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## Food intake and serum cholesterol levels in women nutritionists

### *Consumo alimentar e níveis de colesterol sérico em mulheres nutricionistas*

#### Abstract

**Introduction:** Food intake and its association with the lipid profile have been widely studied, since excessive intake of cholesterol and saturated fats are implicated in the genesis of cardiovascular diseases, as well as overweight. Health professionals, as well as nutritionists, are not immune to these health problems. **Objective:** To evaluate the correlation between food intake and serum cholesterol levels in women nutritionists with and without overweight. **Methods:** The sample consisted of 169 women nutritionists working in the state of Pernambuco, who, through an online questionnaire, reported the following variables: age, body mass index, total serum cholesterol, and answered a 24-hour Food Recall in duplicate. A descriptive analysis of the data was performed; Pearson's correlation coefficient and multiple linear regression were used, considering  $p < 0.05$  as significant. **Result:** The prevalence of hypercholesterolemia was 27.2%, and overweight was 21.9%. The higher protein intake of the diet proved to be a determining factor for the reduction of total serum cholesterol.

ol levels in nutritionists with and without excess weight. The increase in body mass index and age was also a determining factor for hypercholesterolemia in both groups evaluated in this study. **Conclusion:** Food intake seems to have an important influence on total cholesterol serum levels, especially proteins.

**Keywords:** Nutritionists. Nutritional Status. Food Intake. Cholesterol.

### Resumo

**Introdução:** O consumo alimentar e sua associação com o perfil lipídico vêm sendo bastante estudados, visto que o consumo excessivo de colesterol e gorduras saturadas estão implicados na gênese das doenças cardiovasculares, assim como o excesso de peso. Os profissionais de saúde, bem como os nutricionistas, não estão imunes a esses agravos à saúde. **Objetivo:** Avaliar a correlação do consumo alimentar com o nível de colesterol sérico em mulheres nutricionistas com e sem excesso de peso. **Métodos:** A amostra foi constituída por 169 mulheres nutricionistas atuantes no estado de Pernambuco, que através de um questionário online, referiram as variáveis idade, índice de massa corporal, colesterol total sérico e responderam a um Recordatório Alimentar de 24 horas em duplicata. Realizou-se a análise descritiva dos dados; foram utilizados o coeficiente de correlação de Pearson e a regressão linear múltipla, considerando-se significante  $p < 0,05$ . **Resultado:** A prevalência de hipercolesterolemia foi de 27,2%, e de excesso de peso, 21,9%. A maior ingestão proteica da dieta se mostrou um fator determinante para a redução dos níveis de colesterol total sérico, em nutricionistas com e sem excesso de peso. O aumento do índice de massa corporal e da idade também foi fator determinante da hipercolesterolemia em ambos os grupos avaliados neste estudo. **Conclusão:** O consumo alimentar parece ter influência importante sobre os níveis séricos de colesterol total, com destaque para as proteínas.

**Palavras-chave:** Nutricionistas. Estado Nutricional. Consumo Alimentar. Colesterol.

## INTRODUCTION

Nutritionists, health professionals who deal with weight disorders, are not immune to the diagnosis of overweight and obesity.<sup>1</sup> There are reports in the literature that the prevalence of overweight among women nutritionists is 47.6% – values close to the data on national prevalence –, and that about 25% present hypercholesterolemia.<sup>2</sup> That is, despite the technical knowledge, the nutritional disorders present similar prevalence to that of the data on the Brazilian population.<sup>2</sup>

Higher body mass index (BMI) values are related to higher plasma levels of total cholesterol and LDL (low density lipoprotein). Therefore, the use of low-calorie diets may be favorable in the control of excess weight and, therefore, hypercholesterolemia.<sup>3</sup>

The relationship between food intake and nutritional status, as well as its association with the lipid profile, has been widely studied, and one nutrient that has been gaining prominence is protein. However, the effects of reduction in serum levels of cholesterol, triglycerides and apo-B have been better observed with hyperproteic diets (20 to 30% of total energy value - TEV), when compared with protein values of around 10% of TEV in the diet.<sup>4</sup>

The quality of fat in the diet can also influence the health of individuals and, among the fats consumed, saturated fat has been associated with changes in the lipid profile, with significant increases in concentrations of total cholesterol and LDL cholesterol. For this reason, it is considered atherogenic and a nutrient that presents cardiovascular risk.<sup>5</sup>

Unlike saturated fatty acids, monounsaturated fatty acids would act by reducing LDL cholesterol and triglycerides, and increasing HDL (high density lipoprotein). Thus, consuming monounsaturated fatty acids as the main source of dietary fat to replace saturated fatty acids can improve the lipid profile of individuals and reduce other cardiovascular risk factors.<sup>6</sup> Omega-3 polyunsaturated fatty acids also present consistent scientific evidence with benefits that are dose-dependent in reducing hypertriglyceridemia and increasing HDL-c levels.<sup>5,7</sup>

Another nutrient associated with the improvement of the lipid profile is the soluble dietary fiber, which would reduce serum levels of total cholesterol and LDL-c, besides helping to maintain body weight and reduce systemic blood pressure and inflammation indicators.<sup>8,9</sup>

Thus, this study aimed to assess the correlation of food consumption with the level of total serum cholesterol in female nutritionists in the state of Pernambuco, according to the overweight condition.

## MATERIAL AND METHODS

This was a cross-sectional study, based on the analytical epidemiological model, involving women nutritionists enrolled in the Regional Council of Nutritionists - 6th Region (CRN6), working in the state of Pernambuco, Brazil, and who had an e-mail registered in the Council. Nutritionists associated to CRN6 and working in the state of Pernambuco in 2013 were invited to participate, i.e., about 2,100 professionals, of which 90% were females (n=1,890). The sampling used was non-probabilistic, according to the availability of the respondents, since the data collection was performed through online questionnaires.

CRN6 informed, via e-mail, all nutritionists in the state about the research, its objectives and the address of the questionnaire page on the Internet (link). By clicking on the link, the participants had access to a website that presented the research team and the participation method, by completing the questionnaire. In this stage, the nutritionists were informed about the confidentiality of the data and the ethical aspects of the study, and were invited to confirm their participation by clicking the "I accept to participate" button to proceed to the following screen, where they found the electronic questionnaire. It contained schedule instructions, and the participants would see a message displayed on the screen if they had not completed all the questions, indicating the open items, to avoid sending incomplete data. After completion, they were instructed to click the "Submit questionnaire" button, and the data were stored on the Internet server. All nutritionists received the information that they could withdraw from the research at any time, simply by not clicking the above-mentioned button.

Nutritionists who declared to be pregnant and those who completed the questionnaires incorrectly or incompletely were excluded from the study. It is worth mentioning that, despite the easy access of these professionals to the digital environment, this study did not achieve the expected adherence.

To assess the occurrence of overweight, the BMI was used according to the World Health Organization classification,<sup>10</sup> and all data were used to calculate the BMI (weight and height). Although it can be considered an information bias, it is important to emphasize that the sample was made up of professionals trained to take anthropometric measurements, many of whom use them in their daily work routine, and that the referred weight and height present acceptable levels of validity, even among the obese and in groups with low schooling levels.<sup>11</sup>

To evaluate the total serum cholesterol, the blood tests reported by the own professionals were used, which were performed up to six months before the study, during their health assessment routines, and were considered to be appropriate values lower than 200mg/dL.<sup>12</sup>

The 24-hour Food Recall (R24h) was chosen for the analysis of the food intake of nutrients, and it was applied in duplicate with the objective of reducing the intrapersonal varia-

tion in energy consumption and the macronutrients evaluated (carbohydrate, protein, total fat, saturated fat, polyunsaturated fatty acids (omega-3, omega-6) and monounsaturated fatty acids (omega-9) and fibers. It is noteworthy that it was requested that both R24h were filled with an interval of at least three days between the collections, and that it was not performed on weekends or holidays. The online questionnaire also included questions related to dietary variables, such as: the amount of portions of food consumed per day, referring to each group of the adult food pyramid, adapted from Philipi et al.<sup>13</sup>

The data were recorded with double entry and verified with Validate, module of the Epi-info Program version 6.04 to check their consistency and validation. Statistical analysis was performed using the Statistical Package for Social Sciences - SPSS version 13.0 (SPSS Inc., Chicago, IL, USA).

The analysis of the diet composition was performed using the Nutrition support software of Escola Paulista de Medicina (1993). The base table of this program is the one from the United States Department of Agriculture, 1976-1986. Thus, due to the occurrence of numerous regional consumables, some foods were added to the program, through the information available in the Taco Tables<sup>14,15</sup> and in the Nutritional Composition Tables of Food Consumed in Brazil.<sup>16</sup>

For statistical analysis, the Kolmogorov-Smirnov test was performed in order to assess the normality of the distribution of the studied variables, and all of them had a Gaussian distribution. To evaluate the correlation of total serum cholesterol with food intake, age and BMI, Pearson's correlation coefficient was used; and to analyze the factors that may influence serum cholesterol levels in nutritionists with and without overweight, multiple linear regression was used, based on the independent variables that presented significant statistical differences. The level of statistical significance was  $p < 0.05$ .

This study was guided by the ethical norms for research involving human beings, contained in Resolution n. 466/2012 of the National Health Council, and was approved by the Ethics Committee of the Federal University of Pernambuco (CAAE: 13380613.4.0000.5208). It is noteworthy that the nutritionists who agreed to participate received all the information about the study and only had access to the electronic questionnaire after clicking the "I agree to participate" button.

**RESULTS**

A total of 169 nutritionists working in the state of Pernambuco were evaluated, of which 27.2% (n = 46) presented hypercholesterolemia and 21.9% (n = 37) had excess weight (16.5% overweight and 5.4% obese). Table 1 describes the mean and standard deviation of total serum cholesterol, age and food intake variables according to the occurrence of excess weight.

**Table 1.** Mean and standard deviation of total serum cholesterol, food intake variables and age according to the occurrence of excess weight in nutritionists in the state of Pernambuco, Northeast Brazil, 2013.

Variables	Excess Weight		P*
	Yes (n=37)	No (n=132)	
Total serum cholesterol (mg/dL)	183.0+36.9	179.4+28.8	0.359
Energy (Kcal)	1385+445	1499+426	0.016
Carbohydrate (g)	198.9+71.8	214.0+71.7	0.055
Proteins (g)	69.6+25.9	74.6+24.4	0.071
Fats (g)	37.2+19.6	39.8+16.4	0.165
Saturated fat (g)	12.3+8.3	13.3+6.6	0.205
Monounsaturated fatty acid (g)	11.9+7.1	13.1+6.6	0.090
Polyunsaturated fatty acid (g)	5.2+3.2	5.9+3.4	0.391
Fibers (g)	17.9+7.4	21.2+10.1	0.002
Fruit portions (unit)	2.9+1.1	2.7+1.1	0.026
Green leaves portions (unit)	2.1+0.8	2.3+1.0	0.109
Age (years old)	38.3+11.5	33.9+10.6	< 0.001

\*Student's t test

The mean total serum cholesterol was not statistically significant considering the values of the group with and without excess weight (p = 0.359). In the comparative study, lower energy consumption (p = 0.016) and fiber consumption (p = 0.002) were observed, as well as higher consumption of fruit portions (p = 0.026) in the overweight group. In addition, age was also higher in overweight nutritionists (38.3 x 33.9 years old), p < 0.001 (table 1).

The correlation analyses between total serum cholesterol and the study variables are presented in table 2. It was observed that, in overweight women, no food intake variables, as well as age, showed a significant correlation with the total blood cholesterol. Only BMI showed

a positive correlation with the total serum cholesterol levels (r = 0.221; p = 0.048). In the group without excess weight, there was a significant negative correlation between diet fat intake (r = - 0.130; p = 0.045) and total serum cholesterol; at the same time, it was possible to identify a positive correlation with BMI (r = 0.294; p < 0.001) and age (r = 0.243, p < 0.001).

**Table 2.** Correlation coefficient (r) between total serum cholesterol, food intake variables, BMI and age, according to the occurrence of excess weight in nutritionists in the state of Pernambuco, Northeast Brazil, 2013.

Variables	Total Serum Cholesterol (mg/dL)			
	With excess weight (n=37)		Without excess weight (n=132)	
	r	p*	r	p*
Energy (Kcal)	-0.148	0.215	-0.064	0.327
Carbohydrate (g)	0.000	0.999	0.034	0.604
Proteins (g)	-0.310	0.090	-0.099	0.129
Fats (g)	-0.181	0.127	-0.130	<b>0.045</b>
Saturated fat (g)	-0.212	0.074	-0.064	0.323
Monounsaturated fatty acid (g)	-0.193	0.104	-0.076	0.243
Polyunsaturated fatty acid (g)	-0.027	0.822	-0.084	0.197
Fibers (g)	-0.011	0.929	0.024	0.717
Fruit portions (unit)	0.030	0.794	0.111	0.072
Green leaves portions (unit)	-0.241	0.055	0.034	0.611
BMI (Kg/m <sup>2</sup> )**	0.221	<b>0.048</b>	0.294	<b>&lt; 0.001</b>
Age (years old)	0.179	0.112	0.243	<b>&lt; 0.001</b>

\* Spearman correlation test; \*\*BMI - body mass index.

In multiple linear regression for overweight nutritionists (table 3), it was found that the protein intake (P = - 0.172; p = 0.036), BMI (P = 1.171; p = 0.036) and age (P = 0.615; p < 0.001) are determining factors for total serum cholesterol levels in this population, and that 13% of this variation can be explained by these variables (R<sup>2</sup> adjusted = 0.132 p < 0.001).

**Table 3.** Multiple linear regression for total serum cholesterol (mg/dL) in overweight nutritionists in the state of Pernambuco, Northeast Brazil, 2013.

Independent variables	Regression Coefficient**	p
Proteins (g)	-0.172	0.036
Fats (g)	-0.202	0.346
Saturated fat (g)	0.041	0.094
Monounsaturated fatty acid (g)	0.026	0.053
Green leaves portions (unit)	-2.175	0.235
BMI (Kg/m2)*	1.171	0.036
Age (years old)	0.615	< 0.001

\*BMI - body mass index, \*\*R<sup>2</sup> adjusted for overweight nutritionists = 0.132 (p < 0.001), n=37.

**Table 4.** Multiple linear regression for serum cholesterol (mg/dL) in non-overweight nutritionists in the state of Pernambuco, Northeast Brazil, 2013.

Independent variables	Regression Coefficient**	p
Proteins (g)	-0.161	<b>0.047</b>
Fats (g)	-0.156	0.302
Polyunsaturated fatty acid (g)	0.331	0.647
Fruit portions (unit)	1.359	0.414
BMI (Kg/m2)*	3.610	<b>&lt; 0.001</b>
Age (years old)	0.447	<b>0.012</b>

\*BMI - body mass index, \*\*R<sup>2</sup> adjusted for non-overweight nutritionists = 0.116 (p < 0.001), n=132.

Table 4 analyzed the women nutritionists without excess weight, and also observed that protein intake (P = - 0.161; p = 0.047), BMI (P = 3.610; p < 0.001) and age (P = 0.447; p = 0.012) were also determining factors for total serum cholesterol levels, and that these variables explained 12% of the variation in total serum cholesterol (R<sup>2</sup> adjusted = 0.116 p < 0.001).

## DISCUSSION

The data presented here demonstrate a certain specificity because they were obtained from a sample of female nutritionists, health professionals, who deal with nutritional disorders related to weight, as well as metabolic changes in the routine of their daily work.

Of the 169 nutritionists evaluated, 21.9% were overweight, a value lower than that found in population-based studies in Brazilian adult women, which is higher than 50.0%.<sup>17</sup> That is, the results demonstrate the concern of these women with the maintenance of an adequate weight compatible with the social requirement for the practice of their profession.

On the other hand, the prevalence of hypercholesterolemia (27.2%) was higher than that found by Jardim et al.<sup>18</sup> in their study with health professionals, including nutritionists (17.4%), and by Costa and Thuler<sup>19</sup> in Brazilian adult women (24.6%). Finally, the fact of being a health professional did not reduce the prevalence of hypercholesterolemia, thus demonstrating the relevance of this condition to health. However, when analyzing the mean total serum cholesterol, it was within the normal values, not showing a statistically significant difference between the groups with and without excess weight.

It was also possible to observe that, contrary to expectations, overweight nutritionists had a lower energy consumption than those without excess weight, which may reflect a condition of reverse causality - that is, overweight nutritionists could already be on a low-calorie diet at the time of data collection.

As the design of the study is cross-sectional, it is not possible to assess the issue of causality. However, it has already been described that overweight female nutritionists suffer from the stigma of being within the BMI appropriate for their age,<sup>1</sup> that is, eutrophic, which may have led to information biases and influenced the outcome of this research.

On the other hand, a higher fiber intake was observed among nutritionists without overweight, which may be associated with a higher intake of whole foods and plant-based foods in this group, although they showed similar intake means to those found in other population studies.<sup>20,21</sup> However, in both groups, nutritionists presented fiber/day intake means that meet the minimum intake recommendations (14g per 1,000kcal), proposed by the Guidelines of the Brazilian Diabetes Society.<sup>22</sup>

When analyzing the age of nutritionists, it was observed that the overweight group presented a significantly higher mean than the group without excess weight, corroborating data already described in the literature, according to which excess weight increases with age.<sup>23,24</sup>

It is worth mentioning that hypercholesterolemia has a multifactorial cause and constitutes an independent risk factor for the development of the early atherosclerotic process,

which may begin in childhood, thus increasing the risk for the development of chronic diseases in adulthood.<sup>25</sup> Among the factors correlated with total serum cholesterol levels, the age of the nutritionists, as well as their BMI, confirm the influence of weight increase and age on the increase in total serum cholesterol levels, as already reported in the literature.<sup>3,26</sup>

The negative correlation found between total serum cholesterol and the total fat intake of the diet by nutritionists without excess weight may also be due to reverse causality or the different types of fat consumed by them, since this group has a different technical-scientific knowledge in relation to the general population. This can generate healthier food choices and thus influence the results of the research, since fatty acids can have different functions and actions in our bodies, depending on the type, amount and daily proportion consumed.<sup>5,26</sup>

The absence of a significant correlation between saturated fat intake and total serum cholesterol levels in this study is also noteworthy, which does not corroborate the findings described in the literature.<sup>5,7</sup> This absence of correlation may have been influenced by the low average consumption of saturated fat in this population, not exceeding 10% of the recommended daily intake,<sup>7</sup> besides the lower mean consumption of saturated fat than that found in POF 2008-2009<sup>21</sup> for Brazilian adult women. This reflects, to some extent, the influence of the knowledge acquired with the profession on their food choices.

The higher protein intake of the diet can be considered a determining factor for the reduction of total serum cholesterol levels, both in overweight and non-overweight nutritionists, in agreement with the results by Li et al.<sup>4</sup> These findings seem to suggest that a higher protein intake promotes a metabolic response that significantly reduces cholesterolemia in adult women. However, the effect of consuming hyperproteic diets on total serum cholesterol levels is still controversial and there are studies that do not corroborate these findings.<sup>27,28</sup>

Increased BMI and age were also determining factors of hypercholesterolemia in both groups evaluated in this study, which was also observed by Valle et al.<sup>3</sup> and Pereira et al.<sup>29</sup> It seems that the metabolic and hormonal changes caused by the excess weight, as well as those that appear with age, can change the total serum cholesterol levels in isolated and significant ways in women.

However, other studies are necessary to better clarify the protective effect of the intake of hyperproteic diets, as well as the true association of dietary fats in hypercholesterolemia, so that targeted dietary intervention measures can be defined, as well as more precise food intake recommendations that help in the prevention and treatment of hypercholesterolemia.

This study presented some important limitations, such as the fact that it was carried out through an online questionnaire, not allowing the analysis of the body composition of the

nutritionists, which prevented some conclusions and associations regarding the percentage of body fat of these professionals.

The sample definition can also be considered a limiting factor, considering the fact that it is not random, it is specific and has a reduced number, which does not allow us to extrapolate the results to other population groups.

## CONCLUSION

In view of the data presented, food intake showed, once again, to have an important role in the levels of total serum cholesterol, with emphasis on proteins and dietary fats, which presented significant correlations with serum cholesterol levels.

In addition, the independent variables BMI, age and protein were considered determining factors for cholesterolemia in this population, which confirms the importance of healthy eating habits and the maintenance of body weight within normal limits, in order to promote the prevention of this health hazard.

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**Collaborators**

dos Santos HVD participated in the conception, collection, data analysis and writing of the article. Cabral PC participated in the design of the research, methodology, data analysis, writing and final approval of the article for publication.

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