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Ummugulsum Gundogdu & Ayse Burcu Erdogdu Yildirim

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Anxiety, Depression, Stress, Sleep Disorders and Night Eating Syndrome in Adolescents: An Internet Survey

Ummugulsum Gundogdu and Ayse Burcu Erdogdu Yildirim

Marmara University, Istanbul, Turkey

ABSTRACT

This study examined the association between Night Eating Syndrome (NES) problems, sleep disturbances, and the expression of anxiety, depression, and stress in adolescents, taking gender into account. It also investigated whether sleep problems mediate the relationship between NES and anxiety, depression, and stress. This cross-sectional web-based study included 167 adolescents aged 12 to 18 (55.0% girls). Participants completed the self-report Night Eating Questionnaire (NEQ), Scales for Outcomes in Parkinson's disease (SCOPA) Sleep Scale, and Depression, Anxiety, and Stress Scale–21 items (DASS-21). Increased stress, worsening of depressive symptoms, difficulty falling asleep, and daytime sleepiness were all found to have a significant relationship with NES ($p < .05$). While higher DASS scores for stress and depression were associated with NEQ > 25 in adolescent girls, higher DASS scores for depression and SCOPA were related in adolescent boys ($p < .05$). Having trouble falling asleep and feeling sleepy during the day are directly linked to experiencing Night Eating Syndrome (NES). This is mediated both directly and indirectly through symptoms of depression and stress, with statistical significance ($p < 0.05$). Sleep problems, directly and indirectly, influenced the NES through depression and stress. Reducing depression and stress and addressing sleep problems may help treat NES in adolescents.

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Introduction

Night eating syndrome (NES) is a lesser-known eating disorder. However, due to an increase in the prevalence of obesity and related research, NES has gained attention (Jinbo et al. 2018; Kaur et al. 2022; Lavery and Frum-Vassallo 2022). The characterization of Night Eating Syndrome (NES) was affected by the transition to the DSM-5. In DSM IV-TR (American Psychiatric Association, AP, and American Psychiatric Association 1994), NES was present under the Eating Disorder Not Otherwise Specified (EDNOS) category but has now been characterized as an "Other Specified Feeding or Eating Disorder" after "Eating Disorder Not Otherwise Specified" was dropped as a category of EDs in the DSM-5 (American Psychiatric Association and Association 2013). There are three basic diagnostic criteria for NES. The first is having at least 25% of the daily food intake after dinner or eating two or more nights per week. The second criterion, that of awareness during eating episodes, was necessary to differentiate NES from Sleep Related Eating Disorder (SRED) which involves limited or no conscious awareness during nocturnal ingestions and which may involve ingestion of inedible objects. Third, at least three of the following need to be included: morning anorexia, a strong urge to eat between dinner and sleep or during the night, insomnia, a belief that eating is necessary to induce or regain sleep, and/or a worsening of mood in the evening (Allison et al. 2010; American Psychiatric Association and Association 2013).

CONTACT Ummugulsum Gundogdu glsmgndgd2@yahoo.com Department of Child and Adolescent Psychiatry, Faculty of Medicine, Marmara University, Istanbul, Turkey

The prevalence of NES is difficult to ascertain due to variable criteria used between studies. Overall, estimates of NES in the general population range from 1% to 2%. Significant differences were detected in clinical samples (Lavery and Frum-Vassallo 2022). Kaur et al. concluded that the overall prevalence of NES in the eating disorder, obesity, and bariatric surgery populations ranged from 2.8% to 8.2% (Kaur et al. 2022). A study conducted by He et al. showed that the prevalence of NES was 2.8% (2.4% after excluding students with binge eating) (Jinbo et al. 2018).

Since the number of women is generally higher in studies on weight loss initiatives, it has been concluded in some publications that NES predominantly affects women (Allison, Stunkard, and Thier 2004; Wal and Jillon 2012). However, there are also publications indicating that NES occurs among both men and women. In a population survey stratified by age and sex, similar rates of men and women were found to wake up to eat (Andersen et al. 2004; Farhangi 2019; Kaur et al. 2022; Wal and Jillon 2012).

Researchers believe that cognitions and emotions may play an essential role in NES formation. Most of the symptoms occur at night due to the belief that the individual cannot sleep without eating. Patients may also need to eat to control the anxiety associated with this belief (Lepley, Schwager, and Khalid 2022; McCuen-Wurst, Ruggieri, and Allison 2018; Salman and Kabir 2022). Some publications detect a relationship between cortisol levels and night eating syndrome. For example, Birketvedt and colleagues showed higher cortisol levels in night eaters between 8:00 am and 2:00 am compared to the control group (Birketvedt et al. 1999).

Research has shown that people with NES commonly experience sleep disorders, which can include insomnia, difficulty falling asleep at a reasonable time, and interruptions to their natural sleep cycle (Lundgren et al. 2008; Sateia 2014). Ferhangi et al. indicated poor sleep quality and higher dietary fat intake among adolescents with emotional eating disorder and NES (Farhangi 2019). It is essential to distinguish NES from other eating disorders and sleep-related eating disorders (SRED) (Bos et al. 2013; Lundgren et al. 2008; Mansukhani, Prakash Kolla, and Ramar 2014). In SRED, individuals do not aware that they wake up at night and eat (Lundgren et al. 2008; Mansukhani, Prakash Kolla, and Ramar 2014; Rogers et al. 2006). However, individuals with NES are aware while eating. In addition, those diagnosed with SRED have been found to have sleepwalk and may have other sleep problems such as restless legs syndrome, periodic sleep movements, and obstructive sleep apnea (Hoban 2010; Lundgren et al. 2008; Mansukhani, Prakash Kolla, and Ramar 2014).

In addition to studies that examined the relationship between NES and sleep, there are some studies which examined the relationship between NES and mood. Some studies using depression scales reported significantly higher scores for depression in individuals with NES than those without, and other studies have shown that stress exacerbated clinical conditions (Friedman et al. 2006; Gluck, Geliebter, and Satov 2001; Lundgren et al. 2008). Individuals with NES may also have lower self-esteem and more severe anxiety symptoms (Gluck, Geliebter, and Satov 2001). Researchers who believe that psychiatric disorders in particular play an essential role in the development and maintenance of NES have found that some individuals with NES have both, a belief that a person cannot sleep without eating and a desire to control the anxiety associated with this belief (Allison, Stunkard, and Thier 2004; Kelly C. Allison et al. 2010; Napolitano et al. 2001).

Previous studies have revealed the coexistence of NES and sleep disorders and the coexistence of NES and mood disorders. In this study, we assumed we would detect a relationship between NES and sleep disorders and psychological factors such as depression, anxiety, and stress. We planned to evaluate whether there were differences in NES-related characteristics in adolescent girls and boys. We hypothesized that sleep problems and psychological factors such as stress, depression, and anxiety have different influence on NES symptoms in adolescent girls and boys. Furthermore, we investigated whether sleep problems mediate NES through anxiety, depression, and stress. Our study may contribute to the literature by investigating whether the factors related to NES vary in terms of gender and whether sleep problems contribute to NES through emotional issues such as anxiety, depression, and stress.

Methods

Participants and procedure

This web-based (Google Forms) cross-sectional study, conducted in July 2021, included a sample of 167 adolescents aged 12–18 years. The ethics committee of the university approved the study by the protocol number 227/2021. Informed consent was obtained from all the participants via the study protocol. The study was conducted in accordance with the code of ethics set by the Declaration of Helsinki and all its future amendments or comparable standards. Questionnaires were prepared and first applied to the ethics committee. Then, after the ethics committee approval, an application was made to the "National Education Directorate," Then, the principals and teachers of randomly selected high schools were contacted, their approval papers were shown, and they were asked to send the questionnaires to their students by e-mail.

Data collection

The principals and teachers of three randomly selected high schools in the province where the study was conducted were contacted, and questionnaires were sent to students who wanted to participate in a web-based survey. We did not conduct a preliminary study or project presentation as we plan to randomly select the adolescents to participate in our study from three schools granted permission by the Ministry of National Education for our research. The school principals and teachers made student lists and used the Microsoft Excel Randbetween function to choose students randomly. Then, the selected students received questionnaires with the assistance of administrators and teachers. The questionnaire consisted of questions covering demographic information, such as gender, age, and body mass index. Due to the pandemic, face-to-face studies were suspended, and online survey (the questionnaires were sent, completed and returned via the Internet) were conducted on the Google Forms. It took about 30 minutes to complete the questionnaires. Exclusion criteria included the presence of any neurological, intellectual, or psychotic disorder and any chronic health disease, such as genetic or endocrine; being over 18 years old; submitting a questionnaire in which more than 10% of the items are missing; and refusing to participate in research. At the beginning of the questionnaire, they were asked whether they had a known disease, a neurological diagnosis such as epilepsy, or a psychiatric diagnosis and whether they wanted to participate in the study. Since this information is learned through self-report, the possibility of error should not be ignored. Participants who did not complete the questionnaire or gave invalid responses (absurd or impossible responses such as providing age or personal information in unrealistic values, continuously marking the same item, giving multiple answers to each question) were excluded. Of the 196 participants who responded initially, 167 completed the questionnaire.

Depression, anxiety, and stress scale – 21 items (DASS-21)

The DASS-21 is a self-report scale designed to measure depression, anxiety, and stress (Henry and Crawford 2005). There are three subscales, each consisting of seven items. The depression scale evaluates dysphoria, hopelessness, the worthlessness of life, self-worthlessness, disinterest, listlessness, and sluggishness. The anxiety scale assesses autonomic arousal, situational anxiety, anxiety, and skeletal muscle effects. Finally, the stress scale measures nervous arousal and mild excitability, irritability/over-reactivity and impatience, difficulty relaxing, and subjective feelings. The depression, anxiety, and stress scores are calculated by adding the scores of the corresponding items. The scale was calibrated for Turkish participants in a validity and reliability study conducted by Sarıçam et al. The scale had excellent internal reliability, with Cronbach's alphas ranging from 0.87 to 0.90, and temporal stability, with intra-correlations ranging from 0.82 to 0.93 (Sarıçam 2018). The Cronbach`s alpha coefficient of the present sample showed internal consistency ranging from 0.711 to 0.838. In our country, there is a study conducted with adolescents using DASS-21 (Akcay, Devrim Akcay, and Hekim Bozkurt 2020).

The night eating questionnaire (NEQ)

This is a screening questionnaire which consists of 14 questions developed by Allison et al (Allison et al. 2008). It includes items regarding morning appetite and the first food intake of the day, evening and nighttime eating, frequency of eating after dinner, food cravings, control of nighttime eating, difficulty falling asleep, frequency of nighttime awakenings, alertness, and mood during nighttime eating. All the participants complete the first nine questions of the NEQ. Participants who do not wake up at night or do not snack were directed to continue with the questions in the following manner. Questions 10–12 were completed by participants who wake up at night, and questions 13 and 14 were completed by participants who eat snacks at night. Except for the seventh item, all items are rated on a 5-point Likert scale ranging from 0 to 4. The seventh item enquires about mood changes during the day; those who do not notice any changes during the day score 0. The total score can range from 0–52. The questionnaire was calibrated for Turkish participants in a validity and reliability study conducted by Atasoy et al. The instrument showed satisfactory internal consistency with an overall Cronbach alpha of 0.69 (Atasoy et al. 2013). The present sample showed internal consistency with an overall Cronbach alpha of 0.701. There is a study conducted with university students in our country with NEQ (Ozgur and Aslı 2018).

Scales for outcomes in Parkinson's disease (SCOPA) sleep scale

This is a 12-item scale developed by Marinus et al. in Marinus et al. (2003) to assess sleep problems (such as difficulty falling asleep in the past month, inability to fall asleep, falling asleep very quickly, or staying awake), and sleep quality in patients with Parkinson's disease (Marinus et al. 2003). It consists of 12 items, 5 assessing night sleep, 6 assessing daytime sleepiness, and 1 assessing general sleep quality. For the sub-dimensions of night sleep and daytime sleepiness, responses range from 0–3. For the sub-dimension of general sleep quality with one item, the response is rated on a 7-point scale that ranges from 0–6. The scale was calibrated for Turkish participants in a validity and reliability study conducted by Sonmez et al. The Cronbach`s alpha coefficient was 0.907 for the nighttime sleep sub-dimension and 0.906 for the daytime sleepiness sub-dimension (Sonmez 2018) This questionnaire has excellent psychometric properties. It consists of two scales for assessing nighttime sleep problems and daytime sleepiness. As the items in the scales are not disease-specific, we used this scale in our study. Some researchers have used the SCOPA-Sleep in their research for patients with mental disorders (Hagell et al. 2016; Newe, Pedersen, and Goebel 2022). The Cronbach`s alpha coefficient of the present sample showed internal consistency with an 0.872 for the nighttime sleep sub-dimension and 0.890 for the daytime sleepiness sub-dimension. There is no study conducted with adolescents using SCOPA-Sleep in our country.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS for IBM, 21.0). Descriptive statistical methods, that is, frequency, percentage, mean, and standard deviation, were used when evaluating the study data. The normal distribution of continuous variables was evaluated using the Shapiro-Wilk test. In addition, the MANOVA (Multivariate Analysis of Variance) were used in the analysis of NEQ, SCOPA-Sleep Scale, and DASS-21 between groups (girls and boys, those who are over 25 and below 25 from the NEQ scale)

Correlational analyses were conducted using Pearson's correlation for normally distributed variables and Spearman's correlation for qualitative variables and non-normal distributions. Variables found to be statistically significant were evaluated with the stepwise method in linear regression analysis. The model with the highest number of variables from the model obtained is given as an independent variable in the tables. In the regression model, the multicollinearity problem was checked in two ways. All predictor variables were checked for correlation to control using correlation coefficients, and only one of the two variables with coefficients of magnitudes of 0.8 or higher was used in the analysis. In addition, VIF values were checked. For all analyses, the level of significance was

$p < 0.05$ with corresponding 95% confidence intervals. Finally, a mediation regression analysis was performed to determine the indirect influence of insomnia and daytime sleepiness on NES through anxiety, depression, and stress symptoms (Hayes 2017).

Results

Of the 167 adolescents who participated in this study, 93 (55.7%) were girls, and 74 (44.3%) were boys. The girls' mean age was 14.85 ± 1.54 years, and the boys' was 16.05 ± 1.70 years.

In Table 1, the scores of the scales for girls and boys were compared; girls (5.81 ± 5.41) scored higher than boys (3.78 ± 4.16) on the DASS anxiety scale (this subscale assesses autonomic arousal, situational anxiety, anxiety, and skeletal muscle effects) ($p = 0.009$) (Table 1). The NEQ total score and NEQ-nocturnal ingestion subscale scores were higher in boys ($p < 0.05$) (Table 1).

When assessing BMI in percentiles by age in the adolescent age group, the range between 5 and 85% iles was classified as average body weight, between 85 and 95 as overweight, and above 95 as obese (Weir and Jan 2019). In Table 2, when comparing the scales, the overweight and obese children were placed in one group, the normal-weight children were placed in the second group, and then the differences in the results of the scales for girls and boys were evaluated separately. The girls in the overweight and obese group scored higher on the DASS stress (this subscale assesses nervous arousal and mild excitability, irritability/over-reactivity and impatience, difficulty relaxing, and subjective feelings) scale than the normal-weight girls ($p < 0.05$; Table 2). The NEQ mood/sleep subscale (items regarding difficulty falling asleep, frequency of nighttime awakenings, alertness, and mood during nighttime eating) and total scores (items regarding morning appetite and the first food intake of the day, evening and nighttime eating, frequency of eating after dinner, food cravings, control of nighttime eating, difficulty falling asleep, frequency of nighttime awakenings, alertness, and mood during nighttime eating) were also higher in overweight adolescent girls than in normal-weight adolescent girls ($p < 0.05$; Table 2). Among boys, only the stress subscale of the DASS-21 differed between the overweight and normal-weight adolescents. Boys in the overweight and obese group scored higher on the DASS stress scale than those in the normal-weight group ($p < 0.05$; Table 2).

With the cutoff value of the NEQ scale set at 25, adolescents who scored below and above the cutoff value were divided into separate groups. When the scores of girls and boys with NEQ total scores below and above 25 were compared in Table 3, the SCOPA sleep scale (difficulty falling asleep in the past month, inability to fall asleep, falling asleep very quickly, or staying awake), DASS-stress, depression (this subscale assesses dysphoria, hopelessness, the worthlessness of life, self-

Table 1. Comparison of age and scale scores between girls and boys ($N = 167$).

	Girls 93 (55.7%)		Boys 74 (44.3%)				
	mean	SD	mean	SD	MS	F	p
Age	14.85	1.54	16.05	1.70	59.797	22.963	<0.001**
DASS- anxiety	5.81	5.41	3.78	4.16	169.151	7.050	0.009**
DASS-stress	7.76	4.88	7.37	5.02	6.454	0.264	0.608
DASS-Depression	5.91	5.75	5.46	4.15	8.454	0.324	0.570
Morning anorexia	3.20	1.43	3.32	1.48	0.594	0.282	0.596
Evening Hyperphagia	5.75	2.08	5.85	2.22	0.458	0.099	0.753
Mood/Sleep factor	8.37	3.85	9.38	3.37	41.927	3.152	0.078
Nocturnal Ingestions	4.22	1.60	4.97	2.18	23.095	6.528	0.012*
NEQ Total Scores	21.54	5.06	23.53	6.10	161.998	5.271	0.023*
SCOPA Night sleep	7.77	3.74	7.70	3.30	0.228	0.018	0.893
SCOPA- Daytime sleepiness	3.07	3.33	4.16	3.95	49.172	3.763	0.054
SCOPA-Total	10.84	5.98	11.86	6.44	42.698	1.115	0.293

P-values calculated by MANOVA*, $p < 0.05$ **, $p < 0.01$; MS, Mean Square.
NEQ, Night Eating Questionnaire.
DASS 21, Depression, Stress and Anxiety Scale.
SCOPA- Sleep, Scales for Outcomes in Parkinson's Disease – Sleep.

Table 2. Comparison of the scores of scales for normal weight and overweight girls and boys ($N = 167$).

	Girls 93 (55.7%)							Boys74 (44.3%)						
	Normal weight 69 (74.2%)		Overweight and obesity 24 (25.8%)					Normal weight 40 (54.1%)		Overweight and obesity 34 (45.9%)				
	mean	SD	mean	SD	MS	F	p	Mean	SD	mean	SD	MS	F	p
DASS- anxiety	5.21	5.16	7.54	5.84	97.129	3.404	0.068	3.43	3.60	4.20	4.77	10.791	0.620	0.434
DASS-stress	7.09	4.47	9.71	5.57	122.359	5.378	0.023*	6.26	4.30	8.68	5.53	107.739	4.485	0.038*
DASS-Depression	5.54	5.41	7.00	6.63	38.152	1.156	0.285	5.49	4.06	5.43	4.33	0.050	0.003	0.957
Morning anorexia	3.29	1.26	2.96	1.83	1.957	0.962	0.329	3.53	1.62	3.09	1.29	3.506	1.611	0.208
Evening Hyperphagia	5.54	1.97	6.33	2.32	11.160	2.616	0.109	5.73	2.04	6.00	2.45	1.390	0.278	0.600
Mood/Sleep factor	7.82	3.61	9.96	4.15	81.467	5.768	0.018*	9.38	3.31	9.38	3.48	0.000	0.000	0.996
Nocturnal Ingestions	4.10	1.62	4.57	1.54	3.924	1.537	0.218	4.83	2.12	5.13	2.28	1.620	0.337	0.563
NEQ Total Scores	20.75	4.56	23.82	5.80	167.663	6.978	0.010*	23.46	6.04	23.60	6.26	0.357	0.009	0.923
SCOPA Night sleep	7.65	3.51	8.13	4.40	3.981	0.283	0.596	7.62	3.48	7.79	3.13	0.556	0.050	0.823
SCOPA- Daytime sleepiness	2.91	3.05	3.54	4.06	7.214	0.649	0.423	4.32	3.85	3.97	4.11	2.299	0.146	0.704
SCOPA-Total	10.56	5.51	11.67	7.22	21.913	0.611	0.437	11.94	6.45	11.76	6.53	0.594	0.014	0.906

P-values calculated MANOVA; MS, Mean Square.
Normal weight. BMI ≥ 5th to < 85th percentile; Overweight BMI ≥ 85th to < 95th percentile; Obesity BMI ≥ 95th percentile(Weir and Jan 2019).
NEQ. Night Eating Questionnaire.
*. $p < 0.05$ **. $p < 0.01$.
DASS 21. Depression. Stress and Anxiety Scale.
SCOPA- Sleep. Scales for Outcomes in Parkinson's Disease – Sleep.
BMI. Body mass index.

Table 3. Comparison of the Scores of Other Scales between those who are over 25 and below 25 from the NEQ scale for girls and boys ($N = 167$).

	Girls 93 (55.7%)							Boys 74 (44.3%)						
	NEQ <25 68 (73.2%)		NEQ ≥25 25 (26.8%)					NEQ <25 45 (60.8%)		NEQ ≥25 29 (39.2%)				
	mean	SD	mean	SD	MS	F	p	Mean	SD	mean	SD	MS	F	p
DASS- anxiety	4.56	4.51	9.20	6.24	393.194	15.553	<0.001**	2.71	3.09	5.45	5.04	132.594	8.431	0.005**
DASS-stress	6.13	3.87	12.20	4.64	672.987	40.296	<0.001**	6.23	4.63	9.14	5.16	149.442	6.375	0.014*
DASS-Depression	3.94	4.36	11.28	5.70	984.507	43.558	<0.001**	4.25	4.16	7.33	3.44	167.461	11.037	<0.001**
SCOPA Night sleep	7.18	3.53	9.40	3.87	90.376	6.877	<0.001**	6.60	2.47	9.41	3.73	140.040	15.356	<0.001**
SCOPA-Daytime sleepiness	2.26	2.32	5.26	4.53	163.808	17.441	<0.001**	2.89	2.52	6.14	4.90	186.044	14.078	<0.001**
SCOPA-Total	9.44	5.02	14.66	6.78	497.530	16.230	<0.001**	9.48	4.21	15.55	7.57	648.908	19.610	<0.001**

P-values calculated MANOVA MS, Mean Square*, $p < 0.05$ **, $p < 0.01$.
NEQ, Night Eating Questionnaire.
DASS 21, Depression, Stress and Anxiety Scale.
SCOPA- Sleep, Scales for Outcomes in Parkinson's Disease – Sleep.

worthlessness, disinterest, listlessness, and sluggishness), and anxiety were higher in adolescent girls and boys with NEQ scores of 25 (cutoff value of the NEQ) and above ($p < 0.05$; Table 3). When all adolescents were divided into groups with total NEQ scores below 25, and above 25, without dividing them by gender, scores on the SCOPA sleep scale, DASS-stress, depression, and anxiety were higher in adolescents with an NEQ score of 25 and above ($p < 0.05$; Table 4).

Table 5 shows the data obtained by examining the factors related to NEQ scores above 25 by linear regression analysis. While DASS scores for stress and depression were associated with NEQ > 25 in

Table 4. Comparison of the Scores of Other Scales between those who are over 25 and below 25 from the NEQ scale ($N = 167$).

	NEQ <25 113 (67.7%)		NEQ ≥25 54 (32.3%)				
	mean	SD	mean	SD	MS	F	p
DASS- anxiety	3.82	4.09	7.19	5.89	413.104	18.349	<0.001**
DASS-stress	6.17	4.17	10.56	5.12	702.755	34.781	<0.001**
DASS-Depression	4.07	4.27	9.16	4.99	948.828	46.583	<0.001**
SCOPA Night sleep	6.95	3.15	9.41	3.76	221.499	19.632	<0.001**
SCOPA- Daytime sleepiness	2.51	2.41	5.73	4.71	378.109	34.146	<0.001**
SCOPA-Total	9.46	4.69	15.14	7.16	1178.402	37.516	<0.001**

P-values calculated MANOVA MS, Mean Square.
NEQ, Night Eating Questionnaire.
*, $p < 0.05$ **, $p < 0.01$.
DASS 21, Depression, Stress and Anxiety Scale.
SCOPA- Sleep, Scales for Outcomes in Parkinson's Disease – Sleep.

Table 5. Comparison of variables related to NEQ score greater than 25 by linear regression analysis.

					95.0% Confidence Interval for B		Collinearity Statistics	
	Independent Variable	Standardized Coefficients	t	p	Lower Bound	Upper Bound	Tolerance	VIF
Girls	DASS- Depression	0.354	2.942	0.004**	0.009	0.046	0.487	2.054
	DASS- stress	0.301	2.503	0.014*	0.006	0.049	0.487	2.054
Boys	SCOPA-Total	0.399	3.857	<0.001**	0.015	0.046	0.944	1.059
	DASS- Depression	0.270	2.616	0.011*	0.008	0.056	0.944	1.059
All	DASS-Depression	0.357	5.040	<0.001**	0.020	0.046	0.856	1.168
adolescent	SCOPA-Total	0.295	4.157	<0.001**	0.012	0.033	0.856	1.168

NEQ. Night Eating Questionnaire.
*. $p < 0.05$ **. $p < 0.01$.
DASS 21. Depression. Stress and Anxiety Scale.
SCOPA- Sleep. Scales for Outcomes in Parkinson's Disease – Sleep.
Dependent Variable: those who are over 25 and below 25 from the NEQ scale.

adolescent girls, DASS scores for depression and SCOPA total scores were related to NEQ > 25 in adolescent boys ($p < 0.05$; Table 5). Factors associated with NEQ > 25 in all adolescents were DASS depression and SCOPA total score ($p < 0.05$; Table 5).

Mediation model test

We used a mediator regression analysis generated by Preacher and Hayes to determine whether night eating symptoms influence disordered eating attitudes through insomnia and daytime sleepiness (Preacher & Hayes, 2004). The models were bootstrapped 5000 times to avoid non-normality. Also, the bootstrap bias-corrected and accelerated procedure was preferred to obtain more reliable results (Hayes 2017). Demographic data, such as age, sex were used as covariates in a multiple mediation analysis model.

In model 1, we found that SCOPA-insomnia (difficulty falling asleep in the past month, inability to fall asleep), scores had a direct influence on the NES scores (β = 0.59; SE = 0.10 95% CI (0.39, 0.79) $p <$ 0.001), and higher insomnia scores were a statistically significant risk factor for elevated NES scores. When mediator influences were examined, the indirect influence of the SCOPA-insomnia on the NES scores via DASS anxiety (β=-0.03; 95% CI (−0.17, 0.09) $p > 0.05$), DASS-21- depression (β = 0.13; 95% CI (0.38, 0.26) $p < 0.05$), DASS-21- stress (β = 0.11; 95% CI (0.03, 0.26) $p < 0.05$). The meditation regression model is illustrated in Figure 1.

In model 2, we found that SCOPA-daytime sleepiness scores (falling asleep very quickly, or staying awake), had a direct influence on the NES scores (β = 0.39; SE = 0.10 95% CI (0.18,

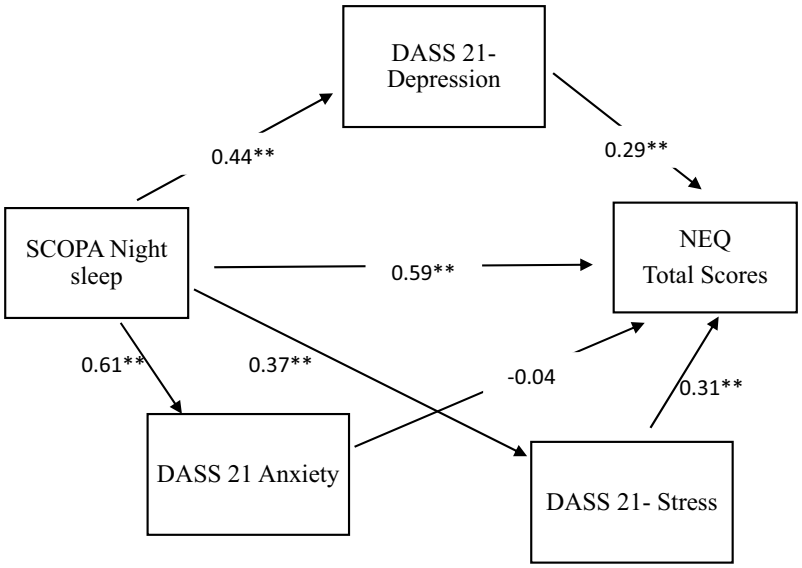

Figure 1. Model 1. The diagram represents associations between the NES and SCOPA Night sleep scores. In the multiple mediation model age, sex were covariates which were not illustrated in the diagram. NEQ= Night Eating Questionnaire DASS 21= Depression, Stress and Anxiety Scale SCOPA=Sleep, Scales for Outcomes in Parkinson's Disease – Sleep Note. *: $p < 0.05$; **: $p < 0.01$.

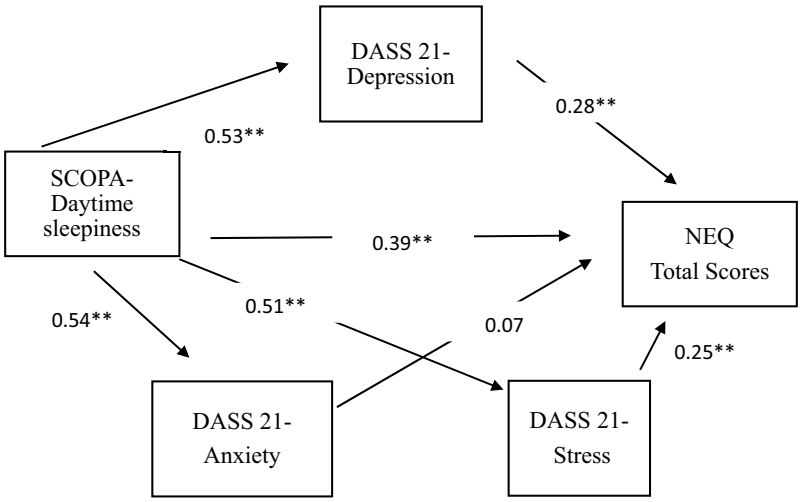

Figure 2. Model 2. The diagram represents associations between the NES and SCOPA-Daytime sleepiness. In the multiple mediation model age, sex were covariates which were not illustrated in the diagram. NEQ= Night Eating Questionnaire DASS 21= Depression, Stress and Anxiety Scale SCOPA=Sleep, Scales for Outcomes in Parkinson's Disease – Sleep Note *: $p < 0.05$; **: $p < 0.01$.

0.60) $p < 0.001$), and higher daytime sleepiness scores were a statistically significant risk factor for elevated NES scores. When mediator influences were examined, the indirect influence of the SCOPA- daytime sleepiness on the NES scores via DASS anxiety ($\beta = 0.04$; 95% CI (−0.06, 0.14) $p > 0.05$), DASS-21- depression ($\beta = 0.15$; 95% CI (0.05, 0.27) $p < 0.05$), DASS-21- stress ($\beta = 0.13$; 95% CI (0.02, 0.27) $p < 0.05$). The meditation regression model is illustrated in Figure 2.

Discussion

This study aimed to enhance our understanding of the association between sleep quality and NES. Specifically, we examined whether NES in adolescents was associated with sleep problems and depression, anxiety, and stress, which have different influence on NES symptoms according to gender. Furthermore, a mediation regression analysis was performed to determine the indirect influence of insomnia and daytime sleepiness on NES through anxiety, depression, and stress symptoms. The results provide several noteworthy findings.

Psychosocial stressors may exacerbate NES symptoms; specifically, NES symptoms were found to occur in patients during stressful times, and stress was more pronounced in individuals who ate at night (Lundgren et al. 2008; Macht and Simons 2011; Torres and Nowson 2007). Some studies have noted that emotional eating, which is not caused by hunger, mealtimes, or social needs but is a response to negative emotions, is associated with NES (Macht and Simons 2011). Emotional eating is often associated with low self-esteem, feelings of inadequacy, and eating disorders (Nguyen-Rodriguez, Unger, and Spruijt-Metz 2009). Emotional eating behaviors are more common during unplanned snacks than meals. Therefore, it was inferred that people with snacking behavior use food to regulate their emotions (Gianini, White, and Masheb 2013).

NES has also been associated with depressed mood. Individuals with NES generally are more depressed than controls, and their moods often worsen in the evening and nighttime (Allison et al. 2010; Birketvedt et al. 1999). In our study, NES symptoms were related to stress, anxiety, and depression in both boys and girls. This relationship was maintained when all adolescents were evaluated together.

Furthermore, when factors related to the NES cutoff score were assessed, it was found through regression analysis that depressive symptoms were associated with increased NES symptoms in adolescents. These findings are consistent with the existing literature (Farhangi 2019; Gluck, Geliebter, and Satov 2001; Salman and Kabir 2022). In contrast to boys, increased stress was associated with NES in girls. One of our findings related to stress is that both boys and girls who suffer from obesity describe more stress than their normal-weight peers. Studies investigating the effect of stress on individuals have reported that intense and chronic stress, perceived or uncontrollable, may cause problems such as anxiety, depressive and psychosomatic disorders, substance abuse, obesity, and metabolic syndromes (Cooper et al. 1997; Gluck, Geliebter, and Satov 2001; Jinbo et al. 2018). In addition, it is thought that chronic stress may contribute to obesity in children and adults through both behavioral and biological mechanisms (Pervanidou and Chrousos 2011). Pervanidou et. showed that children with chronic stress or suffering from anxiety, post-traumatic stress disorder, or depression have high peripheral cortisol (Pervanidou and Chrousos 2011; Pervanidou et al. 2007). The abnormal cortisol and catecholamine secretion in individuals with these disorders may lead to the development of obesity and obesity-related morbidities (Pervanidou and Chrousos 2011). DASS-anxiety subscale scores were found to be higher in girls than boys. This finding is in line with numerous studies showing that anxiety symptoms are more common in girls (Willis and Gregory 2015). However, in this study, anxiety was not associated with an increase in NES in either girls or boys.

In addition, the mood/sleep subscale of the NEQ scale was also associated with increased weight in girls. In the mood/sleep subscale, questions regarding difficulty falling asleep, eating to sleep, and worsening mood at night are asked (Allison et al. 2008). There is evidence to suggest that obesity can contribute to depressed mood and that depressed mood can also contribute to obesity and excessive weight gain (Markowitz, Friedman, and Arent 2008). It is thought that obesity may increase the risk of depression because it can increase body image dissatisfaction, affect physical health, and impair functionality (Faith et al. 2004). In depression, problems such as eating to regulate mood can increase the risk of obesity. The relationship is considered to be bidirectional (Markowitz, Friedman, and Arent 2008). In some studies on the bidirectional relationship between obesity and depression, it has been

shown that the relationship between depressed mood and obesity only exists among girls (Anderson et al. 2011). In our research, the mood/sleep subscale was associated with increased BMI only in girls.

When the BMI ratios of girls and boys together were calculated and divided into two groups, that is, normal weight, and obese and overweight, we observed that NES symptoms were not associated with weight. However, when boys and girls were evaluated separately, NES symptoms were associated with body weight status in girls. Consistent with studies showing that NES is more common in boys, we found that NES and nocturnal ingestion were more common in adolescent boys (Farhangi 2019).

In our study, NES symptoms were found to be related to problems falling asleep and daytime sleepiness in both boys and girls. This association persisted when all adolescents were evaluated together. In addition, when factors related to the NES cutoff score were evaluated, it was found through regression analysis that sleep problems increased NES symptoms in girl and boy adolescents. These findings are consistent with the existing literature (Vetrugno et al. 2006; Farhangi 2019). Polysomnography studies examining the relationship between NES and sleep examined the sleep patterns of individuals with NES. Patients were found to awaken more frequently, most of which were related to eating (Lundgren et al. 2008; O'reardon John et al. 2004; Vetrugno et al. 2006).

Scales associated with girls and boys scoring above or below 25 on the NEQ scale were analyzed by linear regression analysis. While DASS-stress and depression scores were associated with NEQ > 25 in adolescent girls, DASS-depression and SCOPA total sleep scores were related to adolescent boys. The difference between girls and boys was that stress in girls and sleep problems in boys was associated with NES. Depression scores showed a significant relationship with NES in both groups.When we investigated whether sleep problems directly and indirectly affected the NES through psychological factors such as anxiety, depression, and stress, we found that sleep problems were directly related to NES and indirectly through depression, and stress symptoms. Not getting enough sleep can cause you to feel more tired and stressed out, which can make you more likely to choose unhealthy foods. Sleep problems can also make anxiety and stress worse, especially if you already struggle with eating disorders. This can make it harder to make healthy food choices (Nguyen-Rodriguez, McClain, and Spruijt-Metz 2010). This findings demonstrates the importance of recognizing and supporting the ability of adolescents with NES to cope with stress and carefully examining comorbidity existence.

Conclusion

In conclusion, while NES symptoms were associated with increased stress and depressive symptoms in girls, they were associated with depression and sleep disturbances in boys. While increased BMI was found in girls with NES symptoms, this difference was not found in boys. Sleep disorders, stress, and depression were associated with NES symptoms. In mediating analysis, sleep problems directly and indirectly affected the NES symptoms through depression, and stress. These findings demonstrate the importance of recognizing and supporting the ability of adolescents with NES to cope with stress, depressive symptoms, and sleep problems, and carefully examining the prevalence of comorbidities.

Limitations

Although our study contributes to the literature, it has some limitations. First, due to the cross-sectional analysis, causal and temporal relationships cannot be precisely determined. Longitudinal and experimental studies are required to confirm the causal mechanisms. Second, the generalizability of the study was limited due to the small sample size. Future studies should use a broader sample and replicate this study. Third, data collection in this study was based on self-report responses via the Internet. Self-report can result in limited objectivity. The use of objective methods, such as actigraphy, to determine sleep disturbance would be more helpful in generalizing the results of this study. There is no study conducted with adolescents using SCOPA in our country. The use of another scale with validity and reliability studies in adolescents instead of this scale could increase the power of the study. The use of SCOPA Sleep instead of another scale is one of the limitations of our study.

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Notes on contributors

Ummugulsum Gundogdu is Associate Professor of Child and Adolescent Psychiatry at Marmara University Faculty of Medicine. Her research focuses on neurobiological psychiatry. She predominantly works on executive functions and perception skills.

Ayse Burcu Erdogdu Yildirim is a Child and Adolescent Psychiatry Professor at Marmara University Faculty of Medicine. Her research has focused on psychopathologies and sexual dissatisfaction in children and adolescents.

ORCID

Ummugulsum Gundogdu http://orcid.org/0000-0001-6327-4808

Data sharing and declaration

The data supporting the findings of this study are available upon reasonable request from the corresponding author.

Ethical approval

Research procedures complied with universal ethical standards and the tenets of the Helsinki Declaration of 1975, as revised in 2000. Ethics Committee of the Bolu Izzet Baysal Training and Research Hospital, Bolu, Turkey approved the study by the protocol number 227/2021. Informed consent was obtained from all participants via the survey website.

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