

Nutritional knowledge, anthropometric profile, total cholesterol, and motivations among Peruvian vegetarians and non-vegetarians

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Recibido: 30/noviembre/2020. Aceptado: 12/febrero/2021.

ABSTRACT

Background: Research often reports on the anthropometric and biochemical profile of vegetarians and non-vegetarians, yet few have compared nutritional knowledge in both populations. This cross-sectional study compared nutritional knowledge, anthropometric profile, and total cholesterol among Peruvian vegetarians and non-vegetarians. In addition, the motivations for choosing a vegetarian diet were analyzed.

Materials and methods: A registry card and a questionnaire were administered to evaluate sociodemographic, anthropometric, total cholesterol, nutritional knowledge, and motivation data of the vegetarians. Data were analyzed using Chi-square and t-student tests, considering a significance level of 5%.

Results: No significant difference was found in the level of nutritional knowledge of the two groups. In addition, a sufficient score was not observed in either group (>80 %). Total cholesterol concentration was significantly lower in vegetarians (166.307 ± 26.139 mg/dL vs. 189.138 ± 38.451 mg/dL, $p < 0.01$). Vegetarians had significantly lower average weight, body mass index (BMI), and waist circumference (WC) compared to non-vegetarians (59.948 ± 8.923 kg vs.

64.362 ± 12.272 kg, $p = 0.017$), (23.22 ± 3.026 kg/m² vs. 25.152 ± 3.373 kg/m², $p < 0.01$) and (78.435 ± 10.883 cm vs. 86.207 ± 13.662 cm, $p < 0.01$), respectively. The "health benefits" were the main motivations to opt for vegetarianism (32.3%).

Conclusions: Vegetarians presented a better anthropometric profile and lower levels of total cholesterol. However, there were no differences regarding knowledge levels. The highest proportion of vegetarians report choosing the vegetarian lifestyle for health reasons.

KEYWORDS

Body Mass Index, Motivation, Waist Circumference, Vegetarian diets, Cholesterol, Peru.

INTRODUCTION

Vegetarianism is more than abstaining from meat and meat products, it consists of the adequate consumption of minimally processed foods of vegetable origin. In addition, it constitutes one of the healthiest dietary patterns that positively influences a person's state of health and nutrition. This quality makes the vegetarian diet an ideal diet capable of maintaining a BMI, WC, and plasma cholesterol levels within healthy ranges¹. Moreover, people who practice a vegetarian diet have a lower risk of chronic non-transmissible diseases such as obesity, cardiovascular disease², different types of cancer, and type 2 diabetes mellitus³. Although there are certain inconsistencies⁴.

An individual's motivation to follow a vegetarian diet can have very positive implications on the intake of essential nu-

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trients and thus on his/her anthropometric profile and plasma cholesterol concentration. There are several reasons that motivate people to follow the vegetarian lifestyle⁵. Among the most prominent motivations are the benefits of physical and mental well-being, the desire to care for the environment, and compassion for animals⁶.

Despite the benefits of vegetarian diets, it seems that not everyone who follows this diet can meet their nutritional requirements. Plant-based diet, especially the vegan diet, is associated with a favorable anthropometric profile and nutritional biomarkers, however, low concentrations of essential micronutrients such as 25 hydroxyvitamin D3 (25 (OH) D3), iodine and selenium have been found compared to reference values⁷. This deficiency could be explained by the minimal basic knowledge that some vegetarians have about the diet.

To enjoy the health benefits of a vegetarian diet, an adequate and optimal nutritional intake is important. Such a dietary intake would not be possible without adequate nutritional knowledge. Regardless of dietary pattern, nutritional knowledge is a key factor in achieving a healthy dietary habit and maintaining optimal health⁸.

Lack of nutritional knowledge is considered one of the main causes of inadequate dietary habits in vegetarians and non-vegetarians. Although the vegetarian diet generally follows a more varied and nutritious pattern of intake, it creates a question as to whether or not vegetarians have greater nutritional knowledge than non-vegetarians⁹. The few existing studies on the subject have shown that both vegetarians and non-vegetarians often have misconceptions about nutrition and are misinformed about dietary recommendations¹⁰. This highlights the need for nutrition education for both population groups. Additionally, only a few studies have compared nutritional knowledge between vegetarians and non-vegetarians¹⁰. Having ample information on this variable is crucial, since it can highlight the need for health professionals, specifically nutritionists, to be trained to adequately address and orient people to the importance of adopting a balanced diet. In addition, information on the level of nutritional knowledge would help meet the need to design and implement specific interventions on nutrition for the study population based on nutritional education.

This study aims to compare nutritional knowledge, anthropometric profile, total cholesterol, and motivations among Peruvian vegetarians and non-vegetarians.

MATERIALS AND METHODS

Design, type of research and participants

A cross-sectional study was conducted. A total of 149 vegetarians and non-vegetarians between the ages of 18 and 49 from the eastern region of the city of Lima were recruited to participate in the study. Participants were selected through

non-probability sampling for convenience. Participants who did not sign the informed consent form, who did not fill out the instruments correctly, and those who presented diabetes mellitus, cardiovascular disease, hypercholesterolemia, and those who underwent psychological treatment were excluded. The purpose of this study was explained to the participants before the data was collected. The study was conducted in accordance with the ethical principles indicated in the Declaration of Helsinki and received the approval of the Research Ethics Committee of Universidad Peruana Unión and registered under reference number: N° 00124-2020/UPeU/FCSCIISA.

Registration form and nutritional knowledge

Data collection was done through validated instruments designed from relevant previously published studies⁶. A registration form was used to collect sociodemographic data such as age, gender, nationality, marital status, level of education. In addition, anthropometric and biochemical data were taken into account, such as weight, height, BMI, WC, and total cholesterol concentration. Likewise, the motivations for choosing vegetarian diets. The levels of knowledge of the participants were determined through a questionnaire developed according to the criteria suggested by FAO in its Guide to assess knowledge, attitudes, and practices in nutrition, whose questions can be viewed at <http://www.fao.org/3/i3545e/i3545e00.htm>. To determine the clarity and feasibility of the questionnaire, the instrument was tested. Reliability was determined through the Kuder-Richardson analysis. Cronbach's α coefficient was > 0.7 . The evaluation of nutritional knowledge was made considering a scale based on a minimum score of 60% and was classified in the following way: scores lower than or equal to 60% of correct answers were considered low knowledge, 61 to 80% of correct answers were considered regular knowledge, and correct answers greater than 80% were considered sufficient knowledge¹¹.

Anthropometric measurements

The anthropometric measurements were taken in the Nutritional Clinic at the Universidad Peruana Unión. To measure weight and height, a calibrated SECA 700 mechanical column scale was used, with a capacity of 220 kg and a measurement range of 60 to 200 cm (SECA®, Hamburg, Germany). The BMI was calculated according to the parameters established by the WHO¹², using the Quetelet index and was classified as follows: thin, ≤ 18.5 kg/m²; between 18.5 and ≤ 24.9 kg/m², eutrophic; between 25.0 and 29.9 kg/m², overweight; ≥ 30 kg/m², obese. The WC was determined through a Cescorf self-retracting metallic steel tape measure (Cescorf Equipamentos Para Esporte Ltda - Epp, Brazil). WC was classified according to the criteria established by the Peruvian Ministry of Health¹³: in men, < 94 cm, low risk; ≥ 94 cm, high risk and ≥ 102 cm, very high risk. In women, < 80 cm, low risk; ≥ 80 cm, high risk and

≥ 88 cm, very high risk. The anthropometric measurements were taken in triplicate by the same professional nutritionist trained in anthropometry.

Determination of total cholesterol

Five ml of blood were extracted during the first two hours of the morning. Commercial Colestat AA enzyme kits by Wiener Lab were used to determine serum cholesterol with standardized techniques based on enzymatic and colorimetric methods, by spectrophotometry, according to the manufacturer's recommendations. Concentrations equal to or higher than 200 mg/dL were considered hypercholesterolemic. The extraction and processing of the serums were carried out by a certified and Trained Medical Technologist from the Microbiology Laboratory of Universidad Peruana Unión.

Statistical analysis

The program SPSS, version 25 (SPSS Inc., Chicago, IL, USA) was used for data processing and analysis. Descriptive analysis was also carried out using tables and graphs for frequency and percentage. The chi-square test was used to contrast the proportions in tables 1 and 3 of the study population. In addition, a significance level of 5% was considered.

RESULTS

A total of 149 participants were voluntarily included in the study: 62 vegetarians and 87 non-vegetarians. The socio-demographic characteristics of the sample and motivations of the vegetarians are shown in table 1. The participants were between 18 and 59 years old. Vegetarians and non-vegetarians who were 18-25 years old represented 32.3% and 20.7%, respectively, while 46.8% and 41.4% represented vegetarians and non-vegetarians over 36 years of age, respectively. The two groups of the study population had almost equal proportions of being married and single. Regarding the sex of the participants, the largest proportion of the sample was made up of vegetarian women (69.4%) compared to non-vegetarians (65.5%). Regarding the level of education, the greatest proportion of vegetarians presented a higher level of education compared to non-vegetarians, and this difference was significant (85.5% vs 40.2%, $p < 0.01$). In addition, the main reasons for following the vegetarian diet are described. "Health benefits" were highlighted, followed by "ecological or environmental reasons" and "moral principles" with a proportion of 32.3%, 24.2%, and 21.0% of the sample, respectively.

To identify possible differences between the variables nutritional knowledge, weight, height, BMI, WC, and total cholesterol in vegetarians and non-vegetarians, a Student t-test was carried out (table 2). No significant difference was found

in the nutritional knowledge level of the two groups. In addition, a sufficient score was not observed in either group (> 80 %). Vegetarians had significantly lower average weight compared to non-vegetarians (59.948 ± 8.923 kg vs. 64.362 ± 12.272 kg, $p < 0.01$). The findings showed no significant difference for the size of both groups. It was found that BMI values of vegetarians were significantly lower than non-vegetarians (23.22 ± 3.026 kg/m² vs. 25.152 ± 3.373 kg/m², $p < 0.01$). The WC was significantly lower (78.435 ± 10.883 cm vs. 86.207 ± 13.662 cm, $p < 0.01$) in vegetarians than non-vegetarians, although the values were within the normal ranges for both groups. Vegetarians had a significantly lower concentrations of total cholesterol compared to non-vegetarians (166.307 ± 26.139 mg/dL vs. 189.138 ± 38.451 mg/dL, $p < 0.01$), although the total-cholesterol values were within the recommended range.

To improve the data analysis, the variables were classified according to the cutoff points described in materials and methods. It was found (table 3) that the proportions observed for the variable nutritional knowledge were similar in both vegetarians and non-vegetarians; a greater proportion of vegetarians (72.6%) presented normal weight in comparison to non-vegetarians (48.3%, $p < 0.01$); significant differences were observed. Regarding WC, more than half (77.4%) of the vegetarians presented a low risk of disease compared to non-vegetarians (39.1%); this difference was significant ($p < 0.01$). Regarding the concentration of total cholesterol, 96.8% of the vegetarians were in the normal range compared to non-vegetarians (41.4%, $p < 0.01$).

DISCUSSION

An adequate level of knowledge about both vegetarian and non-vegetarian dietary patterns is an effective option for reducing the risks of chronic non-communicable diseases, which are a major health concern for both the general population and health professionals. This study compared nutritional knowledge, anthropometric profile, cholesterol, and motivations in vegetarians to non-vegetarians.

According to analyses of the socio-demographic aspects of the study (table 1), the proportion of highly educated participants was significantly higher in vegetarians than in non-vegetarians. This confirms the findings observed previously in other studies where high levels of education have been shown to be related to the vegetarian dietary pattern^{14,15}. It is worth mentioning that education could be considered a powerful predictor in the choice of a healthy dietary pattern. It is worth noting that educated people often demonstrate a greater awareness of the importance of food in the prevention of chronic diseases. In addition, with a high level of education, people may have more resources and tools for nutrition education and health promotion to improve their behaviors or lifestyle and understand how they can take advantage of them for their own and their family's health and well-being.

Another finding of the study is that "health benefits," "ecological or environmental reasons," and "moral principles" were the main reasons for following the vegetarian diet (table 1). Various studies have shown that health, environmental issues, as well as animal welfare, are important for

vegetarians^{7,16,17}. Health is a very significant motivational element in terms of disease prevention and reduction of discomfort when disease is present. The health reasons that motivate people to opt for vegetarian diets are well founded in previous extensive research^{1,3}. These studies showed that

Table 1. Sociodemographic characteristics and motivations of vegetarians and non-vegetarians.

Variable	Vegetarians (n = 62)		Non-vegetarians (n =87)		χ^2	p-value*
	n	%	n	%		
<i>Age (years)</i>					5.515	0.063
≤ 25	20	32.3	18	20.7		
26 - 35	13	21.0	33	37.9		
>36	29	46.8	36	41.4		
<i>Sex</i>					0.242	0.623
Female	43	69.4	57	65.5		
Male	19	30.6	30	34.5		
<i>Nationality</i>					13.775	0.003
Peruvian	48	77.5	84	65.8		
Non-Peruvian	14	22.6	3	3.4		
<i>Marital status</i>					0.000	0.989
Single	32	51.6	45	51.7		
Married	30	48.4	42	48.3		
<i>Level of education</i>					31.307	<0.01**
Basic Education	3	4.8	9	10.3		
Technical Program	6	9.7	43	49.4		
University Degree	53	85.5	35	40.2		
<i>Reasons for a vegetarian diet</i>						
Moral principles	13	21.0				
Religious beliefs	7	11.3				
Ecological or environmental reasons	15	24.2				
Health benefits	20	32.3				
Aesthetic reasons	7	11.3				
Total	62	100.0	87	100.0		

*p of the trend. A Chi-square test (χ^2) was used to evaluate the degree of significance of the sociodemographic data and the type of diet. p represents the probability that there is a significant difference between vegetarians and non-vegetarians in sociodemographic data.** statistical significance.

Table 2. Anthropometric profile, total cholesterol and nutritional knowledge among vegetarians and non-vegetarians.

Variable	Vegetarians (n = 62)		Non-vegetarians (n =87)		t*	p-value**
	Mean	SD	Mean	SD		
Weight (kg)	59.948	8.923	64.362	12.272	-2.413	0.017
Height (m)	1.604	0.103	1.595	0.083	0.603	0.547
BMI kg/m ²	23.22	3.026	25.152	3.373	-4.563	<0.01
WC (cm)	78.435	10.883	86.207	13.662	-3.716	<0.01
Total-cholesterol (mg/dL)	166.307	26.139	189.138	38.451	-4.053	<0.01
NK	64.806	11.901	64.793	12.048	0.007	0.995

*A Student t-test (t) test was used to evaluate the degree of difference in anthropometric, total-cholesterol and NK data between vegetarians and non-vegetarians. **p for trend; represents the probability that the dietary pattern is differentiated with the data already mentioned. SD: standard deviation; BMI: Body Mass Index; WC: Waist Circumference; NK: nutritional knowledge.

Table 3. Anthropometric profile, total cholesterol and nutritional knowledge (dichotomized and polycotomized) among vegetarians and non-vegetarians

Variable	Vegetarians (n = 62)		Non-vegetarians (n =87)		χ ²	p-value*
	n	%	n	%		
<i>BMI (kg/m²)</i>					19.898	<0.01**
Under weight	2	3.2	0	0.0		
Normal	45	72.6	42	48.3		
Overweight	15	24.2	27	31.0		
Obesity	0	0.0	18	20.7		
<i>WC (cm)</i>					31.871	<0.01
Low risk	48	77.4	34	39.1		
High risk	14	22.6	22	25.3		
Very high risk	0	0.0	31	35.6		
<i>Total-cholesterol (mg/dL)</i>					48.472	<0.01
High	2	3.2	51	58.6		
Normal	60	96.8	36	41.4		
<i>NK</i>					0.486	0.784
Sufficient	10	16.1	16	18.4		
Regular	27	43.5	33	37.9		
Under	25	40.3	38	43.7		

*p of the trend. A Chi-square test (χ²) was used to evaluate the degree of significance of the sociodemographic data and the type of diet. p represents the probability that there is a significant difference between vegetarians and non-vegetarians in sociodemographic data.** Statistical significance. BMI: Body Mass Index; WC: Waist Circumference; NK: nutritional knowledge.

a healthy plant-based diet helps reduce the risk of cardiovascular disease, stroke, certain types of cancer, hypertension, obesity, and type 2 diabetes mellitus¹⁻³.

As for the environmental reasons for vegetarianism, these are justified by the fact that meat production and consumption contribute to excessive water use and pollution, greenhouse gas emissions, the use of forest land for crops to graze animals, and soil erosion¹⁸. Conversely, plant-based foods produce lower greenhouse gas emissions¹⁹. A change to a vegetarian diet would result in a significant reduction in gas emissions, in addition to mitigating the negative effects of climate change^{18,20}.

Regarding moral reasons, some studies report similar findings²¹. This could be explained by affective reasons towards animals, which is most evident in women; as it happened in the present study, in the vegetarian group, there was a higher proportion of women than men. Furthermore, for vegetarians, concern for animals and animal welfare is a philosophical expression of nonviolence or nonharm to animals²². Even eating plant-based foods is part of an ethical commitment for some vegetarians²³. Knowing these main motivations for vegetarian diets could be used as an effective method to encourage people about the importance of consuming plant-based foods through nutrition education programs¹⁷.

In this study, the vegetarians had a significantly lower average weight; moreover, they presented a BMI within the normal range (table 2). Our results are consistent with those reported in a study conducted by Cramer et al.⁵. The relationship between vegetarian diets and an adequate anthropometric profile is well documented in the scientific literature. The possible tie between vegetarian diets and weight control and low cardiovascular risk may be explained by the fact that a vegetarian diet is characterized by lower caloric density, and less sodium, due to the presence of a higher content of foods rich in dietary fiber, vitamins C, E, and B₁, folate, Mg, Fe, and bioactive (phytochemical) elements²⁴. Bioactive elements, can have a significant impact on the prevention of chronic non-communicable diseases in the long term. Furthermore, the majority of vegetarians presented a lower WC compared to non-vegetarians, indicating a low risk of presenting cardiovascular disease (table 3). Similar evidence was found by Matsumoto et al.,² who, after conducting a correlation analysis between vegetarian diet and cardiovascular risk factors in a group of participants in the Adventist Health Study-2. This may be due to the fact that the consumption of vegetable proteins is associated with better weight control evidenced by a lower incidence of obesity and, consequently, lower cardiovascular risk²⁵. In addition, a BMI >27.5 kg/m² and a WC above the recommended range are associated with a higher incidence of death from cardiovascular diseases^{26,27}.

As for total cholesterol, we have shown that although most values were within the normal range, they were significantly

lower in vegetarians; furthermore, the majority of vegetarians presented an adequate concentration of total cholesterol. Previous studies^{1,2,7}, have reported similar findings. These results could be due to the fact that vegetarian diets are characterized by a lower intake of cholesterol, total fat, and saturated fatty acids, which would lead to a lower absorption and transport of cholesterol in the blood, thus decreasing the risk of cardiovascular disease by approximately 9% to 10%²⁸. Additionally, plant-based diets contain a high concentration of phytochemicals which are capable of reducing intestinal absorption of cholesterol and, what's, they favor a blood reduction of total cholesterol by inhibiting its biosynthesis²⁹.

Regarding the level of nutritional knowledge, both vegetarians and non-vegetarians presented a score below 80% (table 3), which indicates a regular level of nutritional knowledge; furthermore, there was no significant difference. Although the vegetarians in our study were more academically minded than the non-vegetarians, their nutritional knowledge was not higher than that of the non-vegetarians. Similar results were found in a study in which both vegetarians and non-vegetarians lacked adequate nutritional knowledge³⁰. There is clear evidence of the need to implement nutritional education programs in both groups to maintain an adequate level of nutritional knowledge⁹. On the other hand, there are findings which show that vegetarians demonstrated greater nutritional knowledge¹⁰. The results of the present study suggest a clear need to implement nutrition education programs for both the general population and for healthcare professionals so that they can be trained on healthy dietary patterns, especially vegetarian diets, for better nutritional counseling.

Limitations

The present study has some limitations. First, the size of the sample. Second, the recruitment of participants was carried out in the region of East Lima and third, the cross-sectional design does not allow for a temporal or causal relationship between events to be established, finally, the quality of the participants' diet was not evaluated, since this would imply a bias when evaluating the nutritional status of both groups. A longitudinal research study should be carried out in which an intervention program is considered with the purpose of improving nutritional knowledge. Likewise, it is necessary to take into account the evaluation of the quality of the diet in future research. Additionally, the evaluation of the reliability and validity of the knowledge questionnaire has not yet been carried out and, therefore, the current results should be interpreted with caution.

CONCLUSIONS

In this study, no significant difference was observed in the level of nutritional knowledge in vegetarians and non-vegetarians. In addition, both groups presented an insufficient

knowledge score. On the other hand, vegetarians presented significantly lower BMI and WC compared to non-vegetarians. Total cholesterol was significantly lower in vegetarians. "Health benefits", "ecological or environmental reasons", and "moral principles" were the main motivations for following the vegetarian diet.

ACKNOWLEDGEMENT

This research was supported by the School of Human Nutrition and Human Medicine from the Universidad Peruana Unión and is part of master's thesis by Jacksaint Saintila.

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