



ORIGINAL ARTICLE

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## Investigation of the relationship between type 2 diabetes risk and night eating behavior

Serdar Derya<sup>1</sup>, Burcu Kayhan Tetik<sup>2</sup>, Burak Mete<sup>3</sup>

<sup>1</sup>Malatya Research and Development Hospital Department of Emergency Clinic, Malatya, Turkey

<sup>2</sup>Inonu University, Faculty of Medicine, Department of Family Medicine, Malatya, Turkey

<sup>3</sup>Cukurova University, Faculty of Medicine, Department of Public Health, Adana, Turkey

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### Abstract

The aim of this study is to determine the prevalence of night-eating behavior and risk of undiagnosed type 2 diabetes in the community and to investigate a relationship between them. The study was carried out on 1381 individuals, aged 18-80 years, and living in Malatya province, between February-March 2018. The questionnaire consisting of socio-demographic characteristics, FINDRISK scale and Night Eating Scale was applied by face-to-face interview technique. The data were evaluated by using the SPSS 22.0 program. Significance level was accepted as  $p < 0.05$ . The mean score of 1381 individuals on the FINDRISK scale was 11.17 and the mean score on the night eating scale was 26.93. We found that males, those who do not do exercise and do not have breakfast regularly, those who consumed 2 liters or less water daily, and smokers had a higher risk of developing diabetes mellitus within 10-years. The risk of developing diabetes within 10 years is different in those with and without night eating behavior ( $p=0.010$ ). As a result we couldn't find any relationship between night eating behavior and risk of diabetes determined by the FINDISK scale. Further research is needed on this subject.

**Keywords:** Feeding and eating disorders, hyperphagia, diabetes mellitus

### Introduction

Night eating syndrome is characterized by delayed circadian rhythm of daily nutrient intake and it is a condition related to the change in neuroendocrine functions, such as leptin, ghrelin, and insulin [1]. The incidence of night eating disorders in the American community is around 1.5% and are more commonly seen than traditionally described eating disorders such as anorexia and bulimia nervosa [2]. Recent studies have shown that night eating habits can be modified by psychotherapy and pharmacotherapy [3]. Night eating behavior is usually assessed under night-eating syndrome and characterized by recurrent episodes of excessive food intake after dinner (evening hyperphagia) or excessive need for eating after waking up in the morning (nocturnal hunger) [4]. Evening hyperphagia has been described as intake of more than 25% of daily calorie after dinner [5]. The time after dinner is generally accepted after 5pm [6]. In addition to the main symptoms of evening hyperphagia and nocturnal hunger, symptoms such as

morning anorexia, skipping breakfast, excessive desire to eat at night, insomnia, or a need for eating in order to start sleeping or to return to sleep are also seen [5]. Although it is estimated that there is a relationship between night eating behavior and metabolic function, very few studies have been conducted on this subject,

especially in the diabetic patient group [7]. In the literature, night-eating behavior has been evaluated in diabetic patients and its prevalence was found to be between 8.4% and 12.4% [8]. Evidence suggests that night-eating behavior is higher in patients referred to obesity policlinics and in comorbid conditions such as sleep apnea syndrome [9]. The lack of clarity of relationship between night eating behavior and glycemic control has been related to differences in the ways that the symptoms are measured and the study sample. Studies conducted on patients with type 1 and type 2 diabetes have shown that people with night eating behavior have poor glycemic control [10].

The aim of this study is to determine the prevalence of night-eating behavior and the risk of undiagnosed type 2 diabetes and to investigate presence of any relationship between these.

\*Corresponding Author: Burcu Kayhan Tetik, Inonu University Medical Faculty, Department of Family Medicine, Malatya, Turkey, E-mail: [drburcukayhan@hotmail.com](mailto:drburcukayhan@hotmail.com)

## Hypotheses of the study

H0. There is not a significant relationship between night eating behavior and the possibility of developing type 2 diabetes.

H1. There is a significant relationship between night eating behavior and the possibility of developing type 2 diabetes.

## Materials and Methods

The universe of this cross-sectional study is composed of individuals aged 18-80 years living in Malatya province center. The study was carried out between February and March 2018. The minimum number of individuals to be reached was found to be 596 with reference to 80% power and 95% confidence interval, according to the pilot study results. A total of 1381 people have been reached with easy sampling method. The study protocol was approved by the local ethical committee (Decision: Date: 27.02.2018; Decision Number: 2018 / 5-8). All patients were informed about the procedure by the same clinician and gave written informed consent. The questionnaire form consists of three parts. First part includes questions about sociodemographical data such as, age, gender, education, and income. In this section, when income groups are created, the current hunger and poverty thresholds are accepted as reference.

The second part is consisted of Finland Type-2 DM Risk (FINRISK) scale. The Finnish Type 2 DM Risk Scale consists of 8 questions (age, body mass index, waist circumference, doing or not doing exercise, consumption of vegetables fruits, presence of hypertension, and previous blood glucose levels above the limits or at the borderline. FINDRISK scale was developed to identify persons at risk for Type-2 diabetes without laboratory testing [11]. The FINDRISK scale score is used to assess the risk of type-2 diabetes within 10-years, with a total score ranging from 0 to 26 [12]. The scores below 7 (1%) are accepted to be low risk (The risk of developing diabetes in 10 years is 1%), 7-11 mild (The risk of developing diabetes in 10 years is 4%), 12-14 moderate (The risk of developing diabetes in 10 years is 16%), 15-20 high (The risk of developing diabetes in 10 years is 33%), and the scores above 20 are accepted to be very high risk (The risk of developing diabetes in 10 years is 50%). Numerous studies have examined the validity of the FINDRISK score and cut-off point for the risk of Type 2 diabetes has been identified as 15 and above [13,14]. A total FINDRISK score of 15 and above is defined to be very high risk, in terms of Type 2 diabetes. In study we also defined the cut of point as 15.

The third part consists of the night eating questionnaire. The night eating questionnaire includes 14 5-point Likert type questions. The questions except question 7 were scored between 0 and 4 with a 5-point Likert type measurement, whereas according to the 7th question, those without change of emotional state during the day were scored 0 points. Those scored 30 and above are evaluated in the risky group and for screening purposes the cut-off score is recommended to be 25 [15]. The scale consists of 4 sub-scales. The questions 5,9,10,11,12 and 14 measure sub-factor night eating, the questions 3 and 4 measure sub-factor evening hyperphagia, the questions 1,2 and 7 measure sub-factor inappetence in the morning, and the questions 6 and 8 measure emotional state and sleep disturbance sub-factor. According to the results of the validity

and reliability studies performed in our country, it is possible to diagnose night eating syndrome with sensitivity of 90.7% and selectivity of 73.8% when a night eating behavior score of 18 is accepted as a cut-off value. The Cronbach's alpha coefficient is found to be 0.69 [16]. In our study, the cut- off value is accepted as 30.

The patients with prediagnosed diabetes mellitus (DM), impaired fasting glucose, or impaired glucose tolerance, those with any condition which effects glucose metabolism (Cushing, acromegaly, pheochromocytoma, hyperthyroidism, etc.) or those using any medication effecting plasma glucose levels (antipsychotics, antivirals, beta agonists, diazoxide, phenytoin, steroids, interferon, and thyroid hormones, etc.) and those in post-menopausal period were excluded from the study.

The data were evaluated by using the SPSS 22.0 software. The descriptive data are expressed as percent, median, and arithmetic mean. The Kolmogorov Smirnov test was used to evaluate the normal distribution. Parametric tests were used in the analysis of normally distributed data and non-parametric tests were used in the analysis of non-normally distributed data. Chi-square test was used in the analysis of categorical data. Chi-square test, Binary Logistic regression test, Mann Whitney U test and Kruskal Wallis test were used in the analysis of the data. A value of  $p < 0.05$  is accepted to be statistically significant.

## Results

A total of 1381 people participated in the study and the average age was  $30.36 \pm 12.94$  years. The mean score on the FINDRISK scale was 11.17 and the mean score on the night eating scale was 26.93. While 15.9% of the participants have been doing exercise regularly, 65.5% have been having breakfast regularly, and 21.3% have been smoking cigarettes. The average amount of water consumed per day is 1.72 liters. The sociodemographic characteristics of participants are given in Table 1.

**Table 1.** Socio demographic characteristics of the participants

	n	%
<b>Age</b>		
15-30	868	63.0
31-45	327	23.7
46-60	134	9.7
> 61	49	3.6
<b>Gender</b>		
Male	404	29.3
Female	977	70.7
<b>Monthly income</b>		
Minimum Wage and Below	810	58.7
1608-5106 tl	497	36.0
>5107 tl and above	74	5.4
<b>Education</b>		
Literate- Primary School	198	14.3
Secondary School- High School	343	24.9
University	840	60.8
<b>Total</b>	1381	100.0

When we examined the risk of development of diabetes within 10 years according to the distribution of night eating risk group and FINDRISK group, we found that 876 (63.6%) participants were of low risk. None of the participants were found to be at very high risk. The prevalence of risk of night-eating syndrome (NES) was 29.8% and the prevalence of 10-years of undiagnosed diabetes was 10% (Table 2).

**Table 2.** Distribution of Findrisk and Night Eating Syndrome Risk Groups

Findrisk Group (risk of developing diabetes for 10 years)	n	%
Low	11	0.8
Mild	876	63.6
Moderate	353	25.6
High	138	10.0
Night Eating Syndrome		
No risk	969	70.2
Risky	412	29.8

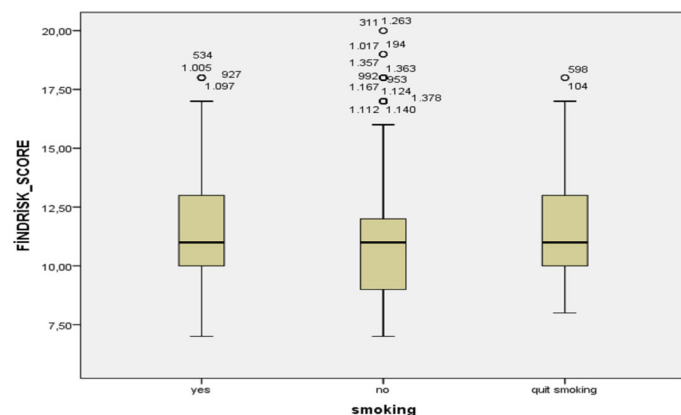
Comparison of the risk of development of diabetes within 10-years according to risk of night-eating syndrome and FINDRISK scale scores is given in table 3. We found that the risk of developing diabetes was higher in those who had night eating behavior ( $p < 0.05$ ). This difference is due to people who have night-eating behavior and have a 4-year risk of developing diabetes for 10 years.

**Table 3.** Comparison of the risk of development of diabetes within 10-years according to risk of night-eating syndrome and FINDRISK scale scores

Risk of night eating syndrome	The risk of development of diabetes within 10 years				
	1%	4%	16%	33%	p
No risk (n/line %)	5/0.5	594/61.4	266/27.5	103/10.6	0.010*
Risky (n/line %)	6/1.5	282/68.8	87/21.2	35/8.5	

\* $p < 0.05$

We found that, males, those who do not do sports and eat breakfast regularly, those who consumed 2 lt or less of water daily, and smokers had higher risk of developing diabetes within 10-years ( $p < 0.05$ ,  $p < 0.001$ ). Findings regarding the score of FINDRISK according to the smoking status are shown in Graph 1.



**Figure 1.** Findings regarding the score of FINDRISK according to the smoking status

Table 5 presents the results of logistic regression analysis based on sex, doing sports regular, having breakfast regularly, smoking and having high or very high risk according to night eating syndrome risk, and for FINDRISK scale. The model was found to be significant (omnibus test  $p = 0.001$ ). The overall ratio of correct estimate of the model is 94.8%. According to the results of the analysis, the risk of diabetes is 3.185 times higher in people who do not have regular breakfast.

**Table 5.** The results of logistic regression analysis for the risk of developing diabetes.

	Risk of developing diabetes within 10 years			CI 95%	
	B	p	Exp(B)	Lower limit	Higher limit
Gender	0.230	0.456	1.259	0.687	2.307
Doing sports regularly	0.725	0.077	2.064	0.923	4.613
Having breakfast regularly	1.159	0.001*	3.185	1.654	6.134
Smoking	0.067	0.842	1.070	0.550	2.080
Night eating syndrome	0.413	0.158	1.511	0.731	1.629

\* $p < 0.05$

## Discussion

Diabetes is one of the most important chronic health conditions and to identify risks before they occur is an important community health task. In this study conducted on 1381 individuals to determine the relationship between night eating behavior and type 2 diabetes risk, the prevalence of those with risk of night eating syndrome (NES) was 29.8% and the prevalence of those with a 10-year unrecognized type 2 diabetes risk was 10%. In addition, males, the ones who did not do sports and eat breakfast regularly, who drunk less than 2 liters of water a day, and smokers had a higher risk of developing diabetes ( $p < 0.05$ ) (Table 4).

**Table 4.** Comparison of average FINDRISK scores according to gender, doing sports regularly, having breakfast regularly, daily consumption of water and smoking cigarettes

Gender	A.O.±S.S.	p
Male	11.51±2.27	0.001*
Female	11.03±2.27	
Doing sports regularly		
Yes	10.29±2.18	0.001*
No	11.33±2.27	
Having breakfast regularly		
Yes	10.85±1.88	0.007
No	11.34±2.45	
Daily consumption of water		
2 lt and less	11.22±2.26	0.026*
More than 2 lt	10.95±2.38	
Smoking cigarettes		
Yes	11.50±2.18	
No	11.06±2.29	<0.001
Quitted	11.53±2.52	

\* $p < 0.05$

In a study conducted in Greece, 45% of the participants were found to have a higher risk according to the FINDRISK scale [17]. Coşansu et al. in their study conducted on 1872 individuals, in 2012, reported that 8.7% of the participants were at high and very high risk [18]. In the study of Koçak et al. the average FINDRISK score was found to be 7.6 [19]. In accordance with the literature, in our study we found an average FINDRISK score of 11.17 and a high risk of 10%. Turkey Endocrinology and Metabolism Association (TEMĐ) emphasized that the FINDRISK scale can be used to identify high-risk individuals for Type-2 diabetes and individuals with a diabetes risk score > 20 should be included in protection programs [20].

Night eating syndrome is a discomfort which individuals wake up and eat meal at night, as a result of a disturbance in the circadian rhythm between eating and sleeping. This condition is interpreted as the lack of desire to eat in the mornings due to the delay in energy intake, and to eat at night instead of it [16]. However, in diabetic patients, such behavior can lead to glucose disorders and unintended complications [21]. Allison and colleagues, in their study of 845 adults, found that night eating behaviour was 8.4% in the community and 9.7% in patients with Type 2 diabetes [8]. Similarly, this rate was found to be 7.4 in individuals with diabetes and obesity [21]. However, in the studies that investigated night-eating behavior in obese individuals without diabetes, this rate was found as high as 9% [22]. It has been detected that 16.5% of the overweighted or obese individuals with severe psychiatric disorders had a risk for night eating syndrome [23]. In our study, this rate was found to be 29.8 in people without diabetes and obesity. To the best of our knowledge, there is no study evaluating FINDRISK and the night eating scales together, in the literature. In our study, we found that the risk of developing diabetes was lower in the individuals with night-eating behavior than those without ( $p < 0.05$ ) (Table 3). This finding suggests that night eating behavior is not a significant variable in terms of risk of developing diabetes. In the logistic regression analysis, we found that night eating behavior was not a significant predictor of risk of diabetes ( $p > 0.05$ ). In the literature, studies conducted in subjects of night eating behavior and risks of diabetes are rare. However, it has been emphasized that obesity, binge eating disorder, and bulimia nervosa will increase the risk of diabetes, while anorexia nervosa will reduce it [8,21]. Morse et al. in their study on 714 patients with Type 1 and Type 2 diabetes, reported night eating behavior in 9.7% of the patients [21]. Allison et al. reported that night eating behaviors were more frequent among obese adults with Type 2 diabetes [8]. Nieto-Martinez and colleagues evaluated whether eating disorders were a risk factor for diabetes in a systematic review and meta-analysis study, conducted in 2017. They reported that bulimia nervosa increases and anorexia nervosa reduces the risk of developing diabetes, whereas studies on binge eating disorder are inadequate [24].

In the literature it has been reported that doing exercise regularly prevents weight gain and fat accumulation and decrease the body blood sugar level [25,26,27]. In our study, the risk of developing diabetes within 10-year was found to be statistically significantly lower in individuals doing exercise regularly. In the literature, it was reported in the NHANES study that smokers had higher risk of developing diabetes than non-smokers [28]. On the other hand, similar studies conducted in our country reported no relationship

between smoking and risk of diabetes [27,29]. In our study, smokers were found to have a statistically significantly higher risk of developing diabetes, confirming the hypothesis that smoking increases diabetes and diabetic complications. However, variety of the results reported in the literature suggests that further studies with larger number of participants are needed

## Conclusion

In our study, we found that, males, those who do not do exercise and have breakfast regularly, those who consumed 2 liters or less water daily, and those who smoke tobacco had a higher risk of developing diabetes within 10-years. The comparison of the FINDRISK scale and night eating behavior scale indicated that risk of developing diabetes was higher in those without night eating behavior, which was not anticipated. In the logistic regression analysis, we found that, only not having breakfast regularly increased the risk of developing diabetes by 3 times. As a result, we found no correlation between the risk of diabetes and night eating behavior and the FINDRISK scale. Further studies are necessary in this regard.

## Competing interests

*We declare that we have no conflict of interest.*

## Financial Disclosure

*The financial support for this study was provided by the investigators themselves.*

## Ethical approval

*The study was approved by local ethical committee.*

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