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Original Article

Health Effects of Plant-Based Diets in University Life: A Comprehensive Study on the Constipation, Sleep and Obesity

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Abstract

Background: Plant-based diets have gained popularity due to their nutrient density and potential to reduce chronic disease risk. The aim of the study was to examine the relationship between diet quality and plant-based diets consumed with constipation, sleep duration and obesity in university students.

Methods: In this study conducted between September and October 2024, 676 students were recruited as participants and data on socio-demographic information, daily sleep duration, presence of constipation, 24-hour food consumption record and food consumption frequency were collected. Diet Quality Index (DQI) and Plant-Based Diet Index (PBDI) were calculated from food consumption record and frequency data.

Results: Constipation was present in 14.5% of the participants and the BMI of the participants was 21.84±3.47 kg/m^2. There was a significant relationship between age and constipation (P=0.013) and a weak negative relationship between age and sleep duration and PBDI (r=-0.103, P=0.007; r=-0.077, P=0.045, respectively); A weak negative correlation was found between BMI and PBDI and DQI (r=-0.092, P=0.016; r=0.173, P=0.000, respectively); a significant correlation was found between the presence of constipation and gender and income level (P=0.047; P=0.013, respectively).

Conclusion: PBDI and DQI were associated with lower BMI and emphasised the potential of alternative nutritional models in the fight against obesity. The lack of an association between PBDI, DQI and sleep duration and constipation suggests that further research is needed. This study emphasises the importance of healthy eating and lifestyle interventions, but its design limits causal conclusions and requires further research.

Keywords: Plant-based diet; Diet quality; Constipation; Sleep; Obesity

Introduction

Plant-based diets are a nutritional model gained popularity in recent years and are increasingly being investigated for their potential health benefits. These diets may have positive effects on gastrointestinal health, especially thanks to their fiber-rich content, and may help prevent common disorders such as constipation (1). In addition to academic and social pressures, university students often go through a period characterized by irregular eating habits and high consumption of processed foods. Therefore, understanding the effects of diet quality and plant-based nutrition on health in this population group is critical, especially in terms of health problems such as constipation, sleep duration, and obesity (2,3).

Constipation can be defined as infrequent (less than 3 bowel movements per week) hard, small and hard stools. Normal defecation is character-

ized by bulky, soft and easy to pass stools at least three times a week and up to three times a day. Constipation is a common condition worldwide and its prevalence ranges from 2.5% to 79% in adults and the elderly and from 0.7% to 29.6% in children (4,5). The first step in the treatment of constipation is usually dietary and lifestyle changes (6).

Sleep disorders are common disorders characterized by various symptoms that prevent individuals from having a healthy, cognitive and restorative sleep. These disorders may lead to important medical, psychological and social disorders (7). Sleep disorders were 41% in women and 42.3% in men, and 25.7% in a study conducted in university students (8, 9).

The quality of a person's diet can have a significant impact on their overall health and well-being. In particular, studies have revealed that certain dietary patterns, such as plant-based diets, can affect sleep quality and duration. Furthermore, consumption of plant-based diets has been associated with improved digestive function and reduced constipation (10). In addition, diet quality and dietary patterns have been associated with weight management and obesity risk in university students (11, 12). Furthermore, studies have shown how high-fiber and low-fat diets can affect sleep quality and obesity (13).

Previous studies have examined the relationship between plant-based diets and sleep and constipation. However, this study aims to make a unique contribution to the literature by examining the effects of plant-based diet consumption on sleep and constipation in university students who exhibit different eating habits from other segments of the society. The findings from this study aim to provide insight into the role of diet in improving general health and well-being in the university student population.

Materials and Methods

This is a cross-sectional study conducted at a state university in Turkey between September-October 2024. The sample size of the study was found to be 205 with 95% reliability and 5% margin of error. At the end of the research, 676 participants were reached. Volunteers from university students aged between 18-25 years were included in the study.

Participants were informed about the study and permission was obtained from Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee in accordance with the Declaration of Helsinki (Ref. No: 2024/6388).

Within the scope of the study, 705 participants were reached, but 29 of the participants wanted to leave the study stating that the survey questions were too long. As a result, 676 participants completed the study. An online questionnaire including socio-demographic information, health information, daily sleep duration, 24-hour food consumption record, food consumption frequency, height and body weight information was applied to the participants.

Diet Quality Index (DQI): This index was calculated by taking into account the 24-hour food consumption records and food consumption frequency of the participants. It was calculated by measuring a total of 8 parameters (total fat, saturated fat, cholesterol, protein, fruit and vegetable consumption, cereal consumption, sodium and calcium intake) and summing the scores obtained by scoring each parameter between 0-2 (14).

Plant-based diet index (PBDI): Consists of three main categories based on 24-hour food consumption record and food consumption frequency. The index includes 18 food groups is categorized into healthy plant-based, less healthy plant-based and animal-based foods. Each food group is categorized into quintiles with a score FROM 1-5. For the healthy PBDI, healthy foods are scored positively and animal-based foods are scored negatively; for the unhealthy PBDI, less healthy foods are scored positively. As a result, a total score is obtained (between 18-90) (15).

Statistical Evaluation

Data were analyzed using IBM SPSS Statistics 26.0 (IBM Corp., Armonk, NY, USA) and BEBIS 8.1 programmes. Descriptive data were

analyzed as arithmetic mean, standard deviation, number and percentage.

In the normality of the data, kurtosis and skewness values were analyzed within the range of ±1.00. Categorical variables were analyzed by Pearson Chi-Square test, independent sample t-test was used for parametric assumptions for pairwise comparisons and Mann Whitneyy-U test was used for non-parametric assumptions. Pearson Correlation test was used to compare continuous variables. *P* value <0.05 was accepted.

Results

Data on the general information of the participants are shown in Table 1. Accordingly, 74.6% of the participants were female and 50% of them live with their families. 74.9% had sufficient income. 30.8% smoked cigarettes. 14.5% of them had constipation problem. The mean age was 21.47±2.35 years. BMI was 21.84±3.47 kg/m^2 and daily sleep duration was 7.50±1.46 hours.

Table 1: Demographic characteristics of participants

Variable		n	%
Gender	Female	504	74.6
	Male	172	25.4
Residence	Dormitory	125	18.5
	Family	338	50
	Friend	102	15.1
	Alone	111	16.4
Income	Low	106	15.7
	Adequate	506	74.9
	High	64	9.5
Smoking	Yes	208	30.8
	None	405	59.9
	Former smoker	63	9.3
Constipation	Yes	98	14.5
	None	578	85.5
		Mean	**SD**
Age		21.47	2.35
Height		169.39	8.94
Weight		63.12	13.71
BMI		21.84	3.47
Daily sleep duration		7.50	1.46

BMI: Body Mass Index, *P*<0.05

The relationship between the presence of constipation and age, sleep duration. BMI and diet scores of the participants is shown in Table 2. Accordingly, a significant relationship was found between age and constipation (*P*=0.013). However, no significant relationship was found between sleep duration, BMI, PBDI, DQI and fiber consumption (*P*>0.05).

Table 2: Information on the presence of constipation and age, sleep duration, BMI and diet scores

Variable	Constipation				*P*
	Yes		None		
	Mean	SD	Mean	SD	
Age(yr)	**22.19**	**3.17**	**21.35**	**2.16**	**0.013**
Sleep Duration	7.68	1.57	7.47	1.44	0.183
BMI	22.10	3.11	21.80	3.53	0.421
PBDI	63.81	7.80	62.91	6.91	0.245
DQI	8.31	1.69	8.21	1.85	0.629
Fiber consumption	22.55	7.38	22.58	5.72	0.975

BMI: Body Mass Index, **DQI:** Diet quality score, **PBDI:** Plant-based diet score, **t**: independent t-test statistic, *P*<0.05

Data on the relationship between ages, sleep duration, BMI, PBDI, DQI, energy and fiber consumption of the participants are shown in Table 3. Accordingly, there was a weak negative relationship between age and sleep duration and PBDI (r=-0.103, *P*=0.007; r=-0.077, *P*=0.045, respectively); a weak positive relationship between sleep duration and energy intake (r=0.079, *P*=0.040); a weak negative relationship between BMI and PBDI and DQI (r=-0.092, *P*=0.016; r=0.173, *P*=0. 000); a weak negative relationship between PBDI and DQI (r=-0.248, *P*=0.000); a moderate positive relationship between energy intake (r=0.484, *P*=0.000); a strong positive relationship between fiber intake (r=0.573, *P*=0.000); a weak positive relationship between DQI and energy intake (r=0.165. *P*=0.000); a strong positive relationship between energy intake and fiber intake (r=-0.872, *P*=0.000).

Table 3: Associations of age, sleep duration, BMI, PBDI, DQI, energy and fiber consumption

Variable		Age	Sleep Duration	BMI	PBDI	DQI	Energy consumption	Fiber consumption
Age(yr)	**r**	1	-0.103**	0.052	-0.077*	0.067	-0.063	-0.052
	P		**0.007**	0.177	**0.045**	0.084	0.104	0.175
Sleep Duration	**r**		1	-0.003	0.027	0.027	0.079*	0.057
	P			0.938	0.477	0.482	**0.040**	0.137
BMI	**r**			1	-0.092*	0.173**	0.044	-0.011
	P				**0.016**	**0.000**	0.253	0.773
PBDI	**r**				1	-0.248	0.484**	0.573**
	P					**0.000**	**0.000**	**0.000**
DQI	**r**					1	0.165***	0.706
	P						**0.000**	0.676
Energy consumption	**r**						1	0.872**
	P							**0.000**
Fiber consumption	**r**							1
	P							

BMI: Body Mass Index, **DQI:** Diet quality score, **PBDI:** Plant-based diet score, Pearson correlation test, *P*<0.05

In Table 4, the determinants of BMI, constipation and sleep duration scores are presented with a linear regression model. The model was adjusted for age, gender, PBDI, DQI, energy consumption, fiber consumption and salt consumption. According to the results of the analyses, positive significant associations were found between BMI and DQI score (ß=0.124, *P*=0.003) and between male gender and BMI (ß=0.332, *P*=0.000). There was a negative correlation between constipation

and age (ß=-0.136, *P*=0.000) and a positive correlation between female gender (ß=0.103, *P*=0.013). Furthermore, a negative and significant correlation was observed between sleep duration and age (ß=-0.096, *P*=0.014).

Table 4: Predictors of BMI, constipation and sleep duration

Variable	Predictors	95% CI			*P*
		ß	Lower	Upper	
BMI	**Age**	0.012	-0.088	0.124	0.739
	Gender	0.332	2.026	2.257	**0.000**
	PBDI	-0.021	-0.056	0.036	0.664
	DQI	0.124	0.079	0.393	**0.003**
	Energy consumption	-0.103	-0.001	0.000	0.280
	Fiber consumption	0.066	-0.057	0.134	0.431
	Salt consumption	0.001	-0.058	0.059	0.980
R^2= 0.122 F= 14.395 *P*=0.000					
Constipation	**Age**	-0.136	-0.032	-0.009	**0.000**
	Gender	0.103	0.017	0.149	**0.013**
	PBDI	-0.072	-0.008	0.001	0.150
	DQI	-0.011	-0.019	0.015	0.807
	Energy consumption	0.013	0.000	0.000	0.898
	Fiber consumption	0.076	-0.006	0.015	0.392
	Salt consumption	-0.104	-0.012	0.001	0.084
R^2=0 .023 F= 3.270 *P*=0.002					
Sleep Duration	**Age**	-0.096	-0.107	-0.012	**0.014**
	Gender	-0.041	-0.412	0.137	0.327
	PBDI	-0.013	-0.023	0.018	0.792
	DQI	0.021	-0.054	0.087	0.644
	Energy consumption	0.152	0.000	0.001	0.134
	Fiber consumption	-0.054	-0.056	0.029	0.542
	Salt consumption	-0.026	-0.032	0.020	0.672
R^2=0.019 F= 1.800 *P*=0.084					

BMI: Body Mass Index, **DQI:** Diet quality score, **PBDI:** Plant-based diet score, Linear regression test, **ß**:Unstandardized regression coefficient, CI: Confidence interval, *P*<0.05

Data on the presence of constipation and socio-demographic information of the participants are shown in Fig. 1. Accordingly, a significant relationship was found between the presence of constipation and gender and income level (*P*=0.047; *P*=0.013, respectively), while no significant relationship was found between the place of residence.

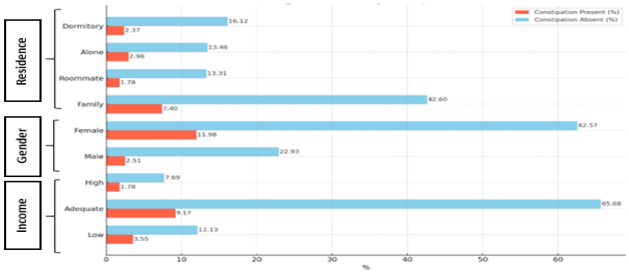

Fig. 1: The relationship between the presence of constipation and socio-demographic characteristics

Discussion

In this study in which the relationship between diet quality and plant-based diets consumed with constipation, sleep duration and obesity was investigated in university students, the presence of constipation was found in 14.5% of the participants. While the presence of constipation was found to be 14.9% in a study conducted in university students in Turkey, this rate was 14.3% in a study conducted in university students in China (16, 17). The data obtained were found to be compatible with the literature. In addition, BMI scores of the participants were found to be 21.84±3.47 kg/m². Similarly, 22.77 ± 4.11 kg/m² was found in a study conducted with university students in Bangladesh (18), which suggests that the BMI values of the current study's participants are comparable to those of other populations in similar age groups, indicating consistent findings across different regions and reinforcing the generalizability of the results.

Increasing age represents a process that includes stages of development, growth and ageing in the body. In this study, it was observed that the prevalence of constipation increased significantly with advancing age. Consistent with these findings, McCrea et al. reported a significant increase in the incidence of constipation with age, especially after the age of 50 (19). Similarly, Stewart et al. recorded a progressive increase in constipation complaints with increasing age (20), further supporting the relationship between aging and gastrointestinal motility dysfunctions and confirming these results.

This study found that sleep duration decreased significantly with increasing age. Similarly, a meta-analysis by Ohayon et al. analyzed 65 studies involving 3577 participants aged between 5 and 102 years and found that aging was associated with a progressive decline in both sleep duration and quality (21). Furthermore, in another meta-analysis, Evans et al. examined individuals aged 6 to 21 years and found a consistent decrease in sleep duration with increasing age (22), further emphasizing the inverse relationship between aging and sleep duration at different life stages.

In this study, no significant relationship was found between sleep duration, PBDI, DQI and constipation. Short sleep duration increased the risk of constipation in men, whereas long sleep duration increased the risk of constipation in women (23). Poor sleep quality may predispose healthy individuals to constipation by increasing rectal compliance and this may contribute to the development of irritable bowel syndrome (24). The differences in the data indicate that new research is needed on the subject. In this study, no relationship was found between PBDI, dietary fiber consumption, DQI, and constipation. Plant-based diet is actually a nutritional model that increases diet quality and fiber consumption. Chiba et al. described a plant-based diet as safe and highly effective in the treatment of uncomplicated and complicated constipation and no side effects were observed (25). Dietary fiber intake may increase the frequency of defecation in patients with constipation, but does not improve stool consistency, treatment success or laxative effect in defecation (26). These different results may indicate limitations that may arise from the sample size, participant characteristics or methods used in our study. In order to clarify the issue, larger samples and different methods should be used in future studies.

Many dietary practices are used in the fight against obesity. Although different results have been observed between different diets, the antioxidant and fibre-rich nature of plant-based diets highlights the importance of these diets. In this study, higher PBDI among participants were found to be associated with a significant reduction in BMI levels. Supporting these findings, a 16-week plant-based diet led to significant weight loss compared to a standard diet (27). Similarly, individuals following a plant-based diet experienced significant weight loss as well as a reduced risk of diabetes and cardiovascular disease in a 4-week dietary intervention (28). Furthermore, Jar-

vis et al. concluded in a systematic review of prospective cohort studies that adherence to plant-based diets significantly reduces the risk of obesity (29).

Obesity is expected to be directly related to the content and quality of the diet consumed. In this study, participants' DQI had a significant negative relationship with their BMI. Boggs et al. found that long-term high diet quality was associated with lower obesity risk in young African American women with normal BMI (30). Similarly, in Canadian adults found those who consumed diets with higher diet quality had lower BMI (31). These findings are consistent with the general consensus that diets rich in nutrients, especially balanced macronutrients and high in fibre, antioxidants and healthy fats, contribute to better weight management and overall health.

When the relationship between socio-demographic factors other than nutrition, sleep and obesity and the presence of constipation was evaluated, women had a higher prevalence of constipation compared to men and individuals with low-income levels exhibited a higher presence of constipation. Women were more likely to experience chronic constipation compared to men (19). Similarly, women suffer from more severe constipation symptoms and experience a lower quality of life compared to men (32). In the United States of America, one out of every four people complained of functional dyspepsia and constipation complaints were more common in women than in men. (33). Furthermore, there was a relationship between low income and constipation (34), while Wang et al. identified poverty and low income as factors contributing to constipation using NHANES 2005-2010 data (35). In this study, body mass index (BMI) values of men were higher than those of women. On a global scale, the average BMI of men has increased by 0.4 kg/m² per decade since 1980, while that of women has increased by 0.5 kg/m² (36). In a meta-analysis, BMI values of women were higher than those of men (37).

The findings of this study are consistent with the existing literature and further emphasize the importance of socio-demographic factors in terms of constipation prevalence and severity.

Conclusion

This study examined the association of plant-based diets with diet quality, constipation, sleep duration and obesity in university students. The findings showed that plant-based diets reduced body mass index and may play a potential role in combating obesity thanks to their antioxidant and fiber content. However, these diets did not have a significant effect on sleep duration and quality. Moreover, constipation was found to be more common in low-income and female students, emphasizing that socio-economic factors have an impact on gastrointestinal health and that these factors should be considered in public health policies. The study demonstrates the importance of promoting healthy eating and lifestyle interventions among students, but due to its cross-sectional nature, the findings are not causal and should be supported by larger studies.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The author confirms that no conflict of interest exists regarding this study.

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