PESEARCH PAPER

Tobacco consumption in Chilean university students and associations with anthropometry, eating habits and sleep quality multicentric study

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Summary

Tobacco Consumption (TC) is one of the main causes of the deterioration of health; however, there are few studies linking its consumption with diet and nutrition among university students. The objective of this study is to test the association of smoking with anthropometry, diet and sleep quality among Chilean university students. Cross-sectional study. University students (n = 1454) from the North, South and Central parts of Chile were evaluated. A self-assessment survey was used to evaluate healthy and unhealthy eating habits. Nutritional status was evaluated by Body Mass Index (BMI). Two surveys were used to assess sleep quality: the Questionnaire of Insomnia and the Epworth Scale. Finally, participants were consulted about Tobacco Consumption: 30% of the students consume tobacco and have a higher score in unhealthy food consumption, less frequent weekly breakfast consumption (< 0.01), lower daily fruit (< 0.01) and vegetables (< 0.05) consumption, higher alcohol consumption (< 0.05) and daily junk food consumption (< 0.05) compared to non-consuming students. Men who consume tobacco present greater insomnia (< 0.001), sleep latency (< 0.001) and daytime sleepiness (< 0.05) compared to non-consumers; and women who consume tobacco have a higher weight (< 0.001) and BMI (< 0.01). When performing logistic regression, tobacco consumption is positively associated with major alcohol consumption (< 0.001), whereas fish (< 0.05) and vegetable (< 0.05) consumption was negatively associated. In conclusion, students of both sexes who smoke have more unfavorable health factors and a poorer quality of life.

Introduction

Between 1960 and 2000, Chile has experienced economic, social and health changes that have influenced lifestyles related to eating habits, sedentary lifestyles, and consumption of tobacco, alcohol and other drugs [1]. Many of these changes have gone hand in hand with the deterioration of the quality of life. In the last two decades an increase in malnutrition due to excess has been reported, affecting 64.5% of the population over 18 years of age [2]. Chile is now among the top countries in the Americas, surpassed only by the United States and Mexico, on the World Health Organization's list of countries with the highest prevalence of obesity [3]. University years are a period of transition to early adulthood where lifestyles associated with risk behaviors are established and the risk of developing obesity and chronic diseases increases [4]. Lifestyle characteristics of university students include factors related to the later development of disease: low economic capital, poor eating habits, frequent skipping of meals, high fast food consumption [6], sedentary lifestyle, smoking, and stress [5-8].
Tobacco consumption is one of the main causes of health

deterioration, associated with several chronic diseases and is positively correlated with a decrease in physical activity [9]. Chile has the highest prevalence of tobacco consumption in Latin America, both among youth and adult population; the 2016-2017 National Health Survey indicates that 33.3% of the population currently smokes, with rates greater in men than in women (37.8 *vs* 29.1%) [2]. The average age of the first cigarette is 15 (a prevalence rate that has been increasing in recent years), but the habit is established at college age. On the other hand, sleep problems have been shown to be associated with the pathophysiology of severe disorders related to smoking [10]. The university population is especially prone to develop sleep disorders due to external factors (social and environmental) and lifestyle habits that can deteriorate their quality of life.
Several recent studies have tried to relate tobacco consumption with Body Mass Index (BMI), eating habits and sleep quality; however, there are few studies, especially in Latin America, relating these 3 variables.
The objective of this study was to test the association of smoking with anthropometry, diet and sleep quality among Chilean university students.

Method

We conducted a descriptive study with 1455 students from 6 universities: University of Antofagasta (located in Northern Chile), University San Sebastian (in Central and Southern Chile), University Autónoma de Chile (in Central and Southern Chile), University Bernardo O Higgins (Central Chile), University Playa Ancha (Central Chile), and the University Católica de Temuco (Southern Chile). The sample was selected using non-probabilistic criteria. All students present at the time of the evaluations were included. Participants provided informed consent. Reasons for non-participation included: unavailability due to internships, illness, or failure to sign the informed consent. The study was developed following the Declaration of Helsinki and was approved by the Ethics Committee of the Universidad Católica de Temuco.

QUESTIONNAIRES

Eating habits survey

The Food Habits Survey created by Durán et al. [11] was used. The survey is self-administered and measures healthy and unhealthy eating habits. The frequency of health habits, such as the consumption of food groups recommended in the Chilean dietary guidelines is assessed with nine items with a minimum score of 1 (does not consume) and a maximum of 5 (suggested portion per day or week). Responses are added up together to obtain a total value between 9 to 45 points; a higher value indicates healthier eating habits. Unhealthy eating habits are assessed with six items: consumption of sugary drinks, alcohol, fried foods, fast food, snacks, and adding salt to meals without tasting them first. Available responses range from 1 (does not consume) to 5 (> 3 portions per day/week) or from 1 to 3 for the question about salt. Response values are added up and the total ranges from 6 to 28 points, with higher values indicating poorer eating habits.

Insomnia Questionnaire or Insomnia Severity Index (ISI)

The ISI is a self-report questionnaire to assess the nature, severity and impact of insomnia [12,13]. A score between 0 and 7 indicates absence of clinical insomnia, 8-14 subclinical insomnia, 15-21 moderate clinical insomnia and 22-28 clinical insomnia (severe).

Epworth Sleepiness Scale (ESE)

The ESE evaluates the propensity to fall asleep in eight different sedentary situations. This scale is self-administered and response options for each item range between 0-3. At the end, cumulative scores between 0 and 24 are obtained, where higher scores represent a greater degree of drowsiness [14].
Information on the amount of sleep and sleep latency was also asked.
Weight and height were measured. Participants were weighed in light clothing using a mechanical scale (SECA) with a maximum capacity of 220 kg and 50 g precision. Height was measured with a height rod that is incorporated in the scale. Body mass index (BMI) was calculated to categorize the nutritional status according to WHO criteria [15].
Finally, participants were asked about tobacco consumption. Participants who reported having smoked in the last week were labeled smokers.

STATISTICAL ANALYSIS

The results are presented as mean ± standard deviations and as percentages according to the type of variable. Kolmogorov-Smirnov normality test was used to determine the normality of the variables. Participants were analyzed by groups, according to their nutritional status. For categorical variables, the Chi-square test was used. For non-categorical variables the T-Test used. Logistic regression was used to assess associations with tobacco consumption. The level of significance used was $\alpha = 0.05$ in all cases. STATA 12.1 was used for analyses.

Results

Out of the 1455 students surveyed, 1439 had complete data. Figure 1 shows a high overall prevalence of tobacco consumption (30.1%), with prevalence starting high in the first year of study and decreasing in the second year, before increasing again in subsequent years. However, no significant differences were observed (0.073).
Among participants who exercised, 32 smoked and 29% of those who did not exercise, smoked ($p > 0.05$).
Table I shows that students who smoke, regardless of sex, have significant differences in BMI, height, score for unhealthy foods, greater daytime sleepiness, insomnia, sleep latency and greater sleep hours, compared to those who did not smoke.
Table II shows that male smokers have a less favorable sleep quality compared to non-smokers, reflecting greater daytime sleepiness, insomnia, sleep latency and also had higher unhealthy food scores. In contrast, female smokers weighed significantly more, had a higher BMI and unhealthy food score compared to non-smoking women, with no differences observed for sleep variables.
Figures 2, 3, 4 and 5 show a dependent and significant relationship between smoking and an unfavorable diet, reflected in lower frequency of breakfast during the week, lower daily fruit consumption, higher daily consumption of junk food (pizzas, hotdogs, hamburgers, fries or *sopaipillas*) and higher consumption of alcoholic beverages compared to non-smoking students ($p < 0.05$). However, as shown in Figure 6, we observed that smokers reported greater daily consumption of vegetables compared to non-smokers.
Table III shows when performing logistic regression, that the consumption of tobacco is positively associated with the consumption of alcohol, while is negatively associated with the consumption of fish and vegetables.

Fig. 1. Tobacco consumption by year of university study (Chi Square = 0.073).
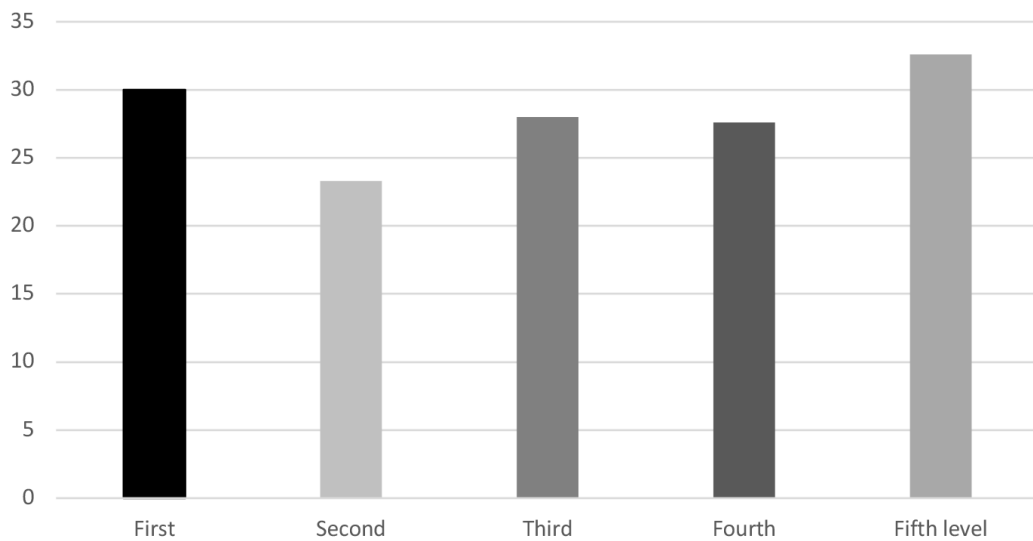
Tab. I. Comparison of anthropometry, food survey score, insomnia and daytime sleepiness by smoking status [1].

	Non-smokers (n = 1015)	Smokers (n = 424)	P-value[2]
Weight (kg)	61.6 ± 10.5	64.1 ± 11.7	0.059
Height (m)	1.62 ± 0.07	1.63 ± 0.08	0.025
BMI (k/m^2)	23.2 ± 3.1	23.8 ± 3.4	0.001
Healthy foods score	55.1 ± 7.3	54.7 ± 7.2	0.375
Unhealthy foods score	12.7 ± 3.3	14.3 ± 3.7	0.011
Epworth	7.3 ± 4.9	8.0 ± 5.0	0.033
Insomnia score	10.2 ± 4.8	10.9 ± 4.9	0.015
Sleep latency (min)	26.3 ± 30.3	31.4 ± 31.4	0.007
Sleep duration (h)	7.6 ± 1.5	7.8 ± 1.6	0.028

[*] Values are mean ± SD. [2] Student T test.

Tab. II. Comparison of anthropometry, food survey score, insomnia and daytime sleepiness by smoking status, stratified by sex [1].

Men	Non-smokers (n = 231)	Smokers (n = 111)	P-value[2]
Weight (kg)	72.3± 10.9	73.7 ± 13.1	0.342
Height (m)	1.72 ± 0.06	1.72 ± 0.07	0.656
BMI (k/m^2)	24.3 ± 3.2	24.5 ± 3.4	0.480
Healthy foods score	55.1 ± 7.3	54.7 ± 7.2	0.061
Unhealthy foods score	12.7 ± 3.3	14.3 ± 3.7	0.001
Epworth	7.3 ± 4.9	8.0 ± 5.0	0.030
Insomnia score	10.2 ± 4.8	10.9 ± 4.9	0.001
Sleep latency (min)	26.3 ± 30.3	31.4 ± 31.4	0.001
Sleep duration (h)	7.6 ± 1.5	7.8 ± 1.6	0.199
Women	**Non-smokers (n = 784)**	**Smokers (n = 313)**	**P-value[2]**
Weight (kg)	58.7 ± 8.4	60,9 ± 9.3	0.001
Height (m)	1.59 ± 0.05	1.60 ± 0.05	0.137
BMI (k/m^2)	22.9 ± 3.0	23.6 ± 3.3	0.002
Healthy foods score	55.1 ± 7.2	55.2 ± 7.5	0.877
Unhealthy foods score	12.5 ± 3.2	14.0 ± 3.5	0.002
Epworth	5.1 ± 4.5	6.3 ± 4.9	0.072
Insomnia score	8.0 ± 4.8	8.6 ± 4.9	0.184
Sleep latency (min)	26.5 ± 31.7	29.0 ± 30.2	0.249
Sleep duration (h)	7.6 ± 1.4	7.7± 1.5	0.106

[1] Values are mean ± SD. [2] Student T test.

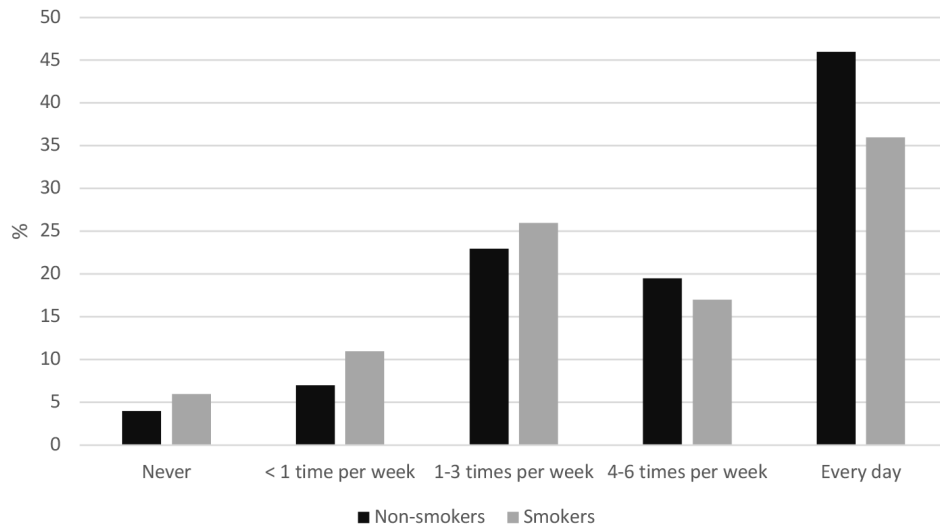Fig. 2. Breakfast consumption by smoking status (Chi Square = 0.004).

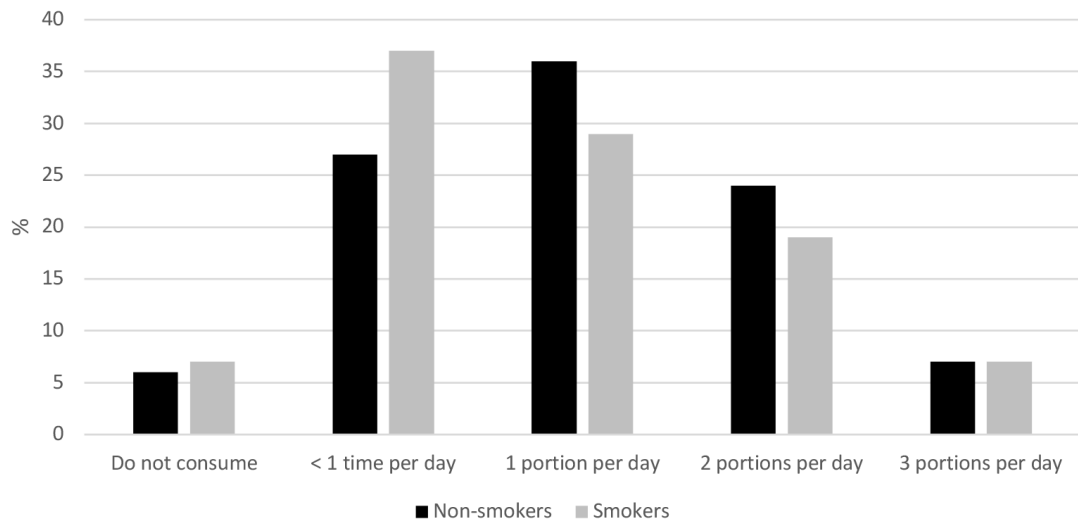Fig. 3. Daily fruit consumption by smoking status (Chi Square = 0.002).
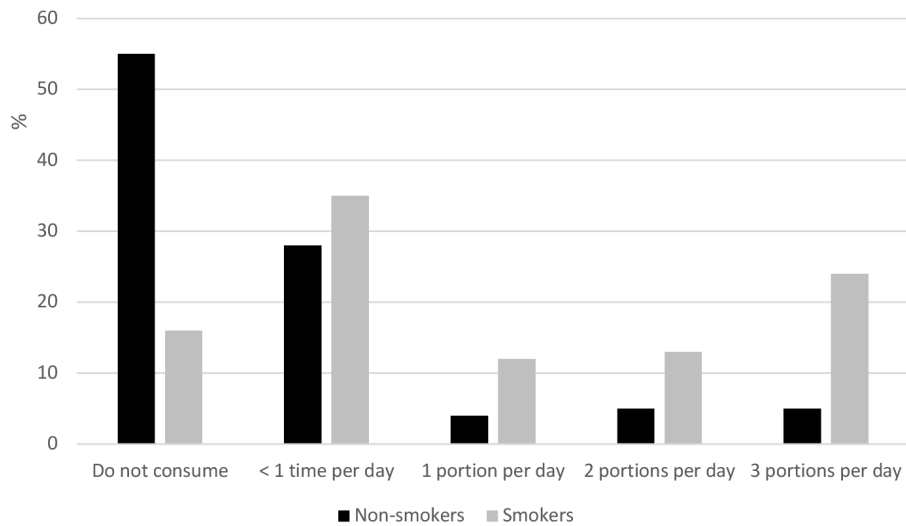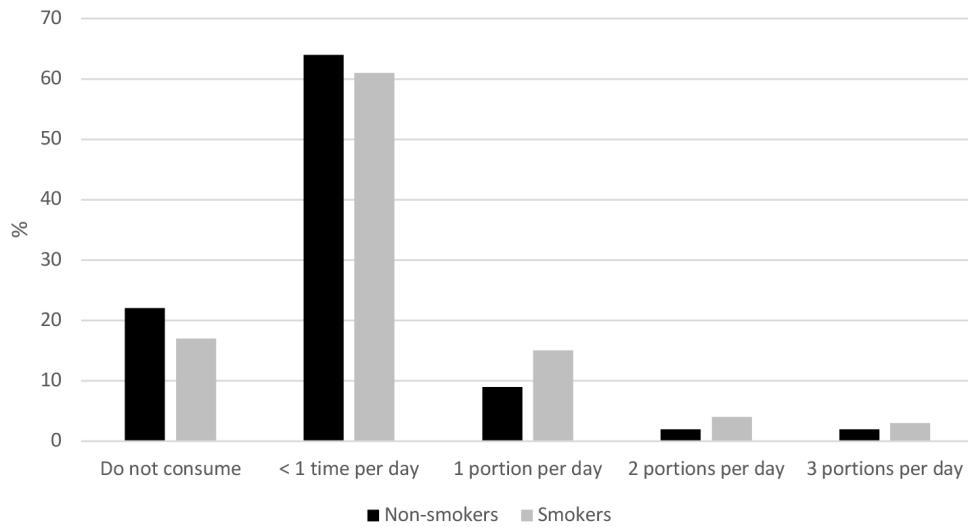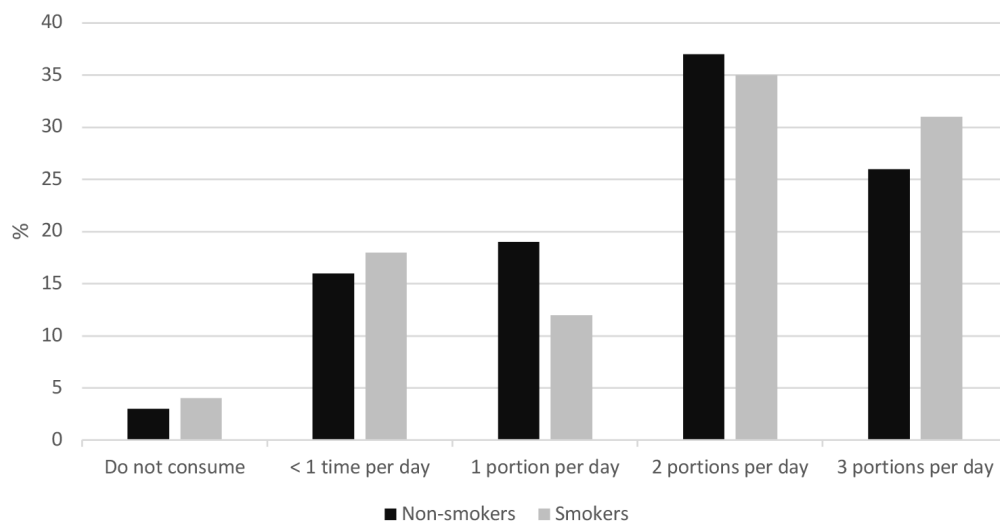

Fig. 4. Daily alcohol consumption by smoking status (Chi Square = 0.001).

Fig. 5. Daily junk food consumption by smoking status (Chi Square = 0.02).

Fig. 6. Daily vegetable consumption by smoking status (Chi Square = 0.03).

Discussion

The main result of this study is that university students of both sexes who smoke have higher unfavorable health factors and a poorer quality of life: they present a higher unhealthy food consumption score, lower frequency of weekly breakfast consumption, lower daily fruit consumption, and higher daily consumption of alcohol and junk food compared to non-smoking students. Male smokers had greater insomnia, sleep latency and daytime sleepiness compared to non-smokers; and female smokers had higher weight and BMI.

Smoking is a chronic and addictive disease, considered by the WHO as the main cause of avoidable death in the world. It is one of the most important risk factors for disease and death in Chile and is related to chronic obstructive pulmonary disease, pulmonary

emphysema, lung cancer, laryngeal cancer, and heart and cerebrovascular diseases [16]. It causes premature death (shortens life by 5-10 years) in more than 50% of smokers, affecting the respiratory and cardiovascular systems, and can cause various neoplasms in the body [17]. According to recent studies that evaluated the age at which the smoking begins, 1 in 3 smokers starts in adolescence or between 18 and 25 years old. We also note that the prevalence of smoking among female has approached that of men in recent years [18-20].

The university population modify their lifestyle to be accepted by their peers. Some studies define university students as a vulnerable group, since many of the healthy habits for adult life can be acquired and modified during this stage [1]. One of the main results obtained in this study is that smoking was associated with unhealthy eating habits. Among men, there

Tab. III. Factors associated with tobacco consumption.

	Estimate	Std. Error	T value	P-value
(Intercept)	-0.084	0.175	-0.484	0.628
Age	0.003	0.005	0.618	0.536
Sex	0.052	0.035	1.461	0.144
nutritional status	0.023	0.052	0.442	0.658
Breakfast	0.045	0.028	1.617	0.106
Dairy products	0.010	0.049	0.208	0.835
Fruits	-0.083	0.077	-1.088	0.276
Vegetables	-0.068	0.032	-2.073	0.038
Fish	-0.096	0.038	-2.518	0.011
Legumes	-0.034	0.031	-1.092	0.275
Bread	-0.007	0.033	-0.219	0.826
Lunch	0.011	0.027	0.404	0.686
Dinner	0.033	0.044	0.752	0.452
Health food habits	-0.015	0.032	-0.464	0.642
Soft drik	0.001	0.034	0.045	0.964
Alcohol	0.307	0.028	10.68	< 0.001
Fries food	0.034	0.054	0.64	0.522
Salt	0.027	0.027	1.016	0.309
Pizza/hog-dog	-0.007	0.037	-0.201	0.840
Cookies	-0.048	0.033	-1.445	0.147
Unhealthy eating habits	0.017	0.042	0.406	0.684
Epworth	0.031	0.031	1.012	0.311
insomnia	0.002	0.029	0.079	0.936
Sleep duration	-0.001	0.001	-0.672	0.501
Sleep Latency	0.016	0.032	0.517	0.605
Physical activity	-0.001	0.001	-0.852	0.394

was a tendency towards a lower score for healthy eating in non-smokers, versus smokers, although the difference was not statistically significant. An attempt has been made to evaluate the relationship between healthy eating and smoking. In a cross-sectional study, young people who consumed fruit ≥ 2 times a day were 53% less likely (RR = 0.47, p < 0.05) than those who did not normally consume fruit to be more heavy smokers. Longitudinally, the association of fruit and tobacco consumption was not significant (RR = 0.61, p = 0.28). There were no significant associations between the consumption of vegetables and smoking. The consumption of fruits, but not the consumption of vegetables, was inversely associated with the frequency of smoking cross-sectionally, but not longitudinally [21]. Another study conducted in a Japanese population, compared the consumption of food and nutrients between persons who consumed tobacco and non-tobacco users, showing that there was a lower intake of vegetables and fruits rich in antioxidants, preventive factors for many diseases, in those who consumed tobacco. In men, smoking was positively related to the consumption of rice, three alcoholic beverages (sake, beer and whiskey), carbohydrates and other eight foods/nutrients (p < 0.05) and negatively associated with consumption of animal protein, fat, fatty acids, dietary fiber, isoflavones and 36 other foods/nutrients (p < 0.05 for all foods). In contrast, in women, smoking was

positively associated with the intake of 13 foods/nutrients, while being negatively associated with the consumption of rice, energy, dietary fiber and other 14 foods/nutrients (p < 0.05 for all food) [22]. These studies support the results obtained in our work, which shows that smokers have a lower nutritional value compared to non-smokers, with less frequent breakfast consumption during the week, less daily fruit consumption, and higher frequency of junk food and alcoholic beverages consumption, compared to non-smokers (p < 0.05). However, it was observed that smokers consumed more daily portions of vegetables compared to non-smokers. Attempts have been made to postulate mechanisms that explain the choice of unhealthy foods in smokers, and the explanation could be at the level of the brain. Jastreboff et al. compared responses in different regions of the brain between smokers and non-smokers during an exposure to their favorite food. Those who consumed tobacco exhibited decreased activation in the caudate, putamen, insula and thalamus [23].

In our study, smoking was associated with greater sleep latency, insomnia and daytime sleepiness. These results are in agreement with other studies [24-28]. Sleep disorders that result in insufficient sleep have been linked with negative physical, cognitive and public health outcomes. Tobacco consumption has been shown to be a predictive variable of sleep disturbances [23]. This interaction was also observed

in individuals with chronic rheumatic diseases, who were more likely to report an average < 6 h of sleep per night and frequent insomnia compared to individuals with a chronic rheumatic condition that did not consume tobacco [25]. A study in US individuals also showed that smokers reported significantly less total sleep time, greater sleep latency, greater difficulty in falling asleep, maintaining sleep and waking earlier than desired compared to those who did not consume tobacco, a result similar to our study. Individuals who were former tobacco users reported alterations similar to non-smokers and smokers experienced lower quality sleep than non-smokers, compared with those who had never used tobacco, smokers had a significantly higher probability of self-reported snoring (OR = 2.0, 95% CI = 1.56-2.56) and short sleep (OR = 1.68, CI 95% = 1.35-2.10; OR = 1.38, 95% CI = 1.09-1.74). A dose-response relationship was observed between amount smoked and sleep symptoms [26]. In multivariate analysis, no significant interaction was observed between sex and smoking for snoring, short sleep or poor sleep. In a study conducted among US adults, current TC was independently associated with greater odds of snoring and sleeping poorly [27]. Sleeping is considered a healthy behavior. Within the relationships that have been described in the literature, persons with a better diet also have better sleep quality and smokers are more likely to report insomnia and insufficient sleep [28].

Although tobacco consumption has been associated with relatively thinner body mass and smoking cessation with weight gain [29], the brain mechanisms underlying these relationships are not well understood and the results have been contradictory in studies that have tried to understand these variables. Compared to non-smokers, smokers have diminished nervous system responses to non-gratifying tobacco stimuli, however, brain response to favorite foods in relation to smoking status have not been investigated. During the exposure to their favorite food, smokers exhibited decreased activations in the caudate, putamen, insula and thalamus, compared to non-smokers. Neuronal responses during stress and neutral relaxation conditions were similar between the groups that smoke versus those who do not and subjective indices of food cravings were similar between groups. Relatively diminished neural responses to favorite food signals in smokers can contribute to lower BMI [23].

Among the main metabolites associated with tobacco consumption, are nicotine, cotinine, thiocyanate, o-cresol sulfate, and hydroxycotinine, among others. Studies have postulated that nicotine could be the cause of weight gain, however it has been shown to stimulate the basal metabolic rate of smokers [30]. TC and nicotine directly affect the metabolism of glucose and body weight as a result of changes in metabolism, activating lipoprotein lipases that break triglycerides to form free fatty acids, which activates the sympathetic nervous system. These are among other changes that result in greater energy consumption and weight loss. Weight loss is associated with the direct stimulation of the melanocortin 4 receptor (MC4-R), which leads lower food consumption and lower leptin levels. It also stimulates the sympathetic nervous system, which increases adrenaline levels and noradrenaline, lipolysis among other processes [31]. Another study showed an inverse correlation between leptin concentrations and nicotine dependence in people who used tobacco [32]. In contrast, our study shows that smokers weighed more and had a higher BMI, especially in women. It is possible that these results are explained by the fact that non-smokers had healthier eating habits, which is protective for weight gain.

The weaknesses of this study include that the number of cigarettes per day was not quantified. In addition, this was a cross-sectional study, thus causality cannot be inferred. The study had several strengths. We were able to evaluate specific relationships between foods consumed, eating habits and tobacco consumption. We considered several variables – diet, physical activity, anthropometry, and sleep quality – which are not usually evaluated together.

Conclusions

University students who smoked were significantly different from non-smokers in factors related to deteriorating health: higher BMI, greater daytime sleepiness, insomnia and sleep difficulties, lower frequency of weekly breakfast consumption, lower fruit consumption, higher consumption of junk food and alcoholic beverages and a higher unhealthy food score. However, tobacco consumption was associated on a differentiated manner according to sex. In men, tobacco consumption had a negative effect on daytime sleepiness, insomnia and sleep difficulties and in women, it was associated with higher weight and BMI.

Abbreviations

Body Mass Index (BMI); Insomnia Severity Index (ISI); Epworth Sleepiness Scale (ESE); World Health Organization (WHO); melanocortin 4 receptor (MC4-R); Unites States (US).

Acknowledgements

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

SDA, VV; Conceptualization. Methodology, formal analysis, investigation, data curation, writing, original draft, writing, review and editing. Conceptualization. Methodology, formal analysis, investigation, data curation, writing, original draft, writing, review, editing and Project administration, GO, MF, MV, MC, VE, FM: Methodology, Investigation, Writing – Review & Editing.

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