

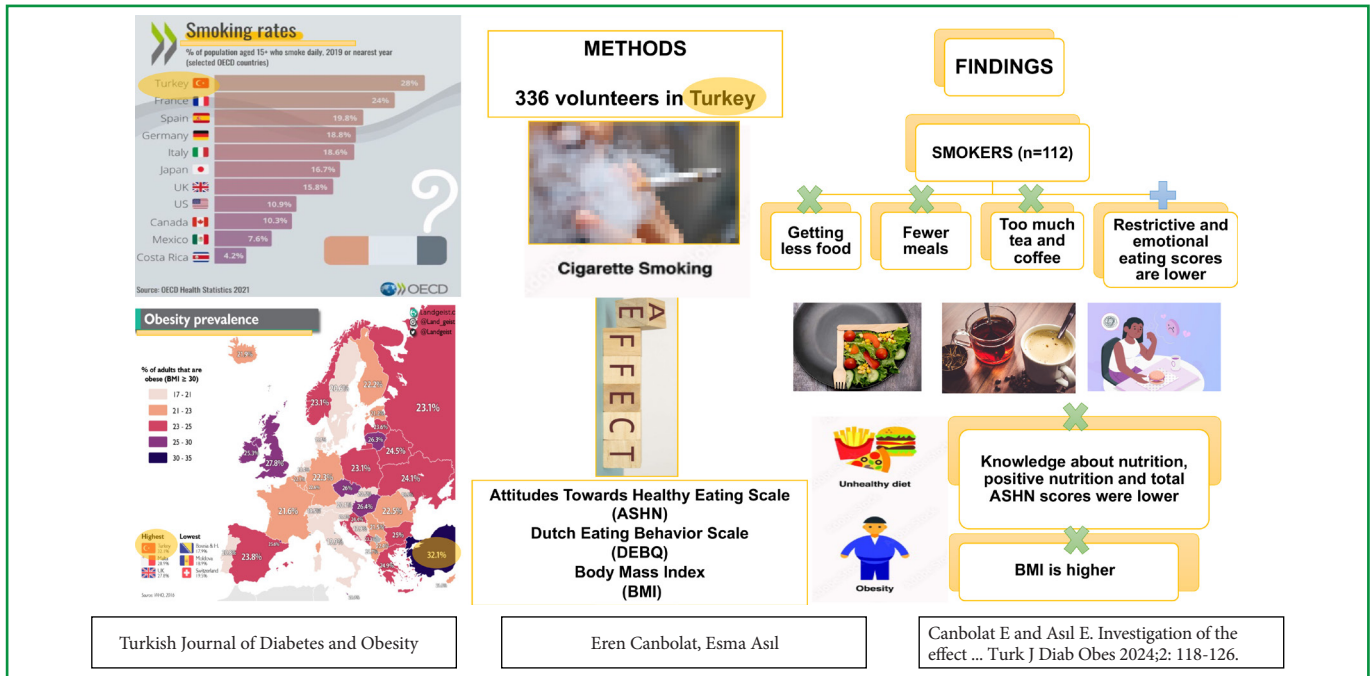
Investigation of The Effect of Smoking on Eating Behaviors and Body Mass Index in Adults: A Cross-Sectional Study

Eren CANBOLAT  , Esmâ ASIL 

Ankara University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Türkiye

Cite this article as: Canbolat E and Asil E. Investigation of the effect of smoking on eating behaviors and body mass index in adults: a cross-sectional study. Turk J Diab Obes 2024;2: 118-126.

GRAPHICAL ABSTRACT



ABSTRACT

Aim: This study was conducted to evaluate the effect of smoking on eating behaviors and body mass index in Turkey, which is one of the countries where smoking is common in the world and has the highest number of obesity cases in Europe.

Material and Methods: This study was carried out with the participation of 336 adult individuals. Body mass index (BMI) was calculated using the body weight and height declared by the participants, and the eating behaviors of the participants were determined by the Attitude Scale for Healthy Nutrition (ASHN) and their eating behavior was determined by the Dutch Eating Behavior Scale (DEBQ).

Results: It was determined that 33.3% of the individuals participating in the study used to smoke. It was concluded that smokers thought that they took less food with diet, they had fewer meals during the day, they consumed more tea/coffee, and their restrictive and emotional eating scores were lower ($p < 0.05$). In addition, knowledge about nutrition, positive nutrition and total ASHN scores of smokers were found to be lower ($p < 0.05$). Finally, it was observed that the BMI values of smokers were higher ($p < 0.05$). IBM SPSS 24.0 statistical package program was used for statistical evaluation of the data. Independent Samples T, Chi-Square Independence Test and

ORCID: Eren Canbolat / 0000-0001-6250-2303, Esmâ Asil / 0000-0003-0809-4008

Correspondence Address / Yazışma Adresi:

Eren CANBOLAT

Ankara University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Türkiye
Phone: +90 (312) 381 23 50-6763 • E-mail: canbolat.eren@gmail.com

DOI: 10.25048/tudod.1466779

Received / Geliş tarihi : 08.04.2024

Revision / Revizyon tarihi : 20.06.2024

Accepted / Kabul tarihi : 25.07.2024

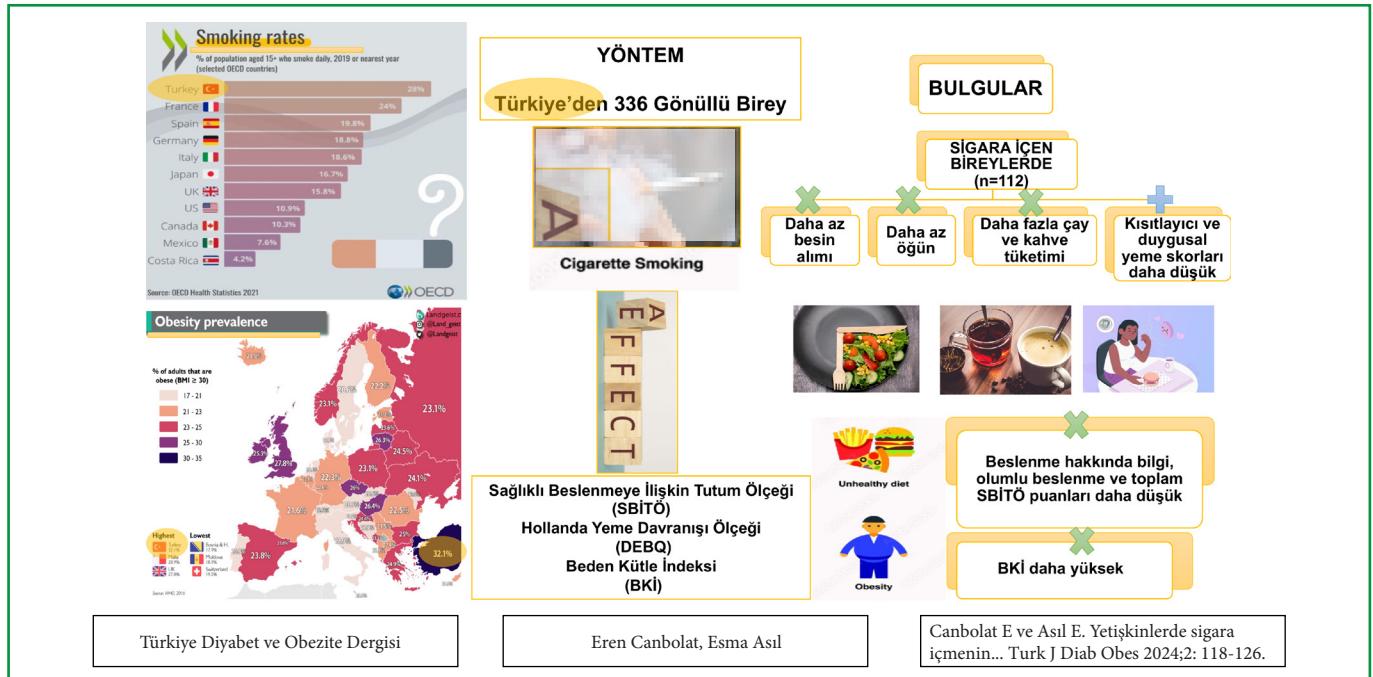
Partial Correlation Analysis were used to analyze the relationship between the study data. $p < 0.05$ values were considered statistically significant.

Conclusion: The data obtained at the end of the study were found to be compatible with the data in the literature that its use reduces appetite and that individuals who smoke maintain an unhealthier diet. At this point, in terms of public health, the relationship between smoking and unhealthy diet should be addressed, public awareness should be raised by nutritionists and the effects of smoking on nutrition and obesity should be evaluated with more comprehensive studies.

Keywords: Smoking, Body weight, Eating behavior, Health, Obesity

Yetişkinlerde Sigara İçmenin Yeme Davranışları ve Beden Kütle İndeksine Etkisinin Araştırılması: Kesitsel Bir Araştırma

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışma dünyada sigara kullanımının yaygın olarak görüldüğü ülkelerden biri olup aynı zamanda Avrupada en çok obezite vakasının görüldüğü Türkiye'de sigara kullanımının yeme davranışlarına ve beden kütle indeksine etkisini değerlendirmek amacıyla yapılmıştır.

Gereç ve Yöntemler: Bu çalışma 336 yetişkin bireyin katılımıyla gerçekleştirilmiştir. Katılımcıların beyan ettiği vücut ağırlığı ve boy uzunluğu kullanılarak Beden Kütle İndeksi (BKİ) hesaplanmış, katılımcıların yeme davranışları Sağlıklı Beslenme Tutum Ölçeği (SBİTÖ) ile, yeme davranışları ise Hollanda Yeme Davranışı Ölçeği ile belirlenmiştir (DEBQ). Verilerin istatistiksel analizi IBM SPSS İstatistik 24.0 yazılım paketi kullanılarak gerçekleştirilmiştir. Independent Samples T, Ki-Kare Bağımsızlık Testi ve Kısmi Korelasyon Analizi ile çalışma verileri arasındaki ilişki incelenmiştir. Verilerin anlamlılık durumu $p < 0,05$ değerine göre tanımlanmıştır.

Bulgular: Araştırmaya katılan bireylerin %33,3'ünün sigara kullandığı tespit edilmiştir. Sigara içenlerin diyetle daha az yiyecek aldıklarını, gün içinde daha az yemek yediklerini, daha çok çay/kahve tükettiklerini, kısıtlayıcı ve duygusal yeme puanlarının daha düşük olduğunu düşündükleri belirlenmiştir ($p < 0,05$). Ayrıca sigara içenlerin beslenme bilgisi, pozitif beslenme ve toplam SBİTÖ skorlarının daha düşük olduğu tespit edilmiştir ($p < 0,05$). Son olarak sigara içenlerin BKİ değerlerinin daha yüksek olduğu saptanmıştır ($p < 0,05$).

Sonuç: Çalışma sonunda elde edilen veriler, sigara kullanımının iştahı azalttığı ve sigara içen bireylerin sağlıksız beslenmeyi sürdürdüğü yönünde literatürdeki verilerle uyumlu bulunmuştur. Bu noktada halk sağlığı açısından sigara kullanımının sağlıksız beslenme ile ilişkisi ele alınmalı, beslenme uzmanları tarafından toplumun bilinçlendirilmesi ve yapılacak daha kapsamlı çalışmalar ile sigara kullanımının beslenme ve obezite üzerine etkilerinin değerlendirilmesi gereklidir.

Anahtar Sözcükler: Sigara kullanımı, Vücut ağırlığı, Yeme davranışı, Sağlık, Obezite

INTRODUCTION

Cigarette is a filtered or unfiltered tobacco product prepared by wrapping tobacco cut on a 70-120 mm long thin paper in the form of an 8 mm thick cylinder. Smoking, which is the main cause of early preventable mortality and morbidity, is one of the biggest public health threats ever encountered, causing the death of more than 8 million people in the World (1, 2). Of these 8 million deaths, nearly 85% (about 7 million) are due to tobacco use, while the remaining 15% (about 1.2 million) are due to non-smokers' exposure to cigarette smoke (3). As reported by the "Global Burden of Disease Study", the countries with the highest number of tobacco users include India, China, Russia, the USA, Indonesia, Vietnam, the Philippines, Bangladesh, and Japan. Among these, China leads the list, accounting for 30% of the 1.14 billion cigarette users worldwide. Turkey ranks tenth among these countries (4), and according to 2019 data, 41% of men, 14% of women and 28% of the entire population smoke in Turkey. In addition, it is stated that the number of people who died due to smoking in the country is about 10 times more than the number of people who died due to traffic accidents (5). Unfortunately, Turkey is the country with the highest smoking-related death rate in the world (26.1% for men and 7.6% for women) (6).

Appetite, known as the desire, to eat, is regulated by various hormones and metabolites secreted by certain cells. The appetite-regulating hormones (peptide YY (PYY), glucagon-like peptide 1 (GLP-1), cholecystokinin (CCK), pancreatic polypeptide (PP), insulin, amylin, and leptin) help reduce food intake and thus suppress appetite. The active form of the hormone ghrelin and hormones such as glucagon are suppressed by food intake and stimulated in case of hunger, thereby increasing the appetite (7, 8). When the effects of smoking on appetite were examined, it was found that smokers had higher ghrelin levels (9), and ghrelin levels were lower in those who quit smoking (10). In this case, while it is expected that smokers will have higher appetite levels, on the contrary, it has been reported that food consumption decreases, energy expenditure increases, and weight loss is observed in these individuals (11). It has also been shown that nicotine exposure suppresses food intake, reduces the number of meals, prolongs the time between meals (12) and increases metabolic rate by activating the sympathetic nervous system (13).

Studies indicate that the risk of type 2 diabetes increases within two years in people who quit smoking, and this is caused by the increase in body weight after smoking cessation (14, 15). Research has also demonstrated that the rate of obesity tends to rise among individuals who quit smok-

ing (16, 17). Conversely, people who have never smoked are at a higher risk of developing obesity compared to those who continue to smoke (17). While the data might suggest that cigarettes could help reduce appetite and prevent obesity, other studies indicate that smokers often have comparable or higher intake levels of energy, total and saturated fats. Additionally, they tend to consume more energy-dense and less healthy foods compared to non-smokers (18, 19).

Finally, the effects of smoking on body weight, appetite and food intake are not clearly stated and are contradictory. Based on all these contradictory data, this study was conducted to evaluate the effect of smoking on eating behaviors and body mass index (BMI) in Turkey, which is one of the countries where smoking is common in the world and at the same time has the highest number of obesity (32.1%) (20) and diabetes (14.7%) (21) cases in Europe.

MATERIALS and METHODS

Participants and Ethics

The cross-sectional study was carried out from December 2021 to March 2022, using an online survey administered to adults aged 18 to 65 years. The survey form was delivered to the participants via e-mail or social media. All individuals living in Turkey who can be reached through snowball sampling from schools, workplaces, social media groups and platforms constitute the population of the study. Snowball sampling is an approach that focuses on finding new information-rich data providers in the network that the researcher initiates with a sample event. In order to determine the sample size required for the study, it was estimated that at least 384 participants would be needed based on a 5% margin of error and 95% confidence level according to standard tables for populations exceeding 1.000.000 people (22, 23). However, after the individuals who gave incomplete answers to the survey questions were excluded, the study was completed with 336 volunteers. "Ankara University Ethics Committee" approved the study protocol (Approval No: 21/228, Date: 27.12.2021).

Study Instrument

General information about the participants, smoking habits, eating behaviors and attitudes towards healthy eating were questioned with an online questionnaire. Cigarette consumption was determined in per/day and BMI was calculated using the body weight and height declared by the participants, and those " $<18.5 \text{ kg/m}^2$ were defined as underweight, $18.5\text{--}24.99 \text{ kg/m}^2$ as normal, between $25.0\text{--}29.99 \text{ kg/m}^2$ as overweight and $\geq 30 \text{ kg/m}^2$ as obese" (24). At this point, the details of how and when the participants will do their body weight and height were stated in the questionnaire.

Eating behaviors of the participants were determined by the Attitudes towards Healthy Eating Scale (ASHN) and their eating behaviors were determined by the Dutch Eating Behavior Scale (DEBQ). "The ASHN is a 21-item scale that includes 4 factors: knowledge about nutrition (items 1-5), feeling towards nutrition (items 6-11), positive nutrition (items 12-16), and malnutrition (items 17-21). The scale was developed by Tekkurşun Demir & Cicioğlu (25) and validity and reliability analyze were performed by these researchers. The Cronbach alpha internal consistency coefficient obtained at the end of the application was 0.90 and calculated as 0.81, 0.79, 0.68 and 0.80 for the sub-dimensions respectively." In this study, the internal consistency of the ASHN scale, measured by Cronbach's alpha, was 0.82. The Cronbach's alpha values for the scale's sub-dimensions were 0.90 for nutrition knowledge, 0.71 for attitudes toward nutrition, 0.72 for positive nutrition, and 0.70 for poor nutrition. The scale items are rated as "Strongly Disagree," "Disagree," "Neutral," "Agree," and "Strongly Agree." "Positive attitude items were scored as 1, 2, 3, 4 and 5, and negative attitude items were scored as 5, 4, 3, 2 and 1. The lowest score that can be obtained from the scale is 21, and the highest score is 105. Evaluation criteria were determined as 21 points very low, 23-42 points low, 43-63 points medium, 64-84 points high and 85-105 points ideally high as having an attitude towards healthy eating (26)."

"Dutch Eating Behavior Scale (DEBQ) Van Strien et al. (27) was developed by. The validity and reliability study in Türkiye was conducted by Bozan et al (28). The cronbach alpha internal consistency coefficient of the whole scale was determined as 0.94. The scale consists of 33 questions and has 3 sub-factors (emotional eating behavior, restrictive eating behavior, extrinsic eating behavior)." While the scale is evaluated with a 5-point Likert scale "(1-never, 2-rarely, 3-sometimes, 4-often, 5-very often)", questions 1-10 of the scale are "restrictive eating behaviors" and questions between 11-23 are "emotional eating behaviors" and questions between 24-33 constitute the sub-dimensions of "extrinsic eating behaviors". The scores that can be obtained from the sub-dimensions of the scale range from 13 to 65 for emotional eating, 10 to 50 for restrictive eating and 10 to 50 for extrinsic eating. Of the scale questions, only the 31st question is reverse coded. The scale yields a total score ranging from 33 to 165. There is no cut-off point in the scoring of the test and the high scores of each sub-dimension indicate the negativity associated with that eating behavior. In this study, the Cronbach's alpha internal consistency coefficient for the DEBQ scale was found to be 0.91. The coefficients for the subscales were 0.91 for emotional eating behavior, 0.96 for restrictive eating behavior, and 0.83 for external eating behavior. The study data were collected using the

Turkish version of the scale, with permission granted by the researchers who developed it.

Statistical Analysis

IBM SPSS 24.0 statistical package program was used in the statistical evaluation of the data obtained from the study. The data with kurtosis and skewness values between $-1.5/+1.5$ were also examined in histogram graphs and accepted as suitable for normal distribution. The Independent Samples T-test was used to compare two distinct groups. The Chi-Square Test was utilized to determine if there was a relationship between two or more qualitative variable groups. Correlation analysis was used to investigate the association between two quantitative variables. In the study, Partial Correlation Analysis was applied in which the variables likely to affect the two variables were taken under control. Correlation coefficients are defined as follows: " $0 < r \leq 0.3$ = weak; $0.3 < r \leq 0.7$ = medium; $0.7 < r \leq 1.0$ = strong relationship." Test results are considered significant with $p < 0.05$.

RESULTS

The findings regarding the sociodemographic and BMI values of the participants are given in Table 1. The majority of the 336 individuals participating in the study were male (75.6%) and university graduates (85.7%). Individuals with

Table 1: Sociodemographic characteristics and BMI of participants.

Variables	Findings (n=336)
Age (years±SD) (Min-Max)	26.0±9.0 (18.0-63.0)
BMI (kg/m ² ±SD) (Min-Max)	22.8±4.0 (15.6-38.4)
Gender*	
Male	82 (24.4)
Female	254 (75.6)
Educational Status*	
Primary education	5 (1.5)
High school	43 (12.8)
University	288 (85.7)
Income *	
Income less than expenses	78 (23.2)
Income equals expense	189 (56.3)
Income more than expenses	69 (20.5)
BMI Classification*	
Weak (<18.5)	43 (12.8)
Normal (18.5-24.99)	211 (62.8)
Overweight (25.0-29.99)	64 (19.0)
Obese (30.0 and above)	18 (5.4)

*Data are shown as n (%). n: number; SD: standard deviation.

an average age of 26.0 ± 9.0 years were predominantly classified as having a moderate income (56.3%) and were generally within the normal BMI range (62.8%). Of the participants, 5.4% were obese and 19.0% were overweight.

When the findings of the participants regarding smoking were analyzed, it was found that 33.3% of the participants smoked even though almost all of them (98.8%) stated that smoking was harmful. It was determined that individuals who smoked 11.9 ± 8.3 cigarettes per/day for an average of 9.7 ± 9.6 years. Smokers generally stated that they smoke whenever they want (49.1%). When the relationship between smoking and dietary habits was analyzed, it was found that smoking did not affect the diet of half of the individuals, while 43.8% of them consumed less food (Table 2).

The relationship between the smoking status of the participants and their eating habits, DEBQ and ASHN scores is shown in Table 3. When the results were examined, it was seen that smokers had fewer meals during the day ($p < 0.05$) and consumed more tea/coffee ($p < 0.001$). When the DEBQ results of the individuals participating in the study were examined according to their cigarette use, it was determined that the restrictive ($p < 0.05$) and emotional eating ($p < 0.001$) scores of the smokers were lower. In addition, DEBQ scores of smokers were lower than non-smokers ($p < 0.05$).

Table 2: Smoking habits of the participants.

Variables	Findings (n=336)
Do you think smoking is harmful to health?*	
Yes	332 (98.8)
No	4 (1.2)
Smoking*	
Yes	112 (33.3)
No	224 (66.7)
Smoking time*	
When I want	55 (49.1)
After dinner	20 (17.9)
Accompanied by tea/coffee during breaks	19 (17.0)
When I'm in a bad mood	18 (16.1)
The effect of smoking on your diet*	
No effect	56 (50.0)
Eat less	49 (43.8)
Eat more	7 (6.2)
Smoking duration (years \pm SD) (Min-Max)	9.7 ± 9.6 (1.0-55.0)
Amount of smoking (per/day \pm SD) (Min-Max)	11.9 ± 8.3 (1.0-35.0)

*Data are shown as n (%). n: number; X: mean; SD: standard deviation.

Table 3: The relationship between eating habits, scale scores and smoking.

Variables	Total (n=336)	Smokers (n=112)	Non-Smokers (n=224)	p
Number of meals*	2.5 ± 0.7	2.4 ± 0.7	2.6 ± 0.6	0.006
Water consumption*(mL)	1421.9 ± 830.0	1424.1 ± 929.0	1420.8 ± 777.9	0.972
Tea/coffee consumption* (mL)	456.6 ± 336.3	578.6 ± 399.2	392.6 ± 281.1	<0.001
DEBQ Score*				
Restrictive Eating	23.5 ± 8.2	22.1 ± 8.8	24.2 ± 7.9	0.030
Emotional Eating	29.7 ± 13.5	26.4 ± 11.8	31.4 ± 14.0	<0.001
Extrinsic Eating	30.5 ± 5.8	30.3 ± 5.8	30.6 ± 5.8	0.617
Total Points	84.1 ± 19.5	79.6 ± 18.0	86.4 ± 19.9	0.003
ASHN Score*				
Information about nutrition	21.5 ± 3.0	20.9 ± 3.1	21.7 ± 2.7	0.013
Feeling towards food	16.4 ± 4.4	16.5 ± 4.4	16.4 ± 4.4	0.807
Positive nutrition	17.6 ± 4.0	16.9 ± 4.2	17.9 ± 3.8	0.024
Malnutrition	18.5 ± 3.8	17.8 ± 3.9	18.8 ± 3.7	0.065
Total Points	73.9 ± 10.3	72.1 ± 9.9	74.9 ± 10.5	0.009
ASHN Classification**, n (%)				
Intermediate	57 (17.0)	21 (18.8)	36 (16.1)	0.176
High	50 (68.1)	80 (71.4)	149 (66.5)	
Ideal	336 (14.9)	11 (9.2)	39 (17.4)	

* Independent Samples T test was used. And data are shown as mean \pm standart deviation. ** The Chi-square test was applied, with bold values indicating statistical significance at $p < 0.05$

When the ASHN responses of the participants were examined, it was seen that the knowledge about nutrition and positive nutrition scores of smokers were lower ($p < 0.05$), but no difference was found between feelings about nutrition and malnutrition scores ($p > 0.05$). Additionally, while smokers were found to have lower ASHN scores ($p < 0.05$), there was no significant difference in nutritional knowledge levels between smokers and non-smokers ($p > 0.05$). When the data of all participants were analyzed, it was understood that 17.0% of them had intermediate, 68.1% had high and 14.9% had ideal level attitudes towards healthy nutrition (Table 3).

Table 4 examines the relationship between the smoking status of the participants and their BMI. When the results were examined, the BMI values of the individuals who smoked were found to be significantly higher ($p < 0.05$). When analyzed according to BMI groups, it is seen that overweight

(43.8%) and obese (66.7%) smoking group are significantly higher than normal individuals (28.9%) and obese individuals (66.7%) are significantly higher than underweight individuals (25.6%) ($p < 0.05$). In the non-smoker group, overweight (56.3%) and obese individuals (33.3%) were compared to normal individuals (71.1%); again, it was determined that obese individuals (33.3%) were less than underweight individuals (74.4%) ($p < 0.05$). Lastly, partial correlation analysis, controlling for gender, revealed a weak but significant positive relationship between smoking duration (in years) ($r: 0.222$; $p < 0.05$) and the number of cigarettes smoked daily ($r: 0.191$; $p < 0.05$) with the BMI values of smokers (Figure 1).

DISCUSSION

Tobacco use represents a major public health issue globally, leading to illness and death for millions of people each year (3). Cigarette, which is widely used among tobacco products, is shown to be responsible for one in ten deaths in the world (29) and it is stated that the resulting mortality exceeds 8 million people annually (2). Cigarette is a tobacco product that increases the risk of diabetes, respiratory problems, cerebrovascular diseases, cancer, cardiovascular diseases and premature death due to its carcinogenic, mutagenic, inflammatory and toxic effects (5). In addition, smoking has a negative effect on healthy life. The study found that smokers scored lower in spiritual development, health responsibility, nutrition, physical activity, interpersonal relationships, and stress management (30). Among these components, the effect of cigarettes on nutrition has not been sufficiently investigated and is a subject with conflicting results. Based on this, this study was conducted to examine the relationship between smoking, eating habits and obesity.

Table 4: Relationship between smoking and BMI.

Variables	Smokers (n=112)	Non-Smokers (n=224)	p
BMI (kg/m ² ±SD) *	23.7±4.6	22.3±3.5	0.004
BMI Classification **, n(%)			
Underweight (<18.5)	11 (25.6) ^{a,b}	32 (74.4) ^{a,b}	0.002
Normal (18.5-24.99)	61 (28.9) ^b	150 (71.1) ^b	
Overweight (25.0-29.99)	28 (43.8) ^{a,c}	36 (56.3) ^{a,c}	
Obese (30.0 and above)	12 (66.7) ^c	6 (33.3) ^c	

* Independent Samples T test was used.

** The Chi-square test was conducted, and post hoc analysis was performed for significant Chi-square results. Columns with different letters denote differences between groups. Bold values indicate statistical significance with $p < 0.05$.

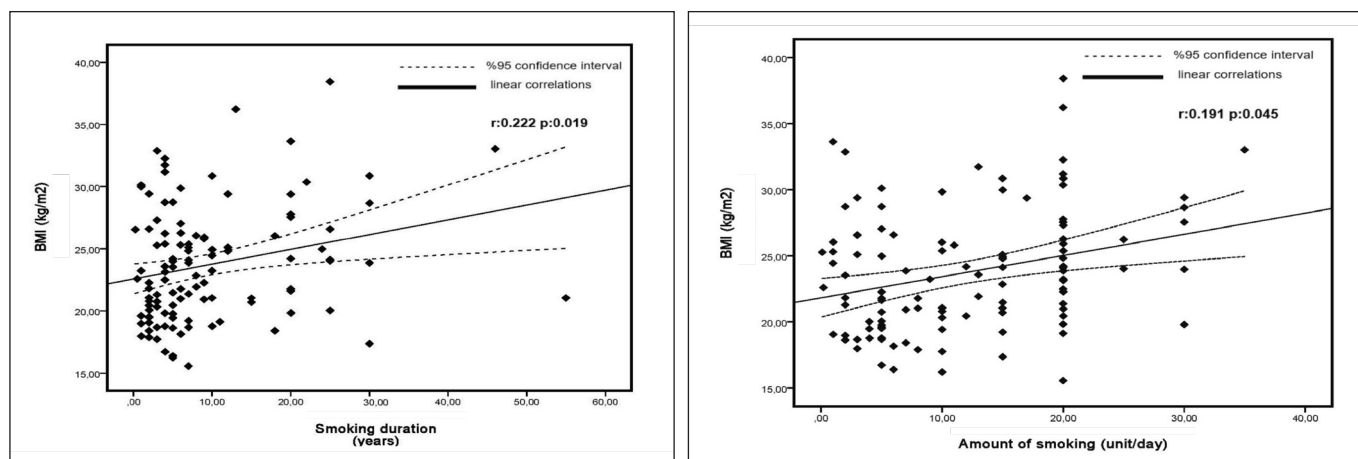


Figure 1: Relationship between smoking (duration and amount) and BMI.

Note: The gender variable was controlled.

In the study, ASHN and DEBQ scales were applied to the participants. While the Cronbach's alpha coefficient of the ASHN scale was 0.90, it was found to be 0.82 in this study, and while the DEBQ scale was 0.94, it was found to be 0.91 in this study. Therefore, it can be stated that the reliability of our study is high. The study was completed with 336 individuals, 82 males (24.4%) and 254 females (75.6%) with a mean age of 26.0 ± 9.0 years. While it was observed that 33.3% of the individuals participating in the study were smokers, it was determined that these individuals thought that they took less food because they smoked ($p < 0.05$) (Table 2) and they had more self-made meals during the day and consumed more tea/coffee ($p < 0.001$) (Table 3). In this case, it can be stated that cigarette use decreases appetite within the scope of the study. When the eating behaviors of the participants were examined, the fact that the restrictive ($p < 0.05$), emotional ($p < 0.001$) and extrinsic ($p > 0.05$) eating scores of the smokers were lower also supports this data (Table 3). When the literature is examined, Raatz et al. stated in their research that nicotine is associated with less energy intake (31). In another study, it was determined that individuals exposed to cigarette smoke get less energy with diet (32). However, there are studies in the literature showing that smokers consume more energy-dense foods and consume more energy, total and saturated fat than non-smokers (18, 19, 33, 34). The contradiction seen in this situation is explained by the fact that some of the approximately 4000 toxic compounds in cigarettes are obesogenic (polycyclic aromatic hydrocarbons) and some have anti-obesogenic effects (chromium, cadmium) (35).

There are data in the literature that smokers maintain an unhealthier diet. For example, in a study, it was found that smokers have lower intakes of folic acid, iron, fiber, polyunsaturated fatty acids, vitamin C, vitamin A, carotene and vitamin E, while their intake of saturated fatty acids is higher (32). In another study, it is seen that smokers consume more white bread, sugar, red meat, butter, whole milk, eggs, and consume less bread made from whole wheat, high-fiber breakfast cereals, vegetables, and fruits (36). In this study, the knowledge about nutrition, positive nutrition and total ASHN scores of smokers were found to be lower ($p < 0.05$) (Table 3) and these data support the literature on this subject. However, no difference was found between the nutritional knowledge levels for the smoking and non-smoking groups ($p > 0.05$) (Table 3). In addition, 87.0% of the participants had a high and ideal level of attitude towards healthy nutrition (Table 3) and the majority (62.8%) had a BMI in the normal range (Table 1), indicating that the selected sample consisted of healthy individuals.

Smoking's impact on body weight is attributed to nicotine's ability to boost metabolic rate, increase energy expenditure, and reduce appetite, leading to weight loss (37). In a study investigating the link between smoking and obesity among adults aged 31 to 69, it was observed that smokers have a lower likelihood of being obese compared to non-smokers (38). In other studies, overweight and obesity were found to be less common in smokers (39-41), while there was no relationship between smoking and BMI (42) or clear results could not be (43) are available in studies. In this study, BMI values of smokers (23.7 ± 4.6 kg/m²) were found to be higher than non-smokers (22.3 ± 3.5 kg/m²) ($p < 0.05$). When analyzed according to BMI groups, it was determined that the overweight and obese were significantly higher than normal and underweight in the smoking group, while the opposite results were found in the non-smoker group ($p < 0.05$) (Table 4). Additionally, partial correlation analysis, with gender controlled for, revealed a weak but significant positive correlation between smoking duration (in years) ($r: 0.222$; $p < 0.05$) and the number of cigarettes smoked daily ($r: 0.191$; $p < 0.05$) with the BMI values of smokers (Figure 1). In this case, the findings of the study differ from the literature, albeit partially. The fact that the participants had lower restrictive ($p < 0.05$), emotional ($p < 0.001$) and extrinsic ($p > 0.05$) eating scores (Table 3); it is generally characterized by lower BMI in the literature (44, 45). And in this case, it can be said that this finding of the study is contradictory. However, although smokers stated that they eat fewer meals and consume food and have lower emotional-restrictive eating scores (Tables 2 and 3), higher BMI values may be associated with maintaining an unhealthy diet. The fact that smokers among the individuals participating in the study had lower knowledge about nutrition ($p < 0.05$) and positive nutrition ($p < 0.05$) scores supports this situation.

This study has a few limitations. First, the participants' BMI and appetite levels were taken according to their own statements. These data can be obtained in the presence of experts. Another limitation is that the Cronbach alpha internal consistency coefficient of ASHN and DEBQ scales is lower than the original studies. This may be explained by the small number of participants. Additionally, the participants' food consumption records were not collected. Because obtaining the data online is a situation that prevents the recording of food consumption. To obtain clearer data in future studies, food consumption records should be obtained in the presence of an expert.

In this study, it was concluded that adult smokers think that they take less food with diet because they smoke, they have

fewer meals during the day, they consume more tea/coffee, and their restrictive and emotional eating scores are lower. These data are compatible with the studies in the literature that smoking reduces appetite. In addition, knowledge about nutrition, positive nutrition and lower total ASHN scores of smokers are also supported by the data in the literature that smokers maintain an unhealthier diet. Finally, in this study, it was observed that the BMI values of smokers were higher. Although the data in the literature on this subject are generally that obesity is less common in smokers, there are also findings indicating that it has no effect. In addition, a few recent studies have found that maternal smoking increases the risk of childhood obesity (46) and that obesity is more common in individuals who smoke electronic cigarettes (47). In conclusion, the effect of smoking on obesity has not yet been clarified and comprehensive experimental studies are needed.

Acknowledgments

We appreciate the adults who took part in the study.

Authorship Contributions

Study design: **Eren Canbolat, Esma Asil**, Data collection: **Eren Canbolat, Esma Asil**, Data analysis: **Eren Canbolat**, Draft preparation: **Eren Canbolat, Esma Asil**, Critical review for content: **Eren Canbolat, Esma Asil**, Final approval of the version to be published: **Eren Canbolat, Esma Asil**.

Conflict of Interest

The authors reported no conflicts of interest.

Financial Support

The authors stated that there was no financial support or funding for the research presented in this article.

Ethics Approval

The study received approval from the "Ankara University Ethics Committee" on December 27, 2021, under decision number 21/228.

REFERENCES

- Murray CJ, Lopez AD. Measuring the global burden of disease. *New England Journal of Medicine*. 2013;369(5):448-457.
- Tichenor M, Sridhar D. Metric partnerships: global burden of disease estimates within the World Bank, the World Health Organisation and the Institute for Health Metrics and Evaluation. *Wellcome Open Res*. 2019;4,35.
- World Health Organization 2021, Who Reports On The Global Tobacco Epidemic 2021. <https://www.who.int/publications/i/item/9789240032095> Accessed: 24.07.2023
- GBD 2019 Tobacco Collaborators. Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. *Lancet*. 2021;397(10292):2337-2360.
- Aksu EE, Uğraş Dikmen A. Smoking frequency and related factors in a military factory in Ankara. *SOYD*. 2022;3(1):11-18.
- Ipek O, Ipek E. The impact of smoking bans on smoking behavior in Turkey. *Ankara Hacı Bayram Veli University, Journal of the Faculty of Economics and Administrative Sciences*. 2020;20(Special Issue):179-190.
- Freire RH, Alvarez-Leite JL. Appetite control: hormones or diet strategies ?. *Curr Opin Clin Nutr Metab Care*. 2020;23(5):328-335.
- Ilhan T, Erdost H. Ghrelin. *Uludağ Üniversitesi Veteriner Fakültesi Dergisi*. 2009;28(1): 67-74.
- Wittekind DA, Kratzsch J, Mergl R, Enzenbach C, Witte V, Villringer A. et al. Higher fasting ghrelin serum levels in active smokers than in former and never-smokers. *The World J. Biol. Psychiatry*. 2020;21(10):748-756.
- Ardehiripur M, Rhein M, Frieling H, Bleich S, Hillemecher T, Muschler M. et al. Desacylghrelin but not acylghrelin is reduced during smoking cessation. *J Neural Transm*. 2018;125:1885–1889.
- Jitnarin N, Kosulwat V, Boonpradern A, Haddock CK, Poston WS. The relationship between smoking, BMI, physical activity, and dietary intake among Thai adults in central Thailand. *J Med Assoc Thai*. 2008;91(7):1109-1116.
- Rupprecht LE, Smith TT, Donny EC, Sved AF. Self-administered nicotine suppresses body weight gain independent of food intake in male rats. *Nicotine & Tobacco Research*. 2016;18(9):1869-1876.
- Kirel B, Alataş I. Serum irisin levels in cigarette smokers. *T Turk J Endocrinol Metab*. 2021;25:95-101.
- Chiolero A, Faeh D, Paccaud F, Cornuz J. Consequences of smoking for body weight, body fat distribution, and insulin resistance. *Am. J. Clin. Nutr*. 2008;87(4):801-809.
- Yeh HC, Duncan BB, Schmidt MI, Wang NY, Brancati FL. Smoking, smoking cessation, and risk for type 2 diabetes mellitus: a cohort study. *Ann Intern Med*. 2010;152:10-17.
- Karaoglan D. Giving Up Smoking and Obesity: The Case of Turkey. *Journal of Research in Economics*. 2019;3(1):46-57.
- Beyaz Sipahi F.B. The associations between smoking status and obesity in turkey. *International Journal of Business Economics and Management Perspectives*. 2021;5(1): 137-147.
- Chao AM, White MA, Grilo CM, Sinha R. Examining the effects of cigarette smoking on food cravings and intake, depressive symptoms, and stress. *Eating Behaviors*. 2017;24:61-65.
- MacLean RR, Cowan A, Vernarelli JA. More to gain: dietary energy density is related to smoking status in US adults. *BMC Public Health*. 2018;18(1):1-7.
- Global Obesity Levels 2021, Obesity rates by country (on-line). <https://worldpopulationreview.com/> Accessed: 20.09.2023
- Akyol Güner T, Kuzu A, Bayraktaroğlu T. The relationship between health literacy and rational drug use in individuals with diabetes. *Turk J Diab Obes*. 2020;4(3):214-223.
- Yagar F, Dökme S. Planning of qualitative researches: research questions, samples, validity and reliability. *Gazi Journal of Health Sciences*. 2018; 3(3):1-9.

23. Yazıcıoğlu Y, Erdoğan S. SPSS Uygulamalı Bilimsel Araştırma Yöntemleri, 4th Edition, Ankara, Detay Publishing, 2014.
24. Ozupek G, Arslan M. Evaluation of the relationship between popular diet practice, nutrition literacy and body mass index: a study on nutrition and dietetics students. *Turk J Diab Obes.* 2021;5(3):340-350.
25. Tekkursun Demir G, Cicioglu HI. Attitude scale for healthy nutrition (ASHN): validity and reliability study. *Gaziantep University Journal of Sport Science.* 2019;4(2):256-274.
26. Ozenoglu A, Gün B, Karadeniz B, Koç F, Bilgin V, Bembeyaz Z. et al. The attitudes of nutrition literacy in adults towards healthy nutrition and its relation with body mass index. *Life Sciences.* 2021;16(1):1-18.
27. Van Strien T, Frijters JE, Bergers GP, Defares PB. The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders.* 1986;5(2):295-315.
28. Bozan N, Bas M, Asci FH. Psychometric properties of Turkish version of Dutch Eating Behaviour Questionnaire (DEBQ). A preliminary result. *Appetite.* 2011;56:564-566.
29. Kunstler B, Fuller R, Pervan S, Merolli M. Australian Adults expect physiotherapists to provide physical activity advice: a survey. *Journal of Physiotherapy.* 2019;65(4):230-236.
30. Tuncer R, Alican EN, Beyhan A, Kolaç N. Comparison of healthy lifestyle behaviors in smoking and non-smoking adults. *Journal Of Public Health Nursing.* 2022;4(2):102-114.
31. Raatz SK, Jahns L, Johnson LK, Scheett A, Carriquiry A, Lemieux A. et al. Smokers report lower intake of key nutrients than nonsmokers, yet both fall short of meeting recommended intakes. *Nutrition Research.* 2017; 45:30-37.
32. Erçim RE, Baydaş B. The effect of passive tobacco smoke exposure on diet quality, oxidative stress index and nutritional status in young adults. *F.Ü.Sağ.Bil.Tıp.Derg.* 2017;31(1):1-10.
33. Bradley DP, Johnson LA, Zhang Z, Subar AF, Troiano RP, Schatzkin A. et al. Effect of smoking status on total energy expenditure. *Nutrition & Metabolism.* 2010;7(81):1-6.
34. Suh SY, Lee JH, Park SS, Seo AR, Ahn HY, Bae WK. et al. Less healthy dietary pattern is associated with smoking in Korean men according to nationally representative data. *J Korean Med Sci.* 2013;28(6):869-875.
35. Göney TG, Yalçın AD. Relationship Between Smoking and Obesity. *Klinik Tıp Solunum Aktüel.* 2019;10(1):8-11.
36. Yilmaz M, Aykut M. Effects of smoking on nutrition and food consumption. *Turkiye Klinikleri J Med Sci.* 2012;32(3):644-51.
37. Schwartz A, Bellissimo N. Nicotine and energy balance: A review examining the effect of nicotine on hormonal appetite regulation and energy expenditure. *Appetite.* 2021;164:105260.
38. Dare S, Mackay DF, Pell JP. Relationship between smoking and obesity: a cross-sectional study of 499,504 middle-aged adults in the UK general population. *PloS One.* 2015;10(4):e0123579.
39. Jacobs M. Adolescent smoking: The relationship between cigarette consumption and BMI. *Addictive Behaviors Reports.* 2019;9:100-153.
40. Keskin Y, Akar Y, Erdem Ö, Erol S. The relationship between body mass index with food preference and nutrition knowledge of adults: cross-sectional study. *E-Journal of Dokuz Eylul University Nursing Faculty.* 2022;15(2):149-162.
41. Restrepo BJ. Obesity prevalence among US adults during the COVID-19 pandemic. *Am J Prev Med.* 2022;63(1):102-106.
42. Aslan N. Determination of psychosocial factors related to the body mass index in women. *KOU Sag Bil Derg.* 2018;4(2):50-56.
43. Taylor AE, Richmond RC, Palviainen T, Loukola A, Wootton RE, Kaprio J. et al. The effect of body mass index on smoking behaviour and nicotine metabolism: a Mendelian randomization study. *Human Molecular Genetics.* 2019;28(8):1322-1330.
44. Barrada JR, van Strien T, Cebolla A. Internal structure and measurement invariance of the Dutch eating behavior questionnaire (DEBQ) in a (nearly) representative Dutch community sample. *European Eating Disorders Review.* 2016;24(6):503-509.
45. Nagl M, Hilbert A, De Zwaan M, Braehler E, Kersting A. The German version of the Dutch eating behavior questionnaire: psychometric properties, measurement invariance, and population-based norms. *PloS One.* 2016;11(9):e0162510.
46. Nkomo NY, Simo-Kengne BD, Biyase M. Maternal tobacco smoking and childhood obesity in South Africa: A cohort study. *Plos one.* 2023;18(2):e0268313.
47. Hod R, Mohd Nor NH, Maniam S. Systematic review on e-cigarette and its effects on weight gain and adipocytes. *PloS one.* 2022;17(7):e0270818.