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Artigo Original

Lower Prevalence of Subclinical Hypothyroidism in Vegetarian Men Compared with Omnivores

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A B S T R A C T

Introduction: Subclinical hypothyroidism (SCH) is diagnosed when the TSH level is elevated above the reference range (0.4-4.5 µUl/mL) and free T4 levels remain within the normal serum range (0.7-1.7 ng/dL). There are many studies showing that a vegetarian dietary pattern could bring benefits at multiple levels. The objective of this study was to investigate the association between dietary pattern and thyroid hormones, as well as to compare the prevalence of SCH among apparently healthy vegetarian (VEG) and omnivorous (OMN) male individuals.
Methods: The study was based on data from two 24-hour dietary recalls, biochemical parameters, and anthropometry obtained from 88 individuals VEG (n = 44) and OMN (n = 44) male, between 35 and 71 years of age, who were participants in the CARVOS study.
Results: The VEG group was found to have TSH values significantly lower than the values found in the OMN group ($p = 0.049$). The prevalence of SCH was 6 times higher in the OMN group when compared to the VEG values (13% OMN versus 2.3% VEG, $p = 0.039$), it was confirmed by multiple logistic regression, in which the OMN group was more likely to have SCH.
Conclusion: The VEG group obtained significantly lower TSH values and were significantly less likely to have SCH compared with those who follow a OMN dietary pattern.

Menor Prevalência de Hipotiroidismo Subclínico em Homens Vegetarianos Comparados aos Onívoros

R E S U M O

Introdução: O hipotiroidismo subclínico (HSC) é diagnosticado quando o nível de TSH está elevado acima da faixa de referência (0,4-4,5 µUl/mL) e os níveis de T4 livre permanecem dentro da faixa sérica normal (0,7-1,7 ng/dL). Muitos estudos mostram que um padrão alimentar vegetariano pode trazer benefícios em vários níveis. O objetivo deste estudo foi investigar a associação entre o padrão alimentar e as hormonas tiroideias, bem como comparar a prevalência de HSC em indivíduos aparentemente saudáveis vegetarianos (VEG) e omnívoros (OMN) do sexo masculino.
Metodologia: O estudo baseou-se em dados de dois registos alimentares de 24 horas, parâmetros bioquímicos e antropometria, obtidos de 88 indivíduos VEG (n = 44) e OMN (n = 44) do sexo masculino, entre 35 e 71 anos, entre os participantes do estudo CARVOS.

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Resultados: O grupo VEG apresentou valores de TSH significativamente menores do que os valores encontrados no grupo OMN (p = 0,049). A prevalência de HSC foi 6 vezes maior no grupo OMN quando comparada aos valores de VEG (13% OMN *versus* 2,3% VEG, p = 0,039), confirmada por regressão logística múltipla, na qual o grupo OMN era mais provável a ter HSC.
Conclusão: O grupo VEG apresentou menores valores de TSH e foram significativamente menos propensos a terem HSC em comparação aos indivíduos do grupo OMN.

Introduction

Hypothyroidism is present when the levels of the thyroid hormone thyroxine (T4) and triiodothyronine (T3) are below the reference range, indicating thyroid failure. Due to thyroid dysfunction, the levels of thyrotropin or also called thyroid stimulating hormone (TSH) are elevated, being an important clinical expression. Subclinical hypothyroidism (SCH) is diagnosed when the TSH level is elevated above the reference range (0.4-4.5 µUl/mL) and free T4 levels remain within the normal serum range (0.7-1.7 ng/dL).[1,2] There is a lack of evidence regarding the risk factors associated with SCH. It is important to review its epidemiology, with recommendations for appropriate evaluation, exploring the risks and benefits of treatment and the consequences of nontreatment.[3]

The normal function of the thyroid gland depends on the presence of trace elements for the metabolism and synthesis of thyroid hormones.[4,5] Nutrient deficiency can affect the endocrine system, leading to several disorders, such as hypothyroidism.6 In this sense, knowledge of the influence of dietary patterns on SCH is of paramount importance.

There are many studies showing that a vegetarian dietary pattern could bring benefits at multiple levels, such as physiology,[7] microbiology,[8] biomarkers[9] and genetics.[10] Thus, we hypothesized that there could be a difference in the prevalence of SCH among individuals with different dietary patterns.

The objective of this study was to investigate the association between dietary pattern and thyroid hormones, as well as to compare the prevalence of SCH among apparently healthy vegetarian and omnivorous male individuals.

Methods

A sample of 88 male subjects, between 35 and 71 years of age, was selected from the participants in the CARVOS study (Carotid Atherosclerosis and Arterial Stiffness of Vegetarian and Omnivorous Individuals). The inclusion and exclusion criteria have been previously described.[7]

A 24-hour food recall for two days a week was applied to characterize dietary patterns. Those who did not consume any type of meat (all animals included) for at least four years (n = 44) were classified as vegetarian (VEG), and those who consumed meat regularly at least four times a week (n = 44) were classified as omnivorous (OMN).

Blood samples were collected after the patient fasted for 10 to 12 hours. Serum lipids, including triglycerides (TG), total cholesterol (TC) and high-density lipoprotein (HDL-c), were analyzed using enzymatic methods with an automatic multichannel chemical analyzer (Siemens Healthcare, Newark, NJ, USA) at the InCor Central Laboratory. Low-density lipoprotein cholesterol (LDL-c) was calculated using Friedenwald's formula for TG levels < 400 mg/dL. As for TSH, T3, T4, and free T4 were analyzed by competitive immunoassay methods using direct chemiluminescent technology. The quality control assessment was carried out daily for all determinations.

Subclinical hypothyroidism was diagnosed when the TSH level is elevated above the reference range (0.4-4.5 µUl/mL) and free T4 levels remain within the normal serum range (0.7-1.7 ng/L).[1,2]

A database for Brazilian food composition was used to calculate the daily intake of energy and nutrients.[11] The iodine intakes were estimated from the total sodium calculated in the diet. For this, the salt iodization values recommended by federal legislation were used as the basis[12,13] and recommendations were used from the Dietary Reference Intakes (DRI) for consumption of iodine and more nutrients for adults.[14] Referred food supplements were recorded for frequency of use and dosage and calculated along with the diet.

The data are presented as mean ± standard deviation (SD), and categorical variables are shown as percentage and number (n). The unpaired Student t test and the Chi-square test were used to test differences for numerical and nominal variables.

To test the association between the dietary pattern (VEG and OMN) and SCH, a multiple logistic regression was performed, considering body mass index (BMI) adjustment variables and daily iodine consumption.

All analyzes were performed using Stata (10.0) (StataCorp, LLC, College Station, TX).

Results

Table 1 shows the average age, BMI, and waist/hip ratio of the study participants. The average duration of vegetarianism was 17.8 ± 12.5 years. Age was similar between groups; however,

Table 1. Anthropometric characteristics, biochemical parameters, average consumption of calories and nutrient intake of vegetarians and omnivores.

Variables	VEG (n=44)	OMN (n=44)	p
Age	45.5 ± 7.8	46.8 ± 9.6	0.23
BMI (kg/m²)	23.1 ± 2.9	27.2 ± 4.8	<0.001
Waist/hip ratio	0.87 ± 0.1	0.92 ± 0.1	<0.001
DBP	75.2 ± 8.6	83.9 ± 10.4	<0.001
SBP	119.5 ± 10.4	129.2 ± 15.1	<0.001
TC (mg/dL)	180.1 ± 40.5	202.7 ± 35.3	0.003
HDL-c (mg/dL)	47.6 ± 9.3	45.5 ± 11.6	0.17
LDL-c (mg/dL)	110 ± 33.2	128.5 ± 32.4	0.005
Non-HDL-c (mg/dL)	132.5 ± 43.2	157.3 ± 36.6	0.002
Triglycerides (mg/dL)	112.2 ± 72.2	143.9 ± 64	0.016
TSH (µUI/mL)	2.2 ± 1.1	2.7 ± 1.8	0.049
T3 (ng/mL)	1.2 ± 1.1	1.2 ± 1.2	0.262
T4 (µg/dL)	8.3 ± 7.9	8.2 ± 7.7	0.302
Free T4 (ng/dL)	1.1 ± 1.0	1.1 ± 1.1	0.420
Calories (kcal)	2177 ± 559	2348 ± 736	0.11
Protein (% of energy)	17.1 ± 7.8	19.5 ± 4.5	0.04
Carbohydrate (% of energy)	63.2 ± 11.6	51.9 ± 9.7	<0.001
Lipids (% of energy)	24.8 ± 8.3	29.1 ± 7.2	0.006
Sodium (mg)	2334.1 ± 1665.3	2633.6 ± 1452.6	0.185
Iodine (mcg)	175.1 ± 124.9	197.5 ± 108.9	0.371
Zinc (mg)	9.0 ± 3.2	12.7 ± 5.8	<0.001
Iron (mg)	21.9 ± 14.6	17.05 ± 5.5	0.042

Data are given as median + standard deviation. BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; HDL-c, high-density lipoprotein; LDL-c, low-density lipoprotein; Non-HDL-c, non-high-density lipoprotein. TSH, thyroid stimulating hormone; T3, triiodothyronine; T4, thyroxine.

BMI and waist/hip ratio, systolic blood pressure and diastolic blood pressure were significantly lower in VEG compared with OMN individuals.

The consumption of zinc was higher in omnivorous individuals ($p < 0.001$) and the consumption of iron was higher in vegetarians ($p = 0.042$).

VEG group was found to have TSH values significantly lower than the values found in the OMN group ($p = 0.049$).

The prevalence of SCH was 6 times higher in the OMN group when compared to the VEG values (13% OMN *vs* 2.3% VEG), a significant difference ($p = 0.039$).

In addition, according to multiple logistic regression in relation to SCH, adjusted for age, BMI, and daily iodine consumption, the OMN group was significantly more likely to have SCH (OR: 13.59, 95% CI 1.20–153.44).

Discussion

As described in this work, it is possible to demonstrate differences regarding the prevalence of SCH among apparently healthy VEG male individuals compared with OMN individuals. To the best of our knowledge, this is the first Latin American study to compare VEG and OMN dietary patterns and their possible relationship with the development of SCH.

Although the mean TSH values of VEG and OMN of our samples are within the reference values, it is noted that the OMN group has significantly higher values compared to the VEG group. The values of T3, T4, and free T4 were not significantly different between groups.

The OMN group was significantly more likely to have SCH, when adjusted for age, BMI, and estimated iodine consumption. Studies of descriptive characteristics carried out by Tostad *et al*,[6] comparing prevalent cases, incidental cases, and cases without hypothyroidism, obtained data demonstrating the strict vegetarian dietary pattern was associated with protection against hypothyroidism, even though the lack of iodine is a risk associated with the complete exclusion of products of animal origin.

Regarding dietary pattern, the OMN group had a higher consumption of protein intake, total fat, saturated fat, and cholesterol, and a lower intake of carbohydrates, mono- and polyunsaturated fat, fiber, potassium, and magnesium ($p < 0.05$) described in the CARVOS study.[7] Possibly, the significantly higher TSH values of the OMN group are influenced by the observed food pattern, typical of the West. Thus, following a vegetarian food pattern could act as protection from thyroid dysfunction.

The vegetarian dietary pattern is shown to be a protective factor in relation to cardiovascular outcomes.[7] In addition, SCH can play a mediating role in this process. In the present study, the VEG group had a lower prevalence of SCH and lower values of TC, LDL-c, non-HDL-c, and triglycerides.

A meta-analysis that analyzed 16 articles suggested that there were higher serum TC, LDL-c, and triglycerides levels in patients with SCH compared with participants with euthyroidism (EU).[15]

Restrictive and/or unbalanced diets can lead to a deficiency of certain minerals, which in turn can contribute to a decrease in the production of thyroid hormones.[16] Unfortunately, selenium values are not presented in this study, because the Brazilian food composition databases do not analyze this nutrient, making it impossible to quantify it based on the individual´s dietary pattern.

In the present study, iron consumption was higher in the VEG group ($p = 0.042$). Much is speculated about the levels of iron in vegetarians, and similar findings are found in the literature regarding the higher consumption of iron in vegetarians.[17,18] According to Zimmermann and Köhrle,[19] the activity of thyroid peroxidase is reduced in iron deficiency. This enzyme present in thyroid cells acts in the synthesis of thyroid hormones. Increased iron consumption could be protective for SCH. Regarding the zinc consumption was higher in the OMN group ($p < 0.001$), as already observed in the literature[20] due to the greater presence of this nutrient in meat and the presence of phytates in plant foods, reducing its absorption.[21] Studies have shown that zinc deficiency adversely affects the synthesis, metabolism, and action of thyroid hormones.[22] Consumption of both nutrients was within the DRI recommendation,[14] according to 24-hour recall calculation. It was not possible to verify these nutrients in serum test in the blood and further studies are needed to explain these points.

Both nutrients were not serum verified, only estimated through the diet, and consumed by groups as recommended by the DRI according to 24-hour recall calculation.

In our study, the estimated value of iodine and sodium consumption was similar in both groups, being above the recommended daily allowance value (150 mcg/day and 1500 mg/day).[14]

Serum TSH levels are known to be positively associated with body weight.[23] Slightly elevated serum TSH levels already demonstrate an increased prevalence of obesity.[24] It is believed that the increase in body mass causes an increase in serum TSH, and not the other way around.[25] The values of BMI and waist/hip ratio were significantly higher in the OMN group, a result that has already been discussed in a previous study.[26]

Other factors can influence a deregulation of the thyroid gland, such as age. Aging is an important factor and is associated with an increased risk of SCH diagnosis. It is known that the prevalence of SCH increases with age.[27] As seen in the present study, the average age of both groups was 46.1 years.

As limitations of the present study, its cross-sectional design, which does not allow testing of causal relationships, should be considered. It was also not possible to calculate iodine and selenium in the recalls used, due to the absence of these minerals in the Brazilian food composition databases. Because of this, iodine intake was estimated from iodized salt. It is unknown the state of autoimmunity status (thyroid autoantibodies) of the original sample, as well as the presence of a family history of thyroid pathology or a personal or family history of autoimmune diseases.

As strengths of the study, it should be noted that the sample, although small, is strongly homogenized, with same-sex and apparently healthy individuals. Additionally, this is a topic little explored by the scientific community, and the findings of the present study may represent yet another factor in protecting the vegetarian dietary pattern. In addition, there are no studies on this theme comparing Latin American VEG and OMN individuals.

Conclusion

In our study, the VEG group obtained significantly lower TSH values compared with the OMN group. Furthermore, multiple logistic regression, adjusted for age, BMI, and estimated daily iodine consumption suggests that adult male individuals who follow an OMN diet, typical of Western countries, are significantly more likely to have SCH compared with those who follow a VEG food standard. Further studies should be carried out comparing these two groups, with the aim of consolidating the relationship between the different dietary patterns and the occurrence of SCH.

Contributorship Statement / Declaração de Contribuição:

JAN and LA: study conception and design, data collection, analysis and draft manuscript preparation.
LFD, EPF, MCPFO and PAC: were responsible for interpretation of results, writing and review.
All authors: reviewed and approved the final version of the manuscript.

Responsabilidades Éticas

Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse na realização do presente trabalho.
Fontes de Financiamento: Não existiram fontes externas de financiamento para a realização deste artigo.
Confidencialidade dos Dados: Os autores declaram ter seguido os protocolos da sua instituição acerca da publicação dos dados de doentes.
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