

The degree of food processing of the diet of Nutrition students is not associated with their quality of sleep



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ABSTRACT

Objective: To evaluate sleep quality and its possible relationship with the diet of undergraduate students

in Nutrition, considering the degree of food processing. Methodology: Observational cross-sectional and analytical study conducted with 88 students regularly enrolled in the undergraduate course in nutrition in institutions located in the city of Fortaleza-CE. Demographic, socioeconomic, lifestyle and food consumption data were collected, this through a food frequency questionnaire. Anthropometric evaluation was also performed and sleep quality was investigated, this through the Pittsburgh Quality Index and the Munich Chronotype Questionnaire. Results: Approximately 55.68% of the students evaluated were found in eutrophy, and dietary energy was mainly due to fresh foods and minimally processed foods (63.99%). As for sleep, only 2.27% of the participants had a good quality, and the average social Jet Lag among them was 1:31h. There was no association between the degree of food processing of the diet and the sleep-related variables of the university students evaluated. Conclusion: Nutrition students exhibit a high proportion of overweight, high consumption of fresh or minimally processed foods and low sleep quality. There is no association between dietary and sleep variables in the group evaluated.

Keywords: Body Weigh, Eating, Ultra-Processed Foods, Sleep Quality, Students.

1 INTRODUCTION

Sleep is a non-homogeneous clinical state composed of two main phases: NON-REM Phase (No rapid eye movement) and REM Phase (with rapid eye movement), rhythmically regulated by the circadian cycle and directly responsible for several functions in the human body, among them the restoration of energy, learning, memory, synthesis of cellular components and the maintenance of the immune system^{1, 2}.

To maintain their good quality and correct performance of their functions, it is estimated that adult individuals, despite their particularities, need a sleep period of at least 7 hours a day³. However,



given the increasing presence of chores and distractions in their routine, the prevalence of individuals with the presence of sleep disorders has become increasing, especially among university students.

When subjected to poor quality sleep in a chronic way, the human body suffers an imbalance in its natural homeostasis, thus resulting in a series of physiological and hormonal dysregulations, and consequently in the development of complications such as stress, anxiety, depression, as well as in the decrease of satiety signals and increased food intake. This situation favors the reduction of the consumption of in natura foods and the greater recurrence of the consumption of ultra-processed foods^{5,6,7,8}.

Thus, the objective of the present study is to evaluate the quality of sleep and its possible relationship with the diet of undergraduate students in Nutrition, considering the degree of food processing.

2 METHODOLOGY

2.1 TYPE OF STUDY

This is an observational study of the cross-sectional and analytical type, which integrates the multicenter research "Nutritionist Health Study – NutriHs", developed by the School of Public Health of the University of São Paulo, which has been investigating behavioral aspects related to the health of nutritionists and nutrition students.

2.2 POPULATION AND SAMPLE

The population consisted exclusively of Nutrition students enrolled in public (Universidade Estadual do Ceará-UECE) and private (Universidade de Fortaleza-UNIFOR, Centro Universitário Estácio-UniFanor Wyden, Faculdade Ateneu and Centro Universitário Fametro-UniFametro) educational institutions located in the city of Fortaleza-CE.

The convenience sample consisted of 88 students who met the following inclusion criteria: university students over 18 years of age, enrolled in the Nutrition course in one of the institutions participating in the research, with internet access and who participated in all stages of data collection. The presence of pregnancy was considered an exclusion criterion.

2.3 DATA COLLECTION AND ANALYSIS

Data collection was carried out from March 2019 to March 2020 and comprised two stages.



2.3.1 First stage

Initially, the participants filled out an electronic questionnaire available on the website of the larger study (<http://www.fsp.usp.br/nutrihs/>), containing data on identification, demographic, socioeconomic, lifestyle (physical activity and smoking) and food consumption.

Some variables were dichotomized and expressed in simple and percentage frequency: gender (female; male); self-reported color (white; not white); marital status (unmarried; married); monthly family income (≤ 5 minimum wages; > 5 minimum wages); work/internship (yes; no); physical activity (yes; no); and smoking (yes; no).

Data regarding the food consumption of the participants were obtained by means of a Food Frequency Questionnaire (FFQ)⁹ that was designed to evaluate the habitual food consumption of adult individuals in a valid way and with good reproducibility.

The questionnaire consists of 60 food items and takes into account the eating habits of an individual over a one-year period. The information in it is referred to in homemade measurements, then transformed into daily consumption amounts, in grams or milliliters, and entered into the database of the U.S. Department of Agriculture (USDA) for the calculation of the composition of the students' diet.

Subsequently, the foods consumed by the students were divided according to the NEW classification proposed for the Food Guide for the Brazilian Population¹⁰, which separates foods according to their degree of processing into 4 distinct groups: in natura or minimally processed foods (Group 1), processed culinary ingredients (Group 2), processed foods (Group 3) and ultra-processed foods (Group 4). Along with this, the daily caloric contribution of each of these groups was calculated in relation to the total caloric value of the participants' diet.

2.3.2 Second stage

The second stage was carried out at the Clinical Analysis Laboratory of the Center for Integrated Medical Care-NAMI, located on the campus of the University of Fortaleza (UNIFOR). At this stage, participants underwent an anthropometric assessment and completed questionnaires related to sleep quality (Pittsburg Sleep Quality Index and Munich Chronotype Questionnaire).

The anthropometric evaluation consisted of obtaining weight and height data and calculating the body mass index (BMI). Weight was measured using a portable digital scale model GLASS G-TECH 200 kg, with an accuracy of 100g. To measure the height, a portable stadiometer, Altuxata, with a capacity of 2.13 m and accuracy of 0.5 cm, was used. BMI was calculated in Kg/m^2 , and was used to classify the nutritional status of students according to the World Health Organization-WHO¹¹, where BMI values $\leq 18.5 \text{ Kg}/\text{m}^2$ indicate low weight; from 18.5 to $24.99 \text{ Kg}/\text{m}^2$ eutrophy; $25\text{kg}/\text{m}^2$ to $29.99\text{Kg}/\text{m}^2$ overweight and values above $30\text{kg}/\text{m}^2$ obesity.



The Pittsburgh Sleep Quality Index (PSQI) was validated for the Brazilian adult population by Bertolazi et al¹². The same is self applicable and It has 10 questions that assess seven distinct sleep components (subjective quality, latency, duration, habitual efficiency, sleep disorders, use of sleeping medication and daytime dysfunction), and each of these questions has a score ranging from 0 to 3. The sum total of the scores ranges from zero to 21 and the results are categorized as follows: 0-4 points good sleep quality; 5-10 points poor sleep quality; and above 10 points, presence of sleep disorders.

The Muniche ChronoType Questionnaire (MCTQ) is an instrument also previously validated in Brazil¹³ composed of 14 subjective questions, and used to evaluate the chronotype of individuals. In this questionnaire, information is obtained about the times when an individual usually sleeps and wakes up, on the days when he works/studies and on the days when he is free of activities. From these answers, it is possible to calculate the midpoint of sleep in both periods, and consequently ascertain their circadian cycle and the presence of Social Jet Lag. Specific formulas were applied to analyze the MCTQ¹⁴.

2.4 STATISTICAL ANALYSIS

The data were organized for presentation in simple frequency and percentage, means and standard deviations. The normality of the sample distribution was assessed using the Kolmogorov-Smirnov test. The BMI categories were dichotomized into overweight and non-overweight for the comparison between genders, using the Chi-Square test. Pearson's correlation was used to verify the association between feeding, according to food processing, and sleep quality. $P < 0.05$ was adopted as the significance level for both tests. The SPSS software, version 20.0, was used for the analyses.

2.5 ETHICAL ASPECTS

This project was designed according to the Guidelines and Norms for research Involving Human Beings of the State University of Ceará – Resolution 466/2012 (BRAZIL, 2012) and submitted to the Brazil Platform, with opinion number 3.528.41 and CAAE 95402618.3.0000.5534. All participants signed the Free and Informed Consent Form (ICF) and were informed in a clear and didactic way about the objectives of the research.

3 FINDINGS

The mean age of the students evaluated was 24.3 (\pm 6.0) years. There is a majority of female students (78.41%), non-white (57.95%), unmarried (87.5%) and with a family income of up to 5 monthly minimum wages (55.68%). Table 1 details the characterization of the participants.



Table 1. Characterization of the university students evaluated (n = 88). Fortaleza, Ceará, Brazil, 2023.

Variables	N	%
Gender		
Female	69	78,41
Male	19	21,59
Skin Color		
White	36	40,91
Non-White	51	57,95
Did not report	1	1,14
Marital status		
Unmarried	77	87,5
Married	11	12,5
Family Income (minimum wages)		
≤ 5 salaries	49	55,68
> 5 salaries	31	35,23
Don't know	8	9,09
Work/Internship		
Yes	29	32,95
No	59	67,05
Physical Activity		
Yes	49	55,68
No	39	44,32
Smoking Habit		
No	88	100

Source: Author (2023).

Regarding nutritional status, the overall mean BMI of the students was 24.5(±3.9) Kg/m², and approximately 55.68% of them were eutrophic. However, after analyzing the results, it is also possible to conclude that another large part of those evaluated is in a situation of nutritional risk since the proportion of overweight or obese women was approximately 34.79%, while that of men was 68.42%, as shown in Table 2.

Considering overweight (overweight + obesity) and non-overweight students, men are more overweight than women (p = 0.009).



Table 2. Distribution of university students evaluated (n = 88) according to nutritional status¹. Fortaleza, Ceará, Brazil, 2023.

Nutritional Status (BMI)	Women		Men		Total	
	N	%	N	%	N	%
Low Weight	2	2,9	0	0	2	2,27
Eutrofia	43	62,32	6	31,58	49	55,68
Overweight	19	27,54	10	52,63	29	32,95
Obesity	5	7,25	3	15,79	8	9,09

Source: Author (2023)

¹Categorized based on body mass index (BMI), according to WHO11

Regarding the food consumption of university students, it was evidenced that their habitual intake was, on average, 2596.43 (\pm 927.71) calories, and their daily energy contribution was mostly constituted by foods from the in natura or minimally processed group (Table 3).

Table 3. Mean daily energy contribution, with standard deviation (SD) of the food according to the degree of food processing. Fortaleza, Ceará, Brazil, 2023.

Daily energy contribution (Kcal)			
Food Processing	Average	DP	%
In natura/minimally processed foods	1681,96	779,47	63,99
Processed culinary ingredients	90,82	78,76	3,86
Processed foods	446,85	343,69	17,29
Ultra-processed foods	372,80	242,94	14,86
Total	2596,43	927,71	100

Source: Author (2023)

The mean PSQI score was 13.55 (\pm 4.78), being similar between genders, 13.74 (\pm 4.8) among women and 12.84 (\pm 4.78) among men. The prevalence of individuals with good quality sleep among the students, according to the sleep quality score, was only 2.27% among all those involved in the study (Table 4). As for Social Jet Lag (JLS), the average was, in hours, 01:31 (\pm 01:01), being 01:28 (\pm 01:02) for women and 01:43 (\pm 00:51) for men.



Table 4. Distribution of university students evaluated (n = 88) according to the variables of sleep quality and gender. Fortaleza, Ceará, Brazil, 2023.

Classification	Women	Men	Total
Sleep score, mean (SD)	13,74 (4,8)	12,84 (4,78)	13,55 (4,78)
Classification Score, n (%)			
Good	1 (1,45)	1 (5,26)	2 (2,27)
Spacious	17 (24,64)	4 (21,05)	21 (23,86)
Presence of sleep disturbance	51 (73,91)	14 (73,68)	65 (73,86)
Social Jet Lag, hours, average (SD)	01:28 (01:02)	01:43 (00:51)	01:31 (01:01)

Source: Author (2023)

Finally, as detailed in Table 5, the association between the variables diet, according to the degree of food processing, and sleep quality (sleep scores and Social Jet Lag), of the university students evaluated was evaluated. There was no association between the variables, because although the inverse association between processed culinary ingredients and Social Jet Lag was significant, it was weak.

Table 5. Association between percentage of dietary intake according to the degree of food processing and sleep-related variables of the university students evaluated (n = 88). Fortaleza, Ceará, Brazil, 2023.

Consumption according to degree of food processing (%)	Sleep scores		Jet lag social	
	r	p	r	p
In natura and minimally processed	0,02	0,842	-0,09	0,398
Processed culinary ingredients	0,07	0,97	-0,23	0,031
Processed foods	-0,08	0,464	0,06	0,552
Ultra-processed foods	0,04	0,726	0,15	0,174
Processed Foods + Ultra-Processed Foods	-0,4	0,716	0,15	0,173

Source: Author (2023)

Values expressed in r (Pearson's correlation coefficient and p-value).

4 DISCUSSION

The living and health conditions of 88 students enrolled in Nutrition courses of institutions located in the city of Fortaleza-CE were analyzed, as well as the quality of sleep and its possible relationship with the diet of these individuals considering the degree of food processing.

Even though they were predominantly young, almost half of the sample (42.04%) was made up of overweight individuals ($BMI \geq 25$ Kg/m²), a proportion that is high, but similar and slightly lower than those demonstrated by Ponte et al.¹⁵, Mori et al.¹⁶ and Sá et al.¹⁷ in studies involving university students from other courses, where this proportion was 43.2, 47.1 and 47.5%, respectively.

In addition, as also demonstrated by Wang et al.¹⁸ and other authors^{19,20}, overweight was even more prevalent among men ($p=0.009$), despite the various physiological particularities present in



the female public that influence their higher fat concentration body and weight gain, such as the lower basal metabolic rate and hormonal changes present in your menstrual period, for example^{21,22}.

This possibly contradictory result can be explained by the fact that nutritional status was diagnosed only through BMI, an indicator that does not take into account the content of lean mass and fat of an individual to define their body composition, generating biases²³, and by the constant concern of women with physical appearance and the desire for a lean body²⁴.

In the long term, especially in young individuals, overweight and obesity can directly influence the emergence of numerous diseases, including neurodegenerative, respiratory, muscular, digestive, cancer, hypertension, diabetes mellitus and others^{25,26}. The frequency of those affected by this disorder continues to grow significantly²⁷, even more so among university students²⁸, a situation that is due to numerous factors of great influence in the globalized world, among them, physical inactivity, inadequate diets, alcoholism, use of antidepressant and/or anxiolytic medications²⁹ and poor sleep quality³⁰.

After a monitoring carried out in a Brazilian university through health surveys, Sousa and Barbosa³¹ demonstrated that over 4 years the fraction of overweight men in the institution went from 30.1% to 36.4%, a result that exemplifies the increase that this condition is having over the years in this public in question.

Moreover, in addition to the aforementioned complications, excess weight is also directly associated with worsening satisfaction with the body image of academics, as demonstrated by Kessler and Poll³² in their analysis involving adults enrolled in different health courses. Therefore, this diagnosis may also end up contributing to the greater recurrence of mental disorders, low self-esteem³³ and consequently risky eating attitudes^{34,35}.

The diet of the evaluated students is in direct accordance with the recommendations established by the Food Guide of the Brazilian Population³⁶, which states that the basis of the menu of adult individuals should be composed of in natura or minimally processed foods because they are products originally rich in bioactive compounds, antioxidants, dietary fibers and other various vitamins and minerals beneficial to health³⁷.

On the other hand, the caloric contribution from ultra-processed foods (14.86%) is in disagreement with the cited publication³⁶, which recommends not consuming them. The most recent Family Budget Survey (POF) showed a higher percentage, of 18.4%³⁸, as in other studies in the area^{39,40}, where the minimum contribution values exceeded 20.4%.

Ultra-processed foods are industrial formulations³⁶ that have a high content of elements such as saturated fats, trans fats, simple sugars, cholesterol, sodium and chemical additives in their composition to make them more durable, convenient and palatable than the others⁴⁰. Therefore, in addition to being addictive, they are products severely harmful to organic health in general when



consumed in excess, mainly due to its influence on the development of chronic non-communicable diseases, hence the need for attention to its intake^{41,42}.

However, due to its high degree of palatability, the recurrent high price of natural foods, the increasingly appealing marketing and the growing dissemination of fast foods in the national culture, the consumption of products of this group continues to grow over the years^{43,44,45}, and this is even worse in the university public, because in addition to the aforementioned factors, They are also susceptible to several others that favor bad eating habits and consequently in the inclusion of foods from this group in their routine, among them the lack of time, indisposition and their greater ease of acquisition and preparation when compared to the other groups⁴⁶.

The inadequate eating behavior of parents, social pressure from friends⁴⁷ and the difficult emotional adaptation in the transition from basic education to higher education were also considered defining risk eating attitudes in this group of individuals⁴⁸.

Despite this current reality, Lanzillotti et al.⁴⁹ showed that the diet of undergraduate students in nutrition today is still composed predominantly of natural foods, while that of processed and ultra-processed foods is less present, similar to what was found in the present study, whose proportions of daily contribution to these foods were 17.29% and 14.86%, respectively.

Through these comparisons, it is assumed that the diet of Nutrition students is still healthier than that of the general population and that of university students from other courses, which is possibly due to the fact that these future professionals already have greater knowledge than the others about the importance of healthy eating on a daily basis and also about the negative consequences of erroneous choices when it comes to eating⁵⁰.

However, there are still findings that demonstrate that despite all the knowledge acquired in college, the dietary pattern of nutrition students, on numerous occasions, is also marked by the low presence of fruits, vegetables, vegetables and other *in natura* or minimally processed products in general, and high industrialized products^{51,52}, and that even the diet of future professionals in the area is in decline regarding its adequacy to health and needs to interventions so that it does not get even worse, as well as the general population.

An aspect that needs to be mentioned and that demands reflection is the absence, in the document cited here³⁶, of a recommendation regarding the percentage limits for the inclusion of processed foods, which makes it difficult to analyze the dietary adequacy of this food group.

From the results it was also possible to observe that, in addition to the average score of the PSQI having been high, approximately the entire sample presented a poor quality sleep or the presence of disorders, results that expose a difficult reality present in the academic environment, especially among those belonging to the health area.



When analyzing the sleep quality of 701 students also belonging to a Public University of Fortaleza-CE, Araújo et al.⁵³ observed that although the general average of hours of sleep of the evaluated had been 6.3 hours, close to that of the rest of the Brazilian adult population, more than half of them (54%) also presented a subjective quality of poor sleep and low efficiency due to their daily academic tasks and the presence of non-smoking habits healthy ones that impair sleep quality, for example, irregular bedtimes, alcohol use, prolonged naps throughout the day, and the habit of studying in bed.

However, the insertion of new technologies, the growing spread and influence of social networks, the changes in the style of young adults and the exhausting routine present in the current academic environment have contributed even more expressively in the decrease of the total hours slept, in the greater difficulty in falling asleep and in the increase in the number of episodes of nocturnal awakenings, that is, in the increase of sleep-related complications⁵⁴.

In recent findings published by Araújo et al.⁵⁵ and Oliveira, Oliveira and Ferreira⁵⁶, for example, the predominance of students with poor quality sleep or disorders reached 79.2% and 82.5% of their sample. As for Santos et al.⁵⁷ and Morais et al.⁵⁸, this predominance was even greater, affecting 86.4% and 90% of its participants, respectively, similar to what was found here.

In addition, in addition to the high IQSP score, JLS values greater than 1 hour were also found, a value that in itself is already capable of causing harmful misalignments in the circadian rhythm⁵⁹, and consequently organic changes that directly impact the dietary pattern⁶⁰ and the health of the individuals affected by it^{61,62}.

In general, circadian dysregulation caused by a short sleep and low regularity are responsible for the increase in the production of a series of pro-inflammatory cytokines (TNF- α , IL-17, IL-6, NF- κ B)⁶³ and for changes in the secretion of hormones directly responsible for the metabolism of macronutrients and the control of hunger/satiety, such as insulin, cortisol, ghrelin and leptin^{64,65}.

Therefore, in addition to having a negative impact on the student's academic performance by affecting their attention, memory and problem-solving capacity⁶⁶, poor sleep quality and the presence of JLS also promote important changes in nutrient absorption, increased hunger and decreased satiety signals, and consequently an increase in energy intake, worsening of eating habits, weight gain⁶⁷ and increased chances of developing chronic non-communicable diseases⁶⁸.

In a meta-analysis it was found that individuals who sleep less consume up to 385 kcal more per day than those whose sleep follows all the recommendations proposed by the current scientific community, which leads to a positive energy balance that in the long term contributes to overweight⁶⁹. In analyses conducted in a fully controlled manner, the increase in intake reached 559 kcal after a period of sleep restriction of only 8 days⁷⁰.



Despite the above, no association was observed between the variables of sleep quality and the diet of university students considering the degree of food processing, unlike numerous trials already published in international databases, where it has been demonstrated that such sleep of low quality and duration is related to lower consumption of fruits, vegetables, whole grains and dairy products⁷¹ and to the higher consumption of unhealthy industrialized snacks (fast-foods), sweets^{72,73} and sugary drinks, especially soft drinks⁷⁴.

However, when evaluating undergraduate students from a Public University, Gonçalves and França⁷⁵ also failed to find any significant association between sleep quality and food consumption of the participants, considering the degree of processing, even with their sample being formed almost exclusively (91%) by poor sleepers (PSQI ≥ 5) and the higher consumption of processed and ultra-processed foods to the detriment of in natura in their daily lives.

Given the controversies present in the literature, the still scarcity of studies that relate sleep quality with food consumption according to the degree of processing, and the limitations present in the cross-sectional design, which makes it impossible to establish the cause-effect relationship between the results, more studies involving this theme, with longitudinal designs, standardized instruments and a larger sample, are necessary to confirm, or not, the association of sleep alterations with the feeding of university students, considering the degree of food processing.

5 CONCLUSION

Through the study it was possible to evidence that the group of nutrition students exhibits a high proportion of overweight weight, especially men, that their diet has a good proportion of in natura and minimally processed foods, despite the still consumption of ultra-processed foods, and that the quality of sleep of its majority is poor.

Despite the findings, no association was observed between feeding, according to the degree of food processing, and the quality of sleep of those evaluated, which demonstrates that a greater number of studies are still needed to prove, in fact, the possible relationship between the variables in question.



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