of this study was to evaluate the association between CVD risk factors with dietary intake, according to the physical activity level.

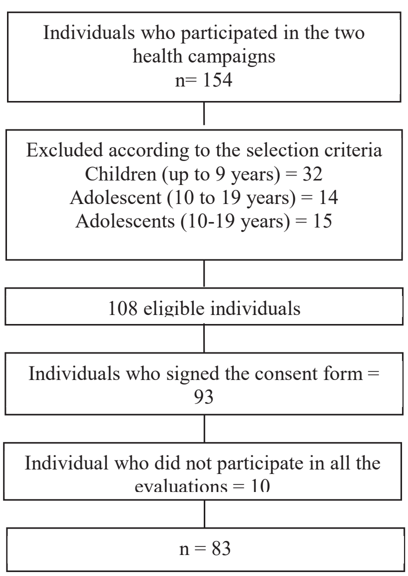
2 Material and Methods

2.1 Study design, sampling and selection criteria

This observational analytical cross-sectional study was developed with adults and older adults attended by the Public Health Service (PHS) of Santo Antônio de Goiás, located in the west central region of Brazil. Data collection occurred during two health promotion campaigns carried out by the Health Department of the city, in October and November 2014.

A total of 154 people were present, with 83 individuals of both genders, aged between 24 and 85 years, being included in this study (Figure 1).

Figure 1 - Flowchart of recruitment and selection of study participants



Source: Research data.

The inclusion criteria of the subjects for the study were: to be an adult (20 to 59 years) or an older adult (over 60 years). Children, adolescents, pregnant women and people with special needs (physical and/or cognitive disabilities) were excluded.

The sample size (n = 83) of the study presented an effect size of 0.57, determined from a sample power of 0.80, $\alpha = 0.05$ and $\beta = 0.20$, according to the sample calculation performed in the G*Power program version 3.0.

2.2 Ethical aspects

The Research Ethics Committee of the Federal University of Goiás (protocol n º 784.446/2014) approved this study. All participants were previously informed about the aim and procedures of the study and signed the consent form. Due to being a research project involving human subjects, all the procedures followed the recommendations of resolution 466/2012 of the National Health Council.

2.3 Evaluation protocols

Socio-demographic and economic characterization. Data about gender, age, marital status, schooling and income were collected from a specific questionnaire.

2.4 Practice of physical activity

For the classification of the practice of physical activity in the free time, individuals that had performed, in the last three months, at least 150 minutes of moderate-intensity activity (eg: bodybuilding, walking, swimming) per week, or at least 75 minutes of vigorous-intensity activity (eg: jogging, football, aerobics) per week were considered active. Participants who reported less time practicing physical activity were classified as inactive.[9]

2.5 Evaluation of blood pressure

To obtain the systolic (SBP) and diastolic blood pressure (DBP) values, the Omron® (HEM-705 CP model, Hoofddorp, Netherlands) electronic digital equipment was used. For the first measurement, the subject was previously sitting by 10 minutes, and another measurement was performed 5 minutes later, considering the average of the two values obtained. Subjects that presented values of SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg,[10] or who reported using antihypertensive medications, were considered hypertensive, one of the risk factors for CVD.

2.6 Anthropometric assessment

The BMI, WC and BF%, considered risk factors for CVD, were evaluated. All anthropometric measurements were collected according to the recommendations of the International Society for the Advancement of Cineanthropometry (ISAK).[11] Weight was measured using a Plenna® (acqua model, São Paulo, Brazil) electronic scale and height with a Seca® (213 model, Hamburg, Germany) portable stadiometer, allowing the BMI to be calculated. The classification of BMI for adults is: low weight for values < 18.50 kg/m², eutrophy between 18.50 and 24.99 kg/m² and overweight ≥ 25.00 kg/m².[12]

Among older adults, a BMI ≤ 22 kg/m² is indicative of low weight, between 22 and 27 kg/m² eutrophy and ≥ 27 kg/m² overweight.[13]

The WC was measured with a Cescorf® (Porto Alegre, Brazil) anthropometric inextensible tape. The cut-off points were: normal WC for values < 94 cm and 80 cm and high WC for values ≥ 94 cm and 80 cm for men and women, respectively.[14]

The body composition of individuals with BMI <30 kg/m² was obtained by calculating the body density estimated by the equation proposed by Petroski.[15] To calculate the body density, the skinfolds were obtained from the triceps, subscapular, iliac crest and medial calf with a Cescorf® (traditional model, Porto Alegre, Brazil) adipometer, considering the mean of three values of each measurement.[15]

For individuals with BMI ≥ 30 kg/m² the Tran and Weltman protocol[16] was used, considering the mean of two measurements of abdominal circumference, obtained by an anthropometric tape (Cescorf ®, Porto Alegre, Brazil). For the classification of BF%, the cut-off points for obesity were ≥ 26% for men and ≥ 39% for women up to 39 years, ≥ 29% for men and ≥ 41% for women aged 40-59 years and ≥ 31% for men and ≥ 43% for women over 60 years.[17]

2.7 Estimation and assessment of dietary intake

Food intake was estimated using an adapted version of semi-quantitative food frequency questionnaire developed and validated to evaluate the frequency and the amount of food and nutrients ingested by the Japanese-Brazilian population of São Paulo.[18] The questionnaire has 11 food groups, totaling 129 foods. For each food was informed about the frequency and quantity consumed, being this value inserted in a Microsoft Excel® 2013 spreadsheet to obtain the daily dietary energy consumption (DEC), carbohydrates, proteins, total fat, saturated fat, cholesterol, sodium and fiber for each participant.

To obtain the daily consumption of added vegetable oil, sugar and salt for each person, the monthly consumption of these ingredients in the residences was divided by the number of people who ate meals at home, with this figure then divided by 30.

The assessment of carbohydrate and total fat intake was performed according to the AMDR (Acceptable Macronutrient Distribution Ranges), which suggests 45.0-65.0% and 20.0-35.0% of EER (Estimated Energy Requirement) for the first and the second macronutrient, respectively. For proteins, the RDA (Recommended Dietary Allowance) of 0.8 g/kg body weight/day was considered.[19] In relation to saturated fat intake, it should be up to 10.0% of EER and cholesterol up to 300 mg per day.[20] An adequate intake (AI) of fiber was considered to be 14 g/1000 kcal of EER and 1500 mg of sodium for individuals between 19 and 50 years of age, 1300 mg for those between 51 and 70 years and 1200 mg for people aged ≥ 71 years.[19] From this, the percentage of adequacy of the consumption of energy and nutrients was calculated.

2.8 Estimated Energy Requirement (EER)

To obtain the EER for each individual, specific equations were selected according to gender and age group, using the values of age (years), body weight (kg), height (m) and the physical activity coefficient. To assess the adequacy of energy consumption the estimated standard deviation, according to age, BMI and gender, were considered.[19]

2.9 Data analysis

The normality of the distribution of the data for each variable was evaluated using the Kolmogorov-Smirnov test. The variables with normal distribution were expressed as mean and standard deviation and those that did not have normal distribution as median and interquartile range (25 and 75 percentiles). Categorical variables were presented as relative frequency.

The comparison of blood pressure, anthropometric data, DEC, nutrients intake and EER between active and inactive subjects was performed using Student's t-test for independent samples with normal distribution variables and the Mann-Whitney test with the non-parametric variables.

Pearson's chi-square test was used to compare the frequency of CVD risk factors and food intake adequacy between active and inactive individuals.

The binary logistic regression analysis was used to investigate whether the anthropometric variables and hypertension were associated to DEC and daily intake of carbohydrates, proteins, total fat, saturated fat, cholesterol, sodium and fiber. The BMI, WC, BF% and hypertension were categorized into: being overweight or not, normal or increased WC, normal or increased BF% and with or without hypertension, respectively. Considering the multicollinearity among the nutrients (r ≥ 0.80), each variable of food consumption was analyzed separately with the dependent variables (risk factors for CVD).

A database was developed using Microsoft Excel® 2013 and data analysis was performed using the software SPSS (Statistical Package for the Social Sciences), 21.0 version. *P* values <.05 were considered significant.

3 Results and Discussion

The study was conducted with 83 participants who had a mean age of 47.81 (± 13.22) years, 55.4% were men, 75.9% adults and 24.1% older adults.

Of the total individuals, 65.1% were married and 13.2% were single; 47.0% had completed kindergarten or elementary education and 31.3% completed high school; 54.2% had a monthly income of up to one minimum wage and 32.5% up to two minimum wages (R$ 788,00).

In relation to the practice of physical activity in the free time, 61.4% were active and 38.6% inactive. No difference was observed in anthropometric and blood pressure values between groups (Table 1). Among active, 47.1% had hypertension and 56.9%, 54.9% and 31.4% had high BMI, WC and BF%, respectively. Among inactive, 50.0% had hypertension and 68.8%, 62.5% and 40.6% had high BMI, WC and BF%, respectively. Also, no difference was observed on the frequency of hypertension and anthropometric inadequacies between the active and inactive subjects ($p \geq .05$).

Table 1 - Anthropometric and blood pressure data of active and inactive individuals

Variables	Active (n=51)	Inactive (n=32)	P value [3]
Weight (kg) [1]	73.6(18.0)	75.9(16.9)	.568
Height (m) [1]	1.6(0.1)	1.6(0.1)	.616
BMI (kg/m²) [1]	28.0(6.3)	28.4(4.9)	.783
WC (cm) [1]	91.9(14.3)	92.7(12.7)	.791
BF% [2]	30.9(23.6-36.0)	32.8(27.4-35.4)	.684
SBP (mmHg) [2]	128(110-140)	130(121-142)	.293
DBP (mmHg) [2]	80(70-90)	85(78-90)	.323

BMI: body mass index; WC: waist circumference; BF%: body fat percentage; SBP: systolic blood pressure; DBP: diastolic blood pressure.

[1] Variables with normal distribution: mean (standard deviation).

[2] Variables without normal distribution: median (25-75 percentiles).

[3] Variables with normal distribution: Student's t-test for independent samples. Variables without normal distribution: Mann-Whitney test.

Source: Research data.

In relation to food consumption, no difference was observed on EER, DEC and nutrients intake between groups ($p \geq .05$) (Table 2). Regardless of the practice of physical activity, more than 50.0% of the individuals presented DEC, carbohydrate, protein, saturated fat, cholesterol and sodium intake above the recommendations, however, the consumption of dietary fiber was adequate. Among the inactive subjects, 71.9% had a total and saturated fat intake above the recommendations. There was no difference in the frequency of energy and nutrients intake adequacy between the active and inactive individuals ($p \geq .05$) (Table 3).

Table 2 - Estimated energy requirement, energy and nutrients intake of active and inactive individuals

Variables	Active (n=51)	Inactive (n=32)	P value[3]
EER (kcal)[1]	2321.3(396.9)	2193.6(412.8)	.164
DEC (kcal)[1]	3149.3(1600.0)	3208.9(1318.2)	.480
Carbohydrate (g)[2]	388.1(275.1-512.5)	401.4(298.7-503.2)	.877
Protein (g)[1]	114.4(57.8)	129.2(63.0)	.227
Protein (g/kg)[2]	1.4(1.1-1.9)	1.6(1.3-2.0)	.389
Total fat (g)[2]	84.6(52.4-132.2)	112.8(67.1-139.0)	.288
Saturated fat (g)[2]	28.1(17.7-45.0)	34.8(23.6-49.7)	.256
Cholesterol (mg)[1]	366.6(226.0)	464.5(287.6)	.096
Fiber (g)[2]	35.8(25.9-48.4)	33.0(22.0-53.3)	.653
Sodium (mg)[1]	3495.4(1786.0)	3867.0(1640.2)	.251
Added vegetable oil (mL)[2]	22.5(13.5-52.5)	30.0(18.8-50.6)	.250
Added sugar (g)[2]	33.3(20.8-55.5)	33.3(22.2-55.5)	.853
Added salt (g)[2]	5.5(4.2-8.3)	7.5(4.2-16.7)	.310

EER: estimated energy requirement; DEC: dietary energy consumption.

[1] Variables with normal distribution: mean (standard deviation).

[2] Variables without normal distribution: median (25-75 percentiles).

[3] Variables with normal distribution: Student's t-test for independent samples. Variables without normal distribution: Mann-Whitney test.

Source: Research data.

Table 3 - Food intake comparison of active and inactive individuals with the recommendation

Energy and Nutrients	Recommendation	Active (n=51) (%)			Inactive (n=32) (%)			P value [4]
		Under	Appropriate	Over	Under	Appropriate	Over	
DEC	EER ± SD [1]	29.4	13.7	56.9	18.8	3.1	78.1	.103
Carbohydrate	45-65% of the EER [1]	17.6	25.5	56.9	18.8	21.9	59.4	.979
Protein	0.8 g/kg [1]	9.8	3.9	86.3	9.4	3.1	87.5	.920
Total fat	20-35% of the EER [1]	21.6	33.3	45.1	12.5	15.6	71.9	.056
Saturated fat	10% of the EER [2]	-	49.0	51.0	-	28.1	71.9	.060
Cholesterol	300 mg [2]	-	47.1	52.9	-	31.2	68.8	.154
Fiber	14 g/1000 kcal [1]	37.3	62.7	-	43.8	56.2	-	.556
Sodium	1200; 1300; 1500 mg [3]	-	3.9	96.1	-	9.4	90.6	.309

DEC: dietary energy consumption; EER: estimated energy requirement.

[1] Source: IOM,2005[19].

[2] Source: Santos et al.,2013[20].

[3] 1200 mg: appropriate intake (AI) for individuals over 71 years; 1300 mg: AI for individuals from 51 to 70 years; 1500 mg: AI for individuals from 19 to 50 years. Source: IOM,2005[19].

[4] Pearson's chi-square.

Source: Research data.

The binary logistic regression analysis indicated that DEC and nutrients intake were not related to the occurrence of high values of BMI, WC, BF% or hypertension when considering all participants or the active subjects ($p \geq .05$). However, it was observed that the consumption of total (OR: 1.021, p = .035) and saturated fat (OR: 1.060, p = .033) among the inactive subjects increased the chance of being overweight (Table 4), according to BMI, with no association between food intake and WC, BF% or hypertension (p ≥ .05).

Table 4 - Binary logistic regression analysis between being overweight and total and saturated fat intake in inactive individuals

Inactive (n=32)		
	OR [1] (95% CI)	**P value**
Total fat	1.021 (1.001-1.041)	.035
Saturated fat	1.060 (1.005-1.117)	.033

95% CI: 95% confidence interval. [1] Odds ratio.

Source: Research data.

The main finding of this study was that only among the inactive individuals the consumption of total and saturated fat increased the chance of being overweight.

Among the individuals who participated in this study, 61.4% practiced physical activity in the free time. This finding was higher than that published by the Health Ministry of Brazil, in which the prevalence of people considered to be active in the free time, in Goiânia (capital of the state where this study took place) and Brazil, was 37.2% and 33.8%, respectively.[5] The higher number of active people found in this study, when compared with the above data, can be attributed to the actions of the City Council of Santo Antônio de Goiás that contribute to the practice of physical activity, such as the construction of hiking trail and squares equipped for sports and leisure activities.

In relation to risk factors for CVD, no difference was observed between active and inactive individuals. Similar data was found by Oliveira et al.[21] who did not observe any difference in the prevalence of obesity and hypertension between active and inactive adults and older adults of São Paulo, Brazil.

Although the practice of physical activity did not influence the frequency of CVD risk factors, more than 50.0% of the active and inactive individuals presented high BMI and WC values. This finding suggests that another life habit, such as inadequate diet, may have contributed more expressively to the high frequency of these risk factors for CVD, in both groups.[7]

In relation to the assessment of food intake, the mean DEC was higher than the mean EER, in both groups, probably contributing to more than half of the participants presenting BMI and WC above the recommendations. Data from the Brazilian Institute of Geography and Statistics (IBGE) of 2008 and 2009 revealed that, in Brazil, among the foods that presented increased acquisition per capita, compared to 2002 and 2003, were soft drinks, beer and bakery products, and all contribute to an energy intake above adequate, as found in this study.[22]

No difference was found in EER, DEC and nutrient intake between active and inactive subjects. Similar results were observed in other studies, in which the DEC, carbohydrate, protein, total fat, saturated fat, cholesterol and fiber intake did not differ in relation to the practice of physical activity.[23-25] Previously, a systematic review also confirmed that an increase in the practice of physical activity may did not influence the energy and macronutrients intake.[26] The data obtained in this study could indicate that the practice of physical activity in the free time did not increase the energy expenditure enough to promote differences in nutrient intake among active and inactive individuals. Therefore, a regular and more intense physical activity would be recommended to increase the energy expenditure, and consequently lead an increase in energy intake.[27]

In relation to added vegetable oil, salt and sugar, the individuals ingested quantities above the recommendation. The mean daily consumption of vegetable oil was 33.2 and 44.5 mL/day/person, for active and inactive subjects respectively, however, the United States Department of Agriculture (USDA) suggests that the total vegetable oil consumption for adults and older adults varies from 23.3 to 32.6 mL/day, according to age group.[28] The World Health Organization (WHO) recommends that added salt should not exceed 5.0 g/day, a value lower than the mean found in both groups (7.3 g/day among active and 9.2 g/day among inactive).[29] The daily consumption of sugar should be a maximum of 5.0% of EER (which equates to a mean of 29.0 g for active and 27.4 g for inactive subjects), with both groups exceeding this recommendation considering only the added sugar (40.1 and 42.5 g/day, respectively).[30]

Regarding the food consumption, it was observed that the adequacy of carbohydrate, total and saturated fat and cholesterol intake where higher in studies with North American and French active and inactive people than in individuals attended by the Brazilian PHS, however, in both groups the adequacy of fiber intake was higher in this study.[23,31] This percentage of appropriate consumption (62.7% and 56.2% among active and inactive, respectively) seems to be mainly related to the ingestion of beans, one of the main food of Brazilian meal, which presented a mean of 189 g (2.2 portions) at lunch and dinner daily, which represents 8.5 g fiber/100 g of food.[32,33]

Regardless the practice of physical activity, a high percentage of individuals with protein intake above the recommendation was identified, which was also identified in other studies.[34,35] However, for a more accurate assessment of this appropriate consumption an evaluation of the quality of protein would be necessary, adjusting the amount ingested for the score of essential amino acids and the digestibility values of different protein sources,[36] a limitation of this study.

In relation to sodium consumption, in both groups more than 90.0% presented consumption above the recommended level. When the tolerable upper intake level was considered, it was observed that 68.6% of the active and 75.0% of the inactive subjects consumed quantities above 2300 mg/day.[19] This is relevant because the excessive consumption of this nutrient can increase blood pressure and consequently cause coronary artery disease, myocardial infarction, renal disease and left ventricular hypertrophy.[37]

It was observed, through the binary logistic regression analysis, that total and saturated fat intake increased the chance of being overweight among the inactive people. A study conducted with Portuguese older men found a direct association between total fat intake and BMI ($p < .05$),[38] similar to the result observed in this study. This finding was probably found only among inactive subjects because the fat consumed would be stored in the adipose tissue instead of being oxidized due to the increase in the energy expenditure caused by the practice of physical exercise.[39] In addition, regarding saturated fat, Casas-Agustench et al.[40] found that saturated fat intake interacts with genes related to obesity, which influenced the increase of BMI of North Americans adults and older adults, corroborating the relationship between BMI and saturated fat identified in this study.

4 Conclusions

In this study, no difference was observed in the frequency of CVD risk factors between active and inactive adults and older adults. However, in both groups an energy intake above the recommendation was found, which probably contributed to the high frequency of subjects with high BMI and WC. In addition, total and saturated fat intake was predictor of being overweight among inactive individuals.

The above findings allow the inference that, although there was no difference in overweight between groups, the practice of physical activity in the free time played a protective role in the increase of body weight among the active individuals, since there was no difference in total and saturated fat intake between the active and inactive subjects.

From a practical perspective, the results can subsidize actions, mainly related to food and practice of physical activity, that promote improvements in the monitoring of adults and older adults attended by the Brazilian National Health System, aiming for the prevention of risk factors for CVD.

Acknowledgments

To the residents of Santo Antônio de Goiás, Brazil, for the receptivity and cordiality.

References

1. Palomo L, Félix-Redondo FJ, Lozano-Mera L, Pérez-Castán JF, Fernández-Berges D, Buitrago F. Cardiovascular risk factors, lifestyle, and social determinants: a cross-sectional population study. Br J Gen Pact 2014;64:627-33. doi: 10.3399/bjgp14X681793
2. Gheorghe A, Griffiths U, Murphy A, Legido-Quigley H, Lamptey P, Perel P. The economic burden of cardiovascular disease and hypertension in low- and middle-income countries: a systematic review. BMC Public Health 2018;18(1):975. doi: 10.1186/s12889-018-5806-x.
3. Nascimento BR, Brant LCC, Oliveira GMM, Malachias MVB, Reis GMA, Teixeira RA, et al. Epidemiologia das doenças cardiovasculares em países de língua portuguesa: dados do “Global Burden of Disease”, 1990 a 2016. Arq Bras Cardiol 2018;110(6):12. doi: https://doi.org/10.5935/abc.20180098
4. WHO - World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Genebra: WHO; 2009.
5. Brazil. Health Ministry. VIGITEL Brasil 2013: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2013. Brasília: Health Ministry; 2014.
6. WHO - World Health Organization. Waist circumference and waist-hip ratio. Genebra: WHO; 2011.
7. Schmidt MI, Duncan BB, Silva GA, Menezes AM, Monteiro CA, Barreto SM, et al. Chronic non-communicable diseases in Brazil: burden and current challenges. Lancet 2011;377(9781):1949-61.
8. Xu J, Eilat-Adar S, Loria C, Goldbourt U, Howard BV, Fabsitz RR, et al. Dietary fat intake and risk of coronary heart disease: the Strong Heart Study. Am J Clin Nutr 2006;84(4):894-902.
9. WHO - World Health Organization. Global recommendations on physical activity for health. Genebra: WHO; 2010.
10. Brazilian Society of Cardiology. VI Diretrizes Brasileiras de Hipertensão. Arq Bras Cardiol 2010; 95:1-51.
11. ISAK. Padrões internacionais para avaliação antropométrica. Guardalupe: International Society for the Advancement of Kinanthropometry; 2011.
12. WHO - World Health Organization. Physical status: the use and interpretation of anthropometry. Genebra: WHO; 1995.
13. Lipschitz DA. Screening for nutritional status in the elderly. Primary Care 1994;21(1):55-67.
14. Lean M, Han T, Morrison C. Waist circumference as a measure for indicating need for weight management. BMJ 1995;311(6998):158-61.
15. Petroski EL. Desenvolvimento e validação de equações generalizadas para a estimativa da densidade corporal em adultos. Santa Maria: Federal University of Santa Maria; 1995.
16. Tran ZV, Weltman A. Predicting body composition of men from girth measurements. Human Biol 1988;60(1):167-75.
17. Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamoto Y. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr 2000;72(3):694-701.
18. Cardoso MA, Stocco PR. Desenvolvimento de um questionário quantitativo de frequência alimentar em imigrantes japoneses e seus descendentes residentes em São Paulo, Brasil. Cad Saude Publica 2000;16(1):107-14.
19. IOM. Dietary Reference Intakes (DRIs): Estimated Average Requirements. Washington: Institute of Medicine; 2005.
20. Santos R, Gagliardi A, Xavier H, Magnoni C, Cassani R, Lottenberg A. I diretriz sobre o consumo de gorduras e saúde cardiovascular. Arq Bras Cardiol 2013;100(1):1-40.
21. Oliveira GF, Bartholomeu T, Tinucci T, Forjaz CLM. Risco

cardiovascular de usuários ativos, insuficientemente ativos e inativos de parques públicos. Rev Bras Cineantropom Desempenho Hum 2008;10(2):170-5

22. IBGE. Pesquisa de Orçamentos Familiares 2008-2009: aquisição alimentar e domiciliar per capita. São Paulo: IBGE; 2010.
23. Rolland Y, Pillard F, Garrigue E, Amouyal K, Riviere D, Vellas B. Nutritional intake and recreational physical activity in healthy elderly women living in the community. J Nutr Health Aging 2005;9(6):397-402.
24. Kim Y, Kim HA, Kim J-H, Kim Y, Lim Y. Dietary intake based on physical activity level in Korean elementary school students. Nutr Res Pract 2010;4(4):317-22.
25. Keska A, Sobczak M, Lutoslawska G, Mazurek K, Tkaczyk J, Klos A, et al. Indices of body composition, energy and macronutrient intakes in young men and women with different physical activity. J Pre Clin Clin Res 2013;7(1):36-9.
26. Donnelly JE, Herrmann SD, Lambourne K, Szabo AN, Honas JJ, Washburn RA. Does increased exercise or physical activity alter ad-libitum daily energy intake or macronutrient composition in healthy adults? A systematic review. PLoS One 2014;9(1):e83498. doi: 10.1371/journal.pone.0083498.
27. Westerterp KR. Exercise, energy expenditure and energy balance, as measured with doubly labelled water. Proc Nutr Soc 2018;77(1):4-10. doi: 10.1017/S0029665117001148.
28. USDA. All about oils. Washington: Department of Agriculture; 2015.
29. WHO - World Health Organization. Diet, nutrition and the prevention of chronic diseases. Genebra: WHO; 2003.
30. WHO - World Health Organization. Guideline: sugar intake for adults and children. Genebra: WHO; 2019.
31. Brodney S, Mcpherson RS, Carpenter R, Welten D, Blair SN. Nutrient intake of physically fit and unfit men and women. Med Sci Sports Exerc 2001;33(3):459-67.
32. Brazil. Ministério da Saúde. Guia alimentar para a população brasileira. Brasília: MS; 2008.
33. NEPA. Tabela brasileira de composição de alimentos (TACO). Núcleo de Estudos e Pesquisas em Alimentação. Campinas: NEPA; 2011.
34. Quintão D, Oliveira G, Silva S, Marins J. Estado nutricional e perfil alimentar de atletas de futsal de diferentes cidades do interior de Minas Gerais. Rev Bras Futebol 2013;2(1):13-20.
35. Leal GVS, Philippi ST, Matsudo SMM, Toassa EC. Consumo alimentar e padrão de refeições de adolescentes, São Paulo, Brasil. Rev Bras Epidemiol 2010; 13(3):457-67.
36. WHO - World Health Organization. Necesidades de energía y de proteínas. WHO; 1985.
37. Adrogué HJ, Madias NE. Sodium and potassium in the pathogenesis of hypertension. N Engl J Med 2007;356(19):1966-78.
38. Rodrigues A, Pereira PC, Vicente AF, Brito JA, Bernardo MA, Mesquita MF. Food intake, body mass index and body fat mass in elderly. Asian J Clin Nutr 2012;4(8):107-15.
39. Hansen K, Shriver T, Schoeller D. The effects of exercise on the storage and oxidation of dietary fat. Sports Med 2005;35(5):363-73.
40. Casas-Agustench P, Arnett DK, Smith CE, Lai C-Q, Parnell LD, Borecki IB, et al. Saturated fat intake modulates the association between an obesity genetic risk score and body mass index in two US populations. J Acad Nutr Diet 2014;114(12):1954-66. doi: 10.1016/j.jand.2014.03.014.