



Trabajo Original

Epidemiología y dietética

Attitudinal factors associated with protein sufficiency in Chilean vegan university students — A pilot study

Factores actitudinales asociados a la suficiencia proteica en estudiantes universitarios veganos chilenos. Estudio piloto

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Abstract

Introduction: vegan diets are currently an essential topic of discussion because they are recognized as a prototype of a healthy diet but are also associated with deficits in the intake of critical nutrients such as protein. Evaluating the factors that influence the deficit in their intake in vulnerable populations such as university students represents an important topic of interest, considering that this is one of the groups where veganism is most popular. Given this, the present study aimed to determine the degree of protein sufficiency and its associated factors in a sample of Chilean vegan university students.

Materials and methods: an exploratory cross-sectional study was conducted on 114 vegan university students who responded to an online survey on academic, attitudinal, clinical, dietary, and sociodemographic variables. Protein intake was calculated, and based on self-reported weight, daily protein adequacy was calculated according to the recommendation of 0.9 g/kg/day. Finally, the association between protein adequacy and previously consulted variables was calculated by determining the odds ratios.

Results: only 53.5 % had adequate daily protein intake, which was associated with the length of time respondents had been vegan (OR, 2.86; 95 % CI, 1.07 to 7.34; $p < 0.05$), use of supplements (OR, 5.24; 95 % CI, 1.17 to 25.2; $p < 0.05$), and the frequency with which they ate lunch at home (OR, 87.7; 95 % CI, 24.1 to 304; $p = 0.000$).

Conclusion: there needs to be more protein adequacy in the assessed sample. Protein adequacy is associated with the length of time on the vegan diet, frequency of eating lunch away from home, and use of supplements regularly.

Keywords:

Protein intake. Dietary protein. Vegan diets. Plant-based diet. University students.

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Resumen

Introducción: en la actualidad, las dietas veganas representan una importante temática de discusión debido a que son reconocidas como prototipo de régimen saludable pero también se encuentran asociadas a déficits en la ingesta de nutrientes críticos como las proteínas. La evaluación de los factores que influyen en el déficit de su ingesta en poblaciones vulnerables como los estudiantes universitarios representa un importante tema de interés, considerando que es uno de los grupos donde mayor popularidad presenta el veganismo. Frente a esto, el presente estudio tuvo como objetivo determinar el grado de suficiencia proteica y los factores asociados a esta en una muestra de estudiantes universitarios veganos chilenos.

Materiales y método: se realizó un estudio de alcance exploratorio de corte transversal en 114 estudiantes universitarios veganos que respondieron a una encuesta *online* sobre variables académicas, actitudinales, clínicas, dietarias y sociodemográficas. Se calculó la ingesta proteica y, en función del peso autorreportado, se calculó la adecuación proteica diaria de acuerdo con la recomendación de 0,9 g/kg/día. Finalmente se calculó la asociación entre la adecuación proteica y las variables anteriormente consultadas a partir de la determinación de los *odds ratios*.

Resultados: solo un 53,5 % presentaron una ingesta diaria adecuada de proteínas, la cual se asocia al tiempo de antigüedad del veganismo de los encuestados (OR: 2,86; IC 95 %: 1,07 a 7,34; $p < 0,05$), la utilización de suplementos (OR: 5,24; IC 95 %: 1,17 a 25,2; $p < 0,05$) y la frecuencia con la que almuerzan en el hogar (OR: 87,7; IC 95 %: 24,1 a 304; $p = 0,000$).

Conclusión: existe una importante falta de adecuación proteica en la presente muestra evaluada. La adecuación proteica se asocia con la duración del régimen vegano, la frecuencia de almuerzos fuera de casa y la utilización de suplementos de forma regular.

Palabras clave:

Ingesta proteica. Proteínas dietarias. Dietas veganas. Dieta basada en plantas. Estudiantes universitarios.

INTRODUCTION

Vegan diets correspond to diets based exclusively on the intake of plant-based foods, excluding ingredients of animal origin and their derivatives mainly for ethical, moral, environmental, and health reasons (1). In the current 21st century, the population adopting such diets has increased worldwide, with reports indicating a 350 % increase in the last decade (2), mainly popular with teenagers, young adults, and especially women (3).

It has been framed academically as a prototype of a healthy lifestyle as long as these diets are adequately planned (4) offering cardiovascular and metabolic health benefits, as it would correspond to a diet that improves clinical parameters of hypercholesterolemia, hypertension, coronary heart disease, type 2 diabetes *mellitus*, and obesity (5). However, evidence also reports critical nutritional deficiencies for the present regime, as indicated by a 2021 systematic review that included 36 cross-sectional studies, reporting that veganism is associated with low intakes of protein, vitamin B2, vitamin B3, vitamin B12, vitamin D, iodine, zinc, calcium, potassium, and selenium (6). Special attention is paid to protein as a critical macronutrient, as studies indicate that vegans not only ingest less protein than non-vegans but also have lower concentrations of essential amino acids in their blood (7). This is a risky situation considering that deficiencies lead to complications beyond their functions in skeletal muscle and other tissues, as they also disrupt different physiological systems, affecting growth and promoting vascular dysfunction and immune depletion (8).

While the main reason for lower intakes of this nutrient may be mainly due to the restriction of plant-based diets in contrast to the omnivorous Western dietary pattern, the main reason for lower intakes of this nutrient may be due to the restriction of plant-based diets in contrast to the omnivorous Western dietary pattern (9), the influence of attitudinal and sociodemographic factors may also be playing a critical and essential role as in the general population. For example, younger age, male sex, and regular meat intake are factors that reduce the risk of low protein intake (10).

Along the same lines, high socioeconomic status has been associated with higher total protein intake, and low socioeconomic status has worse body protein depletion metrics (11,12). In particular, this could affect specific age groups such as university students, who represent a particular focus of attention as they are a population with a particular connection to animal welfare causes, are in transition to adulthood, and are making various independent decisions related to diet and lifestyle. These can be detrimental in terms of health, given the limited time they have to prepare food, the limited resources available to them, as well as the lack of access to sanitary devices due to their distance from them (13,14).

At the national level, information on this topic is still quite limited, as there is a report from 2013 that evaluated 53 vegan subjects, reporting that the primary motivation for following the diet was based on animalistic principles (75 %), and only 2 % considered the health benefits. It also reported that most respondents (27 %) used internet data as their primary source of information, and a significant percentage needed information on nutritional deficiencies in omega-3, vitamin D, and zinc, all critical nutrients in the vegan population (15). While this data strongly disagrees with a study published in 2020, which also asked about motivations and knowledge of deficiencies, the latter study did not specify the population opting for strict vegetarian diets. It was aimed exclusively at first-year university students at an institution that does not represent the socioeconomic reality of the country (16).

Considering the ethical and moral principles that underpin the choice of this type of diet and that do not consider health as the main focus, the lack of knowledge previously mentioned, and the fact that information on this subject is still quite limited at the national level, it is necessary to investigate how this type of diet is being carried out in the national university population in order to provide inputs that will allow us to improve the nutritional care aimed at this population group. Given this, this study aimed to determine the degree of protein sufficiency and its associated factors in a sample of Chilean vegan university students.

METHODS

A descriptive, cross-sectional, exploratory study was conducted on Chilean university students who declare themselves vegans and therefore follow a plant-based diet. The sample was calculated by cross-referencing the information declared by the Ministry of Education of the Government of Chile on the university population enrolled in the country (considering 1,194,311 enrolled students) (17) and the 4 % vegan population of the country according to projections by Chile's leading market research and public opinion company (18). From this, and using the Qualtrics® application, with 95 % confidence and a maximum of 5 % error, the figure of 384 people was obtained.

Recruitment was carried out online between October and December 2022 through a poster disseminated through the Facebook® profiles of all the student federations of the country's universities, both public and private. Influencers promoting plant-based diets on Instagram® were also contacted to publish the poster on their social networks. Interested individuals were able to click on a link that presented the poster, directing them to a survey on the Google Forms® platform where they had to give their informed consent to participate and then go on to complete the self-report survey. The survey asked about age, gender, weight, height, length of time on a plant-based diet, type of university, academic area, level of study, extracurricular activities, and coexistence. In addition, the time spent eating, budget, and eating occasions outside the home were asked about. Finally, a 24-Hour Reminder Survey (ER24H) was included, in which each subject presented his or her daily diet to determine the total protein intake per day and protein adequacy according to the indicated weight. To determine those mentioned above, an intake of at least 90 % of the daily protein requirement was considered adequate, calculated as 0.9 g per day/kg self-reported weight. Concerning the inclusion and exclusion criteria, only undergraduate university students who had been on the plant-based diet for at least one month were eligible to participate, and those on an evening diet or those on a second undergraduate course were excluded as these are variables that affect eating habits. Responses from ovo-lacto-vegetarians who demonstrated that they did not eat a strict vegetarian diet were also excluded.

All data obtained were processed in Microsoft Excel®, then exported and analyzed in GraphPad Prism v.9.3.1 for Windows (San Diego, California, USA). To determine the association between variables, each condition was dichotomized against the presence or absence of protein intake adequacy, calculating odds ratios (OR), 95 % confidence intervals (CI), and Fisher's test to estimate statistical significance ($p < 0.05$).

Finally, it is essential to mention that this work was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Universidad Mayor campus in Temuco, Chile (Folio 0341).

RESULTS

A total of 223 responses from volunteers were recruited online, and 114 valid surveys were subsequently screened according to the exclusion criteria. Of these responses, the predominant population was under 27 years of age (85.9 %), women (83.4 %), students of biomedical, exact and natural sciences (57.8 %), four years or more of study (60.6 %), the primary extracurricular activity of physical activity (67.6 %) and predominantly cohabitation of two people or less (57.1 %) and with a family (65.7 %). Regarding the geographical area of the respondents and the financing of the institutions where they studied, there was heterogeneity between metropolitan (47.4 %) and non-metropolitan (52.6 %) regions, as well as public (53.5 %) and private (46.5 %) universities, respectively (Table I). Regarding the associated dietary and economic variables, the majority had a normal nutritional status (69.2 %), had been vegan for more than one year (78.9 %), spent more than 30 minutes at lunchtime (81.6 %), reported using supplements (92.2 %), and reported spending less than six and a half dollars per lunch when eating out (61.4 %), and no more than 125 dollars per month for food (76.3 %). Both dichotomous responses were homogeneous regarding state financial support for food and eating out more than three days per week. As for the primary variable evaluated, established by the degree of protein adequacy, only 53.5 % had an adequate macronutrient intake (Table I).

To determine the association between daily protein adequacy and each of the variables consulted, ORs were calculated as shown in table II. As for those enrolled in private institutions (60.7 %) as well as in humanities and social sciences degrees, they presented higher percentages of adequacy at the intra-group level (60.4 %), also aligning themselves with those who presented a normal nutritional status (50.7 %). However, the association does not reach an acceptable OR or statistical significance concerning the population enrolled in public institutions, natural and biomedical sciences students, and subjects with altered nutritional status.

Conversely, when considering the length of time respondents have been vegan, the magnitude more significant than one year is associated with protein adequacy in respondents, reaching nearly 60 % versus only 33 % of those who had been vegan for less than one year (OR, 2.86; 95 % CI, 1.07 to 7.34; $p < 0.05$), all aligned with supplementation (56.7 %) versus its negative counterpart (20 %), where the association found is higher (OR, 5.24; 95 % CI, 1.17 to 25.2; $p < 0.05$). More specifically, and with a higher significance, the variable of eating lunch less than three times a week outside the home stands out, where those who maintain this practice have a 90.3 % adequacy rate, a figure well above those who eat lunch outside the home more frequently, who do not exceed 10 % adequacy (OR, 87.7; 95 % CI, 24.1 to 30.4; $p = 0.000$).

The variables of age, sex, region of geographic origin, cohabitation, years of study, extracurricular activities, state financial support, money, and time spent on food did not influence the protein adequacy metrics in the present sample evaluated.

Table I. Sample characterization

	<i>n (%)</i>		<i>n (%)</i>
<i>Age</i>		<i>Nutritional status</i>	
18-26 years	98 (85.9 %)	Normal	79 (69.2 %)
27-35 years	16 (14.1 %)	Malnutrition	35 (30.8 %)
<i>Sex</i>		<i>Economic support</i>	
Female	95 (83.4 %)	Yes	63 (55.2 %)
Male	19 (16.6 %)	No	51 (44.7 %)
<i>Region</i>		<i>Vegan time</i>	
Metropolitan	54 (47.4 %)	< 1 year	24 (21.1 %)
Non metropolitan	60 (52.6 %)	> 1 year	90 (78.9 %)
<i>University</i>		<i>Time for lunch</i>	
Public	61 (53.5 %)	< 30 minutes	21 (18.4 %)
Private	53 (46.5 %)	> 30 minutes	93 (81.6 %)
<i>Academic area</i>		<i>Lunch away from home</i>	
Natural, biomedical, and exact sciences	66 (57.8 %)	< 3 times	62 (54.4 %)
Social sciences, humanities, and arts	48 (42.2 %)	> 3 times	52 (45.6 %)
<i>Years of study</i>		<i>Supplementation use</i>	
1-3 years	45 (39.4 %)	Yes	104 (91.2 %)
Four years or more	69 (60.6 %)	No	10 (8.7 %)
<i>Extracurricular activity</i>		<i>Monthly money for food</i>	
Physical activity	77 (67.6 %)	< 125 US Dollars	87 (76.3 %)
Work	38 (33.4 %)	> 125 US Dollars	27 (23.6 %)
<i>Cohabitation</i>		<i>Money for lunches away from home</i>	
Two persons or less	65 (57.1 %)	< 6.5 US Dollars	70 (61.4 %)
Three persons or more	49 (42.9 %)	> 6.5 US Dollars	44 (38.6 %)
<i>Family cohabitation</i>		<i>Protein intake</i>	
With family	75 (65.7 %)	Adequate	61 (53.5 %)
Without family	39 (34.2 %)	Inadequate	53 (46.5 %)

Table II. Association between protein intake and the study variables

	Adequate intake <i>n (%)</i>	Inadequate intake <i>n (%)</i>	OR	95 % CI
<i>Age</i>				
18-26 years	53 (54.1%)	45 (45.9%)	1.18	(0.39-3.53)
27-35 years	8 (50%)	8 (50%)	0.84	(0.28-2.55)
<i>Sex</i>				
Female	52 (54.7%)	43 (45.3)	1.34	(0.52-3.44)
Male	9 (47.4%)	10 (52.6)	0.74	(0.19-1.90)
<i>Region</i>				
Metropolitan	28 (51.9)	26 (48.2)	0.88	(0.43-1.79)
Non metropolitan	33 (55)	27 (45)	1.13	(0.55-2.31)
<i>University</i>				
Public	24 (45.3)	29 (54.7)	0.54	(0.25-1.11)
Private	37 (60.7)	24 (39.3)	1.86	(0.90-3.92)

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Table II (cont.). Association between protein intake and the study variables

	Adequate intake <i>n</i> (%)	Inadequate intake <i>n</i> (%)	OR	95 % CI
<i>Academic area</i>				
Natural, biomedical, and exact sciences	32 (48.5)	34 (51.5)	0.61	(0.28-1.27)
Social sciences, humanities, and arts	29 (60.4)	19 (39.6)	1.62	(0.78-3.49)
<i>Years of study</i>				
1-3 years	26 (57.8)	19 (42.2)	1.33	(0.63-2.86)
Four years or more	35 (50.7)	34 (49.3)	0.75	(0.34-1.57)
<i>Extracurricular activity</i>				
Physical activity	45 (58.4)	32 (41.6)	1.27	(0.56-2.82)
Work	20 (52.6)	18 (47.4)	0.79	(0.35-1.78)
<i>Cohabitation</i>				
Two persons or less	37 (56.9)	28 (43.1)	1.38	(0.67-2.86)
Three persons or more	24 (49)	25 (51)	0.72	(0.34-1.49)
<i>Family cohabitation</i>				
With family	39 (52)	36 (48)	0.83	(0.39-1.83)
Without family	22 (56.4)	17 (43.6)	1.19	(0.54-2.56)
<i>Nutritional status</i>				
Normal	45 (57)	34 (43)	1.57	(0.68-3.40)
Malnutrition	16 (45.7)	19 (54.3)	0.63	(0.29-1.46)
<i>Economic support</i>				
Yes	36 (57.1)	27 (42.9)	1.39	(0.68-2.87)
No	25 (49)	26 (51)	0.72	(0.34-1.47)
<i>Vegan time</i>				
< 1 year	8 (33.3)	16 (66.7)	0.34	(0.13-0.93)
> 1 year	53 (58.9)	37 (41.1)	2.86	(1.07-7.34)
<i>Time for lunch</i>				
< 30 minutes	11 (52.4)	10 (47.6)	0.94	(0.36-2.58)
> 30 minutes	50 (53.8)	43 (46.2)	1.06	(0.38-2.77)
<i>Lunch away from home</i>				
< 3 times****	56 (90.3)	6 (9.7)	87.7	(24.1-304)
> 3 times	5 (9.6)	47 (90.4)	0.01	(0.00-0.04)
<i>Supplementation use</i>				
Yes*	59 (56.7)	45 (43.3)	5.24	(1.17-25.2)
No	2 (20)	8 (80)	0.19	(0.03-0.8)
<i>Monthly money for food</i>				
< 125 US dollars	43 (49.4)	44 (50.6)	1.03	(0.47-2.27)
> 125 US dollars	18 (48.7)	9 (51.3)	0.96	(0.44-2.11)
<i>Money for lunches away from home</i>				
< 6.5 US dollars	38 (54.3)	32 (45.7)	1.19	(0.52-2.72)
> 6.5 US dollars	19 (50)	19 (50)	0.84	(0.36-1.92)

DISCUSSION

Protein intake in the vegan population is one of the leading nutritional issues facing people who opt for a plant-based diet. Studies indicate that their intake is significantly lower when compared to omnivores, pescetarians, and ovo-lacto-vegetarians ($p = 0.0001$), and there is a high dependence on the consumption of products containing soya-derived protein, accounting for as

much as 3 % of total daily calorie intake (7). Although there are no published studies that refer to the degree of protein adequacy at the national level, a report by Agüero et al. indicated that the Chilean vegetarian-vegan population showed an increase in the consumption of legumes during the SARS-CoV-2 pandemic period and that they ate in a greater diversity of preparations compared to the omnivorous population (19). While this proves a better use of one of the primary protein sources of the plant-based

diet, it is essential to consider that integrating legumes alone is not enough to achieve a correct plant-based protein intake and could be mediated by different sociodemographic or attitudinal factors. In this line, our study is the first work to evaluate this type of variable in the Chilean vegan population, reporting a worrying figure of young adults who do not meet their protein requirements (46,5%), which could be the result of the population's lack of knowledge of their protein requirements due to a lack of access to competent professionals. (15), or conversely, they may have adequate knowledge of their requirements but do not have the means to acquire adequate food and portions (20). A recent qualitative report on Chilean vegans provided essential inputs to understand the reality faced by this population group, from (i) the constant reflection about their diet, which could be favorable for the acquisition of healthy eating habits, but which contrasts with (ii) the constant conflict when opting for a diet that is practical in their daily lives. From this, we can argue that the first idea aligns with our results, giving the length of time people have been vegan as a factor associated with a correct protein intake. This could be mediated by the animalistic and abolitionist motivational component of the regime itself, which would motivate its population to increase awareness of animal welfare but also human welfare to defend their position in front of society (21) if we add to this the environmental component, where individuals who have been vegan for longer can create links or networks with like-minded people who can educate them on better practices for eating well, as evidence has been reported in other minority groups (22). Regarding the second premise, the practicality of a vegan diet in the current context of the Chilean food industry does not seem to be a significant limitation considering the boom of products that have emerged in the last decade, where practically all supermarket chains in the country offer different protein products, from texturized soya to easy-to-prepare ready-made preparations such as croquettes and hamburgers. The development of these products has reached such a level that even a public domain report issued in 2021 by the National Institute of Industrial Property of Chile exposed the different technologies patented and used for the production of food for vegan and vegetarian diets in order to promote the national market (23). However, it is necessary to consider that the primary motivation for veganism is animal liberation, which is at odds with several brands offering plant-based protein options, as they have historically contributed to the meat industry (24,25). This offers an exciting debate and should establish that food's non-nutritive functions are more linked to ethical principles than strictly physiological ones (26).

About the other variables associated with protein adequacy, it was possible to identify the frequency of lunches at home and the use of supplements, which could implicitly inform cooking skills and concern for their nutritional status. This would be in line with the evidence, as several studies report that cooking skills and nutritional knowledge are directly related to the nutritional quality of the diet (27) and even predict adherence to a healthy diet (28).

On the other hand, and interestingly, food-related economic variables (state support for food, time and money spent on

lunches, and monthly budget for meals) had no influence on protein adequacy in the present sample. These results are related to those published in the German vegan and omnivorous population, where it was concluded that financial constraints would not be a barrier to implementing plant-based diets. The present statement could be because food choice motivations differ from the general population, even turning towards healthier eating in some aspects, such as higher expenditure towards fruits ($p = 0.0003$), vegetables ($p = 0.006$), dairy alternatives ($p = 0.0003$) and legumes/nuts/seeds ($p = 0.0003$). It would be interesting to assess whether this motivation is at the expense of other typical expenditures that the university population might have (29,30).

As for the potential of this study, variables associated with protein adequacy were identified in a minority population group in the country, with statistically significant results. Based on these results, it would be interesting to confirm their influence in longitudinal studies or research considering a population beginning its vegan diet. This could elucidate and confirm whether these variables constitute factors to be considered in comprehensive nutritional care for the vegan population. In addition, a sample with a certain degree of homogeneity in terms of the socioeconomic level was obtained, considering the distribution between those who received state financial aid for food and the type of institution in which they studied (public and private). Regarding the study's main limitations, it is necessary to mention that the calculated sample size was not reached, in addition to the heterogeneity in the distribution of an essential number of variables that could be influencing the results. This should lead to caution in the extrapolation of the results, and it is necessary to replicate this type of initiative with a more extended recruitment and data collection period. On the other hand, and regarding the primary variable under evaluation, only a single nutritional indicator was used to establish protein sufficiency in the sample considered, being possible to complement this variable with the evaluation of the amino acid score and protein digestibility for more complex and complete analysis (31). It could also be interesting to add anthropometric indicators of muscular body composition that denote correct protein utilization (32).

Finally, it is essential to emphasize that although all nutritional care should be personalized and targeted for each individual, there are particular population groups, such as Chilean vegan university students, who present a cross-cutting context and needs. These should be identified to improve the role of health professionals in their care, promoting their health and preventing diseases based on the factors that nutrition and food research can report.

CONCLUSION

The present study reported that 46.5 % of the Chilean university vegan population surveyed had an inadequate daily protein intake. Concerning the subjects with an adequate intake, the length of time on the vegan diet, frequency of eating lunch away from home, and use of supplements were associated factors.

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