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WESTERN DIETARY PATTERNS, SOCIOECONOMIC FACTORS, AND SELF-REPORTED SLEEP DURATION IN UNIVERSITY STUDENTS: A MULTICENTER STUDY IN LATIN AMERICA

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ABSTRACT

Changing dietary patterns, particularly the shift towards a Western diet (WD) high in sugar, fat, and salt, as well as the high availability of ultra-processed products, are impacting the nutritional status of the population; however, little is known about their relationship with sleep quality. The study aims to evaluate the association between dietary patterns and self-reported sleep duration among Latin American university students. A multicenter study of a cross-sectional survey was conducted with 4539 university students older than 18 years from ten Latin American countries: Argentina, Colombia, Costa Rica, Chile, Ecuador, Guatemala, Mexico, Paraguay, Panama, and Peru. The study was conducted during the COVID-19 pandemic, between November and December 2020. Participants in the study completed the survey independently, indicating that the survey was self-administered. Data regarding sociodemographic indicators, sex, sleep, physical activity, and smoking was obtained. In addition, the diet pattern, weight, and height were obtained by self-report. Dietary patterns were assessed using a self-administered multiple-choice question and subsequently classified into four predefined categories: Western diet, prudent diet, vegetarian diets, and other diets. The association between dietary patterns and self-reported sleep duration was assessed using multiple logistic regression models. Model 1 was adjusted for sociodemographic variables (sex, age, socioeconomic level, and country); model 2 additionally included smoking and physical activity; and model 3 further adjusted for nutritional status. Of the participants, 73.6% were women and 85.2% were between 18 and 25 years old. Most participants (74.0%) reported following a Prudent Diet and 11.6% reported Western diet. Adherence to a Western diet was significantly associated with higher odds of reporting sleep durations outside the recommended range, even after adjusting for sociodemographic factors, smoking, physical activity, and nutritional status. This association appeared stronger among women than men. The Western dietary pattern was significantly associated with higher odds of reporting sleep durations outside the recommended range among Latin American university students, particularly among female participants, older individuals, and those classified as obese. These findings may inform future public health policies and interventions aimed at healthier food environments.

Key words: sleep, western diet, female, obesity, Latin America, university students, Ultra-processed foods, multicenter

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INTRODUCTION

Changes in dietary patterns, particularly the shift towards a Western diet (WD) high in sugar, fat, and salt [1,2], are becoming an increasing public health concern [3]. The rise in availability and consumption of ultra-processed products (UPP) and sugary drinks, coupled with the aggressive marketing strategies typical of WD, are influencing the population's eating habits [4]. Just over a decade ago, UPP and sugary drinks accounted for a large proportion of caloric intake in the United States [5]. Similarly, in Latin America, the availability and consumption of UPP have increased rapidly in recent years, contributing to changes in dietary patterns and public health concerns across the region [4].

High consumption of UPP and sugary drinks has been linked to increased rates of obesity, diabetes, and non-communicable chronic diseases (NCD) [6,7]. According to the World Health Organization (WHO), in the pre-pandemic period of COVID-19 (2016), excess of weight affected 1.9 billion adults, of which 650 million were classified as obese; in 2022, 2.5 billion adults were overweight, of which 890 million were living with obesity [8]. In Latin America and the Caribbean (LAC), the prevalence of obesity is particularly concerning, with 29.9% of adults classified as obese [9]. The economic impact of being overweight and obesity is also substantial, affecting health systems and productivity [10].

The correlation between poor sleep quality, obesity, and NCD has been documented in large population-based studies in the United States and internationally, particularly through research on sleep-disordered breathing and its association with chronic disease risk and quality of life [11–13]. Indeed, disruptions in circadian rhythms can impact lipid, sugar, and energy metabolism in the body [14]. Furthermore, poor sleep quality can alter the levels of ghrelin and leptin, hormones that regulate appetite and satiety [15,16]. Clement-Carbonell *et al.* [17] reported a stronger association between sleep quality and mental health, as well as between sleep quality and physical health, in young adults [17]. Similarly, the association between female gender and poor sleep quality has been widely documented [18,19]. This relationship is influenced by a combination of hormonal fluctuations throughout the menstrual cycle, higher prevalence of anxiety and depression, and increased psychosocial and cultural stressors among women [20,21]. These factors, ranging from biological changes to societal roles and expectations, help explain why women, particularly female students, are more vulnerable to sleep disturbances. Additionally, diet has also been shown to impact sleep quality [22]. Therefore, diet patterns seem to be a key factor that could help better understand the interrelationship between sleep quality, socioeconomic factors, and health; however, the impact of dietary patterns on sleep quality is not well-understood. In previous studies, it was reported that more than 60% of Latin American university students experienced sleep

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deprivation during the COVID-19 pandemic, which was associated with a higher body mass index (BMI) [23]. While the associations between dietary patterns, obesity, and sleep quality have been widely studied in adult populations, there is limited evidence specifically addressing these relationships among university students in Latin America. Therefore, this study aims to evaluate the association between dietary patterns and self-reported sleep duration among Latin American university students during the COVID-19 pandemic.

METHODOLOGY

Study design

A cross-sectional survey was conducted as part of a multicenter study coordinated by the Latin American Nutrition Researchers Network (RedLIAN), which included Argentina, Colombia, Costa Rica, Chile, Ecuador, Guatemala, Mexico, Paraguay, Panama, and Peru. This analysis is a component of the project titled 'Quality of Life, Food and Nutrition in Latin American University Students,' which was carried out during the COVID-19 pandemic. The data collection took place from November to December 2020. The overall project was led by academic teams from the Universidad de las Américas and the Universidad San Sebastián, both in Chile, with data collection carried out by local research groups in each participating country.

Participants

The sample size for this study was 4539, university students, ranging in age from 18 to 46 years old. Data was collected through online surveys using Google Docs (Google LLC, Mountain View, California, US). A convenience sampling strategy was used, with voluntary participation. The analysis included adults of both sexes over 18 years of age who were actively enrolled in either public or private universities in the participating countries. Subjects who did not complete the survey or who reported being in postgraduate courses were excluded from the study.

Procedures

Participants in the study completed a self-administered online survey composed of five sections:

(1) sociodemographic information (sex, age, year of study at the university, socioeconomic level, among others);

(2) dietary patterns (classified as vegetarian diet, prudent diet, Western diet, or other, based on a validated self-administrated questionnaire with example of each one dietary pattern);

(3) self-reported weight and height, from which the body mass index (BMI) to determine obesity (BMI≥30kg/m^2) were calculated [24];

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(4) sleep duration, assessed by asking "On average, how many hours do you sleep per night?" with poor self-reported sleep duration was defined based on hours of sleep (≤7 or ≥9 hours per day) [25]; and,

(5) a self-reported questionnaire of physical activity, classified as active (≥150 minutes of moderate or vigorous activity per week) or inactive based on WHO recommendations [26].

For analytical purposes, age was categorized into two groups: 18–25 years and 26–46 years. This cutoff was selected to reflect the typical age range of university students, with the majority falling between 18 and 30 years. The division at the midpoint facilitates interpretation of differences between younger and older students within the sample. The survey instrument was previously prepared and validated by the authors for use in Latin American university populations. A content validation process was conducted prior to the online application of the survey, using the expert judgment method. Ten professionals (nutritionists and sleep specialists) were invited to evaluate the questionnaire in Word format over a two-week period. They assessed the clarity, relevance, and appropriateness of each item and provided feedback. Based on their recommendations, adjustments were made to improve the instrument. Although the results of this validation process were not published, the feedback contributed to refining the final version of the survey.

Dietary pattern

The dietary pattern was determined through a multiple-choice question with the following options: a) Western Diet (WD): an omnivorous diet typically high in animal-based foods, highly processed foods, and lower-than-recommended intake of plant-based foods; b) Prudent Diet (PD): an omnivorous diet characterized by moderate consumption of all foods, avoiding excesses and deficiencies in consumption, in accordance with national dietary guidelines; c) Flexitarian Diet (FD): an omnivorous diet that includes high amounts of plant-based foods, moderate amounts of poultry, dairy, and fish, and low amounts of red meat, highly processed foods, and added sugar; d) Mediterranean Diet (MD): An omnivorous diet characterized by high consumption of vegetables, fruits, nuts, seeds, olives, olive oil, and fish; e) Vegan Diet (VD): a diet characterized by the consumption of only foods of vegetable origin; f) Ovo-dairy-vegetarian Diet (ODVD): a diet characterized by the consumption of vegetable foods, eggs, and dairy products; g) Fish-vegetarian diet (FVD): a diet characterized by the consumption of vegetable foods, fish, eggs, and dairy products; h) Keto Diet (KD): a diet characterized by being high in fat and low in carbohydrates; and, i) Paleolithic Diet (PD): a diet characterized by being rich in meats, vegetables, and seeds, but excludes dairy products, cereals, and legumes. For the analysis proposed in this study, the dietary pattern was classified into four categories: vegetarian diets (VD, all vegetarian modalities), WD, PD, and other diets. The PD

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category also included patterns such as Mediterranean and flexitarian. Conversely, the other diets category comprised patterns not explicitly listed above, including ketogenic and paleolithic diets.

Ethics

All participants agreed to participate in the study through a virtual informed consent form (eConsent) [27]. The form explained the objectives of the study, the structure of the survey, and the voluntary and anonymous nature of participation. No personal identifiers were collected, such as names, ID numbers, phone numbers, or addresses. The study was conducted during the COVID-19 pandemic, under conditions of confinement and remote learning, which made online data collection the most feasible and safe option. To mitigate common limitations of e-consent, such as difficulties in understanding digital information and lack of face-to-face interaction, the form was written in clear and accessible language, and participants were provided with contact information for the research team in case of questions. Data was collected anonymously and stored securely, in compliance with ethical standards for online research. The survey responses were stored in a secure digital database (Excel format) and used exclusively for academic purposes. The project protocol was approved by the Ethics Committee of the Universidad de Las Américas of Chile, with reference number CEC_FP_2020017.

Statistical analysis

All statistical analyses were performed using the Stata 16.1 software package (StataCorp, College Station, Texas, US). Data are presented as mean and standard deviation (SD) after performing an analysis of normality using the Shapiro-Wilks test. Categorical variables are presented as frequency and percentage. A total of 4880 surveys were received, and cases with incomplete data were excluded listwise. The final analysis was conducted with 4539 complete responses. Multiple logistic regression was used to assess the association between dietary patterns and self-reported sleep duration. The response variable was classified as poor self-reported sleep duration (1) for self-reported sleep durations of ≤7 or ≥ 9 hours per day, and as good self-reported sleep duration (0) for self-reported sleep durations of >7 to < 9 hours per day [25]. Model 1 was adjusted for sociodemographic variables (sex, age, socioeconomic level, and country); model 2 included variables from model 1 plus smoking and physical activity; and model 3 included variables from model 2 plus BMI. The measures of association are reported as Odds Ratios (ORs) and their 95% confidence intervals (95%CI). Interaction effects (diet x sex, diet x age, and diet x obesity status) were included in an exploratory manner. An association was considered significant if the p-values for the ORs were less than 0.05.

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RESULTS AND DISCUSSION

The study included a total of 4,539 university students, of which 73.6% were women and 85.2% were between 18 and 25 years old. Regarding the socioeconomic level, 47.7% were classified as medium, 27.0% as low, and 25.3% as high. Regarding the level of physical activity, 34.1% were self-reported as physically active. The mean (SD) for hours of sleep was 6.97 (1.42) hours. The mean (SD) for BMI was 24.39 (4.82) kg/m^2 (see Table 1). Figure 1 shows the distribution of dietary patterns among participants. The majority (74.0%) reported following a PD, 11.6% a WD, 8.8% VD, and 5.6% reported other diets.

Table 2 shows the association between dietary patterns and self-reported sleep duration. Compared to a vegetarian diet, adopting a WD was significantly associated with higher odds of self-reporting sleep durations outside the recommended range (≤7 or ≥9 hours per day), with an odds ratio of 1.74 (95% CI: 1.33; 2.27). After adjusting the model for factors like smoking and physical activity, the association was slightly attenuated. However, WD was associated with higher odds of self-reported sleep duration outside the recommended range with an odds ratio of 1.63 (95% CI: 1.25; 2.13). Finally, for the fully adjusted model (including BMI), WD was associated with higher odds of self-reported sleep durations outside the recommended range with an odds ratio of 1.57 (95% CI: 1.20; 2.06).

Table 3 shows the association between dietary patterns and self-reporting sleep durations, categorized by sex, age range, and obesity status. Regarding sex, WD was associated with self-reporting sleep durations outside the recommended range when compared with vegetarian diets in women, OR of 1.57 (95% CI: 1.15; 2.16). Similarly, a significant association was observed between dietary patterns and self-reported sleep duration across different age groups. The OR was 1.52 (95% CI: 1.12; 2.05) for the 18 to 25-year-old category; and, OR of 1.96 (95% CI: 1.02; 3.75) for the 26-46-year-old category. A significant association was also observed between dietary patterns and self-reported sleep duration in relation to obesity status. The OR was 1.58 (95% CI: 1.18; 2.11) for people with a BMI < 30 kg/m^2, and OR 2.75 (95% CI: 1.14; 6.59) for people with obesity. Interaction terms (diet × sex; diet × age; and diet × obesity status) were included in the regression models to assess whether the associations differed across these subgroups. These interaction tests were pre-specified and conducted in an exploratory manner. The p-values for interaction are presented in Table 3.

The aim of this research was to evaluate the association between dietary patterns and self-reported sleep duration among university students in Latin America. The WD pattern, characterized by a high consumption of UPP and sugary drinks, was found to be associated with self-reported sleep duration outside the recommended

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range (≤7 or ≥9 hours per day). This association remained significant even after adjusting for sociodemographic variables, smoking habits, physical activity levels, and nutritional status. Similarly, the WD pattern was found to be significantly associated with self-reported sleep duration outside the recommended range in women, all age categories, and regardless of nutritional status.

These findings corroborate what was previously reported by Wilson *et al.* on the association of dietary patterns with quality of sleep in a recent review [22]. Consistent with these results, a study conducted among university students from the United Arab Emirates reported a relationship between hedonic hunger, poor sleep quality, and high-stress levels [28]. Additionally, a recent meta-analysis suggests that lifestyle improvement interventions, including physical activity, diet modification, and stress management, can positively impact sleep quality in adults [29]. Although an association between dietary patterns and sleep quality has been found, it remains unclear whether an unhealthy diet causes poor sleep, or whether poor sleep leads to less healthy food choices. Furthermore, the specific ways in which certain nutrients or dietary patterns affect sleep mechanisms, such as melatonin production, cortisol regulation, or gut microbiota, are not yet fully understood. Therefore, further research is needed to continue exploring the relationship between dietary patterns and sleep quality.

In a recent study, Du *et al.* [30] reported that among university students from seven countries, predominantly high-income countries, sleep quality is influenced by multiple factors, including eating habits, stress, and alcohol abuse [30]. The authors emphasized that enhancing sleep quality and resilience among college students could lead to improved eating behaviors, particularly during high-stress situations like the COVID-19 pandemic [30]. In the context of the COVID-19 pandemic, the measures adopted, such as lockdowns, while necessary, had negative implications for the population, such as increased sedentary behavior, stress, anxiety, and a greater tendency towards unhealthy eating habits. In a similar vein, Ludy *et al.* found that college students with good sleep hygiene and healthier eating habits are less prone to weight gain during their early college years [31]. These findings suggest that promoting healthy eating habits may help contribute to improved sleep and weight outcomes and maybe to combat the obesity pandemic [32]. It is also important to implement national food dietary guidelines to educate the university population on healthy eating habits and lifestyles.

A recent study conducted on middle-aged women in Mexico found that healthy dietary patterns, which include the consumption of fresh fruits, vegetables, and other healthy, natural, and minimally processed foods, are associated with better sleep quality [33]. The authors suggest that the high content of red meat and alcoholic beverages in WD may contribute to insomnia, the use of sleep medications, and

increased sleep latency [33]. While it is well-known that alcohol consumption can affect sleep quality [34], the metabolic changes caused by the high lipid and sugar content in WD could also disrupt the circadian rhythm [14].

Although most studies on sleep and diet have been conducted in the United States, Europe, and Asia, recent research from Latin America is emerging. For example, Meza-Miranda *et al*. examined the relationship between body weight, sleep duration, and physical activity among university students from several Latin American countries during the COVID-19 pandemic [23]. Similarly, Jansen *et al*. [33] found that healthier dietary patterns were associated with better sleep quality among midlife Mexican women [33]. These studies, together with evidence from the present research, highlight the importance of considering regional evidence when addressing the interplay between diet and sleep in Latin America.

Study results show that the negative impact of the WD pattern on self-reported sleep duration outside the recommended range was especially pronounced among women. Women who adhered to a WD had a significantly higher risk of poor self-reported sleep duration outside the recommended range compared to men. This gender-specific effect was observed across all age categories and regardless of nutritional status, underscoring the importance of considering sex differences when designing interventions and public health strategies. Zendels *et al*. reported that attitudes towards sleep play a crucial role in understanding how sex influences sleep quality [18]. However, they found that women tend to experience poorer sleep quality and insufficient sleep duration. Similarly, Madrid-Valero *et al.* reported in Spain, that poor sleep quality is common among adults, particularly women [19]. Authors reported that women have almost double probability of poor sleep quality in comparation with men OR 1.88 (95% CI, 1.54; 2.28). Poor sleep quality appears to be associated with female sex, as indicated by the findings of the present study. This could be attributed to various factors, including psychological influences, lifestyle habits, or societal roles. Therefore, additional research should be conducted to better understand the relationship between sex and poor sleep quality, as well as diet quality. For example, with a longitudinal study or an ecological.

Some of the limitations of this study include its cross-sectional design and the use of online surveys. All data, including weight and height, were self-reported, which increases the risk of underreporting and misclassification bias, potentially leading to an underestimation of BMI and obesity prevalence. Additionally, dietary patterns, sleep duration and physical activity were assessed through self-report, which may be affected by recall bias and misinterpretation of the categories provided. The sample was predominantly composed of female students, which may limit the representativeness of the findings for male university students. This imbalance is likely related to the voluntary nature of participation and the online format of the

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survey, which tends to attract higher response rates from women, especially in health-related research. Future studies should aim for more balanced gender representation.

Additionally, the study does not consider key factors that influence sleep quality, such as stress or variables related to the food environment. For example, a recent systematic review concluded that caffeine consumption close to bedtime reduces overall and increases the time it takes to fall asleep. Furthermore, another factor related to poor sleep is that using screen-based devices at night is associated with shorter sleep duration and a delay in falling asleep in adults, suggesting that exposure to artificial light at night disrupts circadian rhythms. In addition, the data were collected during the COVID-19 pandemic, which may limit the generalizability of the findings to the current post-pandemic context, as university students' lifestyles, dietary patterns, and sleep behaviors may have shifted since then. However, this study provides a unique snapshot of health-related behaviors among university students across ten Latin American countries during an unprecedented period, offering valuable insights into the impact of the pandemic on this population.

Despite these limitations, the study's strengths include a large sample size from ten Latin American countries. Likewise, the statistical analysis performed is emphasized. Additionally, this research is one of the few that examines the link between dietary patterns and self-reported sleep duration.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

In conclusion, among Latin American university students, the Western Diet (WD) was found to be associated with poor self-reported sleep duration. Individuals adhering to a WD, particularly women, older participants, and those with obesity, were found to have a higher risk of poor sleep. Interventions are needed to promote healthier eating habits, which could improve self-reported sleep duration among university students in Latin America. Additionally, public policy measures are needed to modify obesogenic food environments. Interventions that use a food system approach can facilitate access to and affordability of healthy diets for Latin American university students.

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Declarations

Ethical Approval: This study was conducted in accordance with the recommendations of the Helsinki Declaration for Human Studies. Availability of data and materials: The data used in this study is available at: https://www.doi.org/10.17605/OSF.IO/VGXU9

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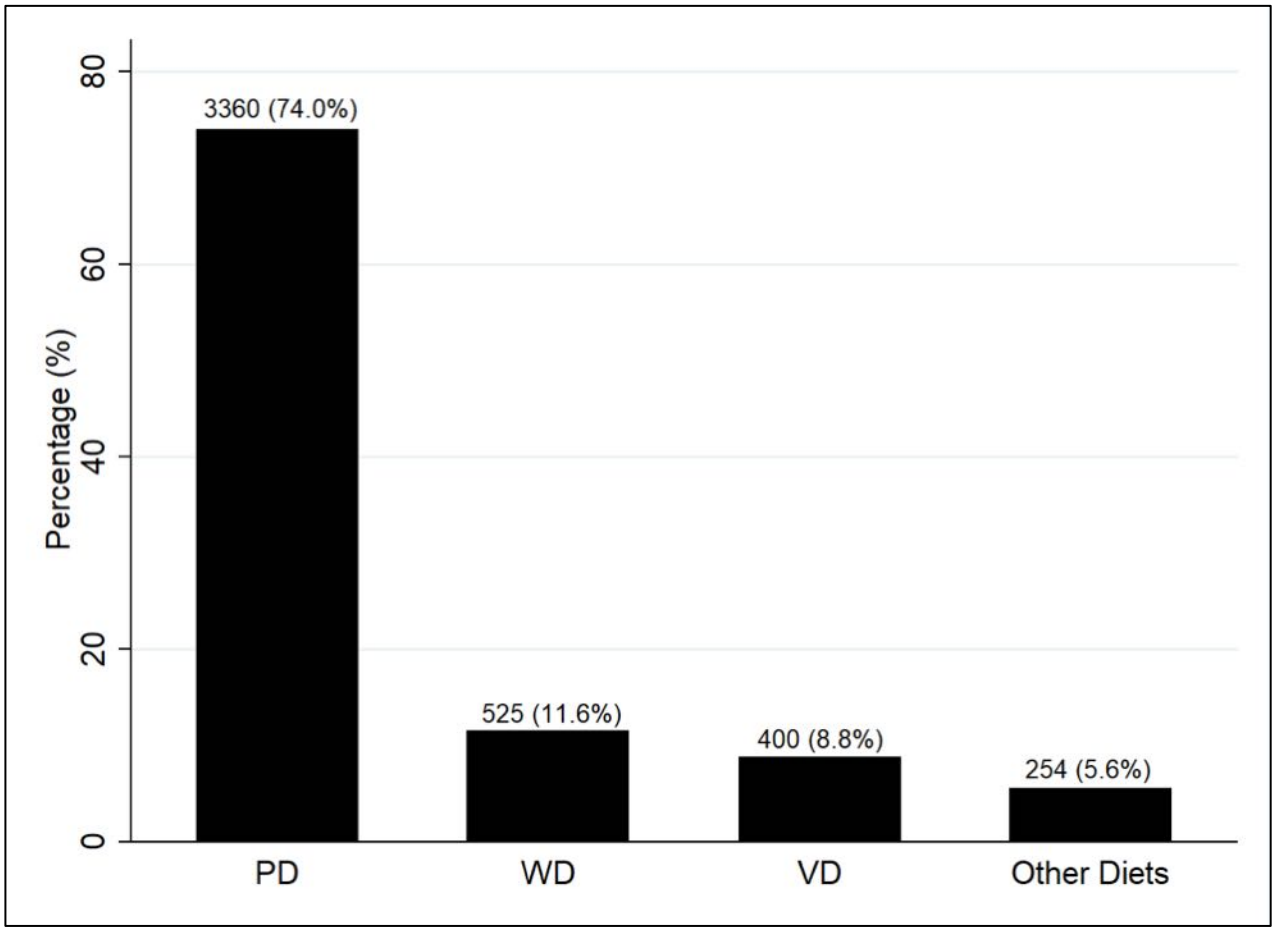
Figure 1: Distribution of Dietary Patterns Among Participants



Data are presented as percentage with absolute frequency [n (%)] for each category. Values shown above the bars indicate the number of participants and corresponding percentage. PD = Prudent Diet; WD = Western Diet; VD = all vegetarian modalities; Other diets = ketogenic and paleolithic diets

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Table 1: Characteristics by type of dietary pattern

	Total	Good self-reported sleep duration (7–9 hours)			Poor self-reported sleep duration (≤7 or ≥9 hours)		
		Total	Women	Men	Total	Women	Men
Sociodemographic characteristics	n=4539	(n=2595)	(n = 1902)	(n = 693)	(n1944)	(n = 1439)	(n = 505)
Age (%)							
18-25	3869 (85.2%)	2251 (86.7%)	1644 (86.4%)	607 (87.6%)	1618 (83.2%)	1201 (83.5%)	417 (82.6%)
26-46	670 (14.8%)	344 (13.3%)	258 (13.6%)	86 (12.4%)	326 (16.8%)	238 (16.5%)	88 (17.4%)
Socioeconomic level (%)							
Low	1227 (27.0%)	714 (27.5%)	547 (28.8%)	167 (24.1%)	513 (26.4%)	378 (26.9%)	126 (25.0%)
Medium	2166 (47.7%)	1202 (46.3%)	901 (47.4%)	301 (43.4%)	964 (49.6%)	730 (50,7%)	234 (46.3%)
High	1146 (25.2%)	679 (26.2%)	454 (23.9%)	225 (32.47%)	467 (24.0%)	322 (22.4%)	145 (28.7%)
Country (%)							
Argentina	473 (10.4%)	310 (11.9%)	278 (14.6%)	32 (4.6%)	163 (8.4%)	131 (9.1%)	32 (6.3%)
Colombia	371 (8.2%)	230 (8.9%)	186 (9.8%)	44 (6.3%)	141 (7.3%)	111 (7.7%)	30 (5.9%)
Costa Rica	245 (5.4%)	127 (4.9%)	91 (4.8%)	36 (5.2%)	118 (6.1%)	93 (6.5%)	25 (5.0%)
Chile	541 (11.9%)	274 (10.6%)	194 (10.2%)	80 (11.5%)	267 (13.7%)	213 (14.8%)	54 (10.7%)
Ecuador	636 (14.0%)	322 (12.4%)	248 (13.0%)	74 (10.7%)	314 (16.2%)	225 (15.6%)	89 (17.6%)
Guatemala	332 (7.3%)	192 (7.4%)	154 (8.1%)	38 (5.5%)	140 (7.2%)	108 (7.5%)	32 (6.3%)

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Mexico	1157 (25.5%)	715 (27.6%)	423 (22.2%)	292 (42.1%)	442 (22.7%)	289 (20.1%)	153 (30.3%)
Panama	251 (5.5%)	143 (5.5%)	124 (6.5%)	19 (2.7%)	108 (5.6%)	78 (5.4%)	30 (5.9%)
Paraguay	253 (5.6%)	149 (5.7%)	102 (5.4%)	47 (6.8%)	104 (5.3%)	74 (5.1%)	30 (5.9%)
Peru	280 (6.2%)	133 (5.1%)	102 (5.4%)	31 (4.5%)	147 (7.6%)	117 (8.1%)	30 (5.9%)
Sociodemographic characteristics							
Area of study, n (%)							
Arts, architecture, and design	59 (1.3%)	29 (1.1%)	15 (0.8%)	14 (2.0%)	30 (1.5%)	16 (1.1%)	14 (2.8%)
Agricultural and biological sciences	181 (4.0%)	116 (4.5%)	63 (3.3%)	53 (7.6%)	65 (3.3%)	39 (2.7%)	26 (5.1%)
Health Sciences	148 (3.3%)	77 (3.0%)	42 (2.2%)	35 (5.1%)	71 (3.7%)	50 (3.5%)	21 (4.2%)
Administration Sciences and Economics.	2908 (64.1%)	1607 (61.9%)	1327 (69.8%)	280 (40.4%)	1301 (66.9%)	1062 (73.8%)	239 (47.3%)
Education, social sciences and humanities	182 (4.0%)	102 (3.9%)	85 (4.5%)	17 (2.5%)	80 (4.1%)	55 (3.8%)	25 (5.0%)
Engineering and exact sciences	821 (18.1%)	517 (19.9%)	261 (13.7%)	256 (36.9%)	304 (15.6%)	141 (9.8%)	163 (32.3%)
Other	240 (5.3%)	147 (5.7%)	109 (5.7%)	38 (5.5%)	93 (4.8%)	76 (5.3%)	17 (3.4%)
Year of university, n (%)							
First year	882 (19.4%)	536 (20.7%)	332 (17.5%)	204 (29.4%)	346 (17.8%)	241 (16.7%)	105 (20.8%)
Second year	1123 (24.7%)	618 (23.8%)	467 (24.6%)	151 (21.8%)	505 (26.0%)	395 (27.4%)	110 (21.8%)
Third year	907 (20.0%)	510 (19.7%)	368 (19.3%)	142 (20.5%)	397 (20.4%)	295 (20.5%)	102 (20.2%)

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Fourth year	717 (15.8%)	423 (16.3%)	338 (17.8%)	85 (12.3%)	294 (15.1%)	225 (15.6%)	69 (13.7%)
Fifth year	910 (20.0%)	508 (19.6%)	397 (20.9%)	111 (16.0%)	402 (20.7%)	283 (19.7%)	119 (23.6%)
Lifestyle factors							
Physical activity, n (%)							
No	2992 (65.9%)	422 (80.4%)	1205 (63.4%)	408 (58.9%)	124 (55.6%)	1033 (71.8%)	346 (68.5%)
Yes	1547 (34.1%)	103 (19.6%)	697 (36.6%)	285 (41.1%)	99 (44.4%)	406 (28.2%)	159 (31.5%)
Quarantine (%)							
No	1805 (39.8%)	1061 (40.9%)	783 (41.2%)	278 (40.1%)	744 (38.3%)	548 (38.1%)	196 (38.8%)
Yes	2734 (60.2%)	1534 (59.1%)	1119 (58.8%)	415 (59.9%)	1200 (61.7%)	891 (61.9%)	309 (61.2%)
Tobacco consumption, n (%)							
No	4201 (92.6%)	2400 (92.5%)	1781 (93.6%)	619 (89.3%)	1801 (92.6%)	1353 (94.0%)	448 (88.7%)
Yes	338 (7.4%)	195 (7.5%)	121 (6.4%)	74 (10.7%)	143 (7.4%)	86 (6.0%)	57 (11.3%)
Hours sitting, Mean (SD)	8.60 (3.22)	8.16 (3.06)	8.25 (3.03)	7.90 (3.14)	9.19 (3.34)	9.29 (3.34)	8.90 (3.31)
Sleep Hours, Mean (SD)	6.97 (1.42)	7.65 (0.70)	7.65 (0.69)	7.65 (0.70)	6.07 (1.63)	6.08 (1.65)	6.03 (1.56)
BMI, Mean (SD)	24.39 (4.82)	24.18 (4.77)	23.87 (4.87)	25.01 (4.40)	24.68 (4.87)	24.43 (4.93)	25.40 (4.60)

Good self-reported sleep duration is defined as 7 – 9 hours of sleep per day; poor self-reported sleep duration is defined as ≤7 or ≥ 9 hours of sleep per day

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Table 2: Association of diet pattern and self-reported sleep duration

	Model 1		model 2		model 3	
	OR 95% CI	p value	OR 95% CI	p value	OR 95% CI	p value
Vegetarian diet	1.00 (Reference)		1.00 (Reference)		1.00 (Reference)	
Prudent diet	1.08 (0.87; 1.34)	0.482	1.07 (0.86; 1.32)	0.553	1.06 (0.86; 1.32)	0.581
Western diet	1.74 (1.33; 2.27)	<0.001	1.63 (1.25; 2.13)	<0.001	1.57 (1.20; 2.06)	0.001
Other diets	1.43 (1.04; 1.97)	0.030	1.38 (1.00; 1.91)	0.050	1.35 (0.98; 1.87)	0.067

Data presented as ORs with its 95% confidence interval. *n = 4,539.* Sleep is the outcome variable, being 1, poor sleep quality. The reference group is students with a vegetarian diet. Model 1: Adjusted for sex, age, socioeconomic level, country. Model 2: Model 1 + smoking, physical activity. Model 3: Model 2 + BMI. BMI: Body Mass Index. sleep quality was defined by self-reported sleep duration only (≤7 or ≥9 hours = poor, 7–9 hours = good

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Table 3: Association between dietary patterns and poor self-reported sleep duration (≤7 or ≥9 hours per day) stratified by sex, age, and BMI among Latin American university students

	Women	Men	P value interaction
Vegetarian diet	1.00 (Reference)	1.00 (Reference)	0.981
Prudent diet	0.81 (0.50; 1.30)	1.11 (0.87; 1.42)	
Western diet	1.33 (0.76; 2.32)	1.57 (1.15; 2.16)	
Other diets	1.06 (0.56; 2.01)	1.40 (0.96; 2.05)	
	18-25 years	**26-46 years**	0.238
Vegetarian diet	1.00 (Reference)	1.00 (Reference)	
Prudent diet	1.05 (0.83; 1.33)	1.14 (0.68; 1.92)	
Western diet	1.52 (1.12; 2.05)	1.96 (1.02; 3.75)	
Other diets	1.30 (0.91; 1.85)	1.54 (0.71; 3.32)	
	BMI <30 km/ m2	**BMI Obesity**	0.604
Vegetarian diet	1.00 (Reference)	1.00 (Reference)	
Prudent diet	1.03 (0.82; 1.29)	1.92 (0.84; 4.39)	
Western diet	1.58 (1.18; 2.11)	2.75 (1.14; 6.59)	
Other diets	1.24 (0.88; 1.74)	3.42 (1.22; 9.54)	

Data presented as OR with its 95% confidence interval. *n = 4,539.* Sleep is the outcome variable being 1, poor sleep quality. The reference group is students with a vegetarian diet. Model 1 adjusted for sex, age, socioeconomic level, country, smoking habit and physical activity, and BMI. Sex, age, and BMI were removed when the variable was the moderator. BMI: Body Mass Index. Sleep duration was self-reported, and poor sleep was defined as ≤7 or ≥9 hours per day

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