Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Sleep quality and the association between ADHD symptoms and night eating symptoms in candidates for metabolic and bariatric surgery: a cross-sectional study

Sümeyye Tuğçe Firidin Bülbül

sfiridin08@gmail.com

Psychiatry Clinic, Kocaeli City Hospital

Büşra Söylemez Karakuş

Psychiatry Clinic, Kocaeli City Hospital

Beyza Türk

Kocaeli University Hospital

Elif Tatlıdil

Kocaeli University Hospital

Research Article

Keywords: night eating syndrome, attention-deficit/hyperactivity disorder, sleep quality, metabolic and bariatric surgery, mediation analysis

Posted Date: November 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11599728/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Sleep quality and the association between ADHD symptoms and night eating symptoms in candidates for metabolic and bariatric surgery: a cross-sectional study

Sümeyye Tuğçe Firidin Bülbül[1], Büşra Söylemez Karakuş[1,2], Beyza Türk[3], Elif Tatlıdil[3]

[1]Psychiatry Clinic, Kocaeli City Hospital, Kocaeli, Turkey

[2]Department of Neuroscience, Bilkent University, Ankara, Türkiye

[3]Department of Psychiatry, Kocaeli University Hospital, Kocaeli, Türkiye

[*]**Correspondence:**

Sümeyye Tuğçe Firidin Bülbül

Akif Street, No. 63, Tavşantepe Neighbourhood, Kocaeli City Hospital

41060 İzmit/Kocaeli, Türkiye

Email: sfiridin08@gmail.com

Phone: +90 5417792418

Background

Night eating syndrome (NES) and attention-deficit/hyperactivity disorder (ADHD) are overrepresented among candidates for metabolic and bariatric surgery, and disturbed sleep is common to both. We estimated the frequency of NES and positive ADHD screening and tested whether sleep quality statistically accounted for the association between ADHD symptoms and night eating.

Methods

In this cross-sectional study, 75 adults evaluated at the psychiatry outpatient clinic of a university hospital before metabolic and bariatric surgery (80% women; mean age 41.5 years) completed the Night Eating Questionnaire, Adult ADHD Self-Report Scale, Pittsburgh Sleep Quality Index and Eating Attitudes Test-40. Depressive symptoms were rated by the interviewing clinician with the Montgomery–Åsberg Depression Rating Scale. Analyses included group comparisons, correlations, hierarchical regression and mediation models with bias-corrected and accelerated bootstrap confidence intervals (5000 resamples).

Results

Night eating syndrome was identified in 33.3% of participants, a positive ADHD screen in 38.7%, and poor sleep in 48.0%. Higher ADHD symptom scores were associated with higher night eating scores (adjusted b = 0.211, p = .012), but this association decreased by 43% and became non-significant when sleep quality was added (b = 0.121, p = .148), while poorer sleep quality was a significant predictor (b = 0.715, p = .002). ADHD symptoms had a significant indirect effect on night eating through sleep quality (b = 0.092, 95% CI 0.042 to 0.170; about 46% of the total effect), with a non-significant direct effect. Indirect effects

through depressive symptoms (p = .076) and eating attitudes (p = .162) were not significant. Subjective sleep quality and sleep disturbance, but not sleep duration or habitual sleep efficiency, were associated with both night eating and ADHD symptoms after Bonferroni correction.

Conclusions

Night eating syndrome and positive ADHD screening were common among candidates for metabolic and bariatric surgery, and the cross-sectional association between ADHD symptoms and night eating was largely accounted for by subjective sleep quality rather than sleep duration. The design cannot establish temporal order, and the small single-centre sample limits generalisability. ADHD and sleep assessment may merit consideration in preoperative evaluation, pending prospective confirmation.

Keywords: night eating syndrome; attention-deficit/hyperactivity disorder; sleep quality; metabolic and bariatric surgery; mediation analysis

Plain English Summary

Some people who are preparing for weight-loss surgery eat a lot at night or wake up to eat. This pattern is called night eating syndrome. Attention-deficit/hyperactivity disorder (ADHD), which affects attention, activity levels and impulse control, is also thought to be more common in people seeking this surgery. Poor sleep is common in both conditions.

We asked 75 adults who came for a psychiatric assessment before weight-loss surgery to complete questionnaires about night eating, ADHD symptoms, sleep, eating attitudes and mood. About one in three showed signs of night eating syndrome, and nearly four in ten showed signs of ADHD on a screening questionnaire. People with more ADHD symptoms tended to eat more at night. Much of this link appeared to be related to how well people felt they slept, rather than how many hours they slept.

Because we looked at people at one point in time, we cannot say that one thing causes another. Our findings suggest that asking about ADHD symptoms and sleep before weight-loss surgery may be worthwhile, and that larger studies following people over time are needed.

1. Background

For individuals with severe obesity, metabolic and bariatric surgery (MBS) remains the most effective intervention, producing greater long term weight loss and more favourable cardiometabolic outcomes than medical treatment [1, 2]. Recurrent weight gain nevertheless remains common: in a systematic review of more than 13,000 patients, approximately one in six experienced clinically significant recurrent weight gain (at least 10% from nadir weight), with emotional eating, binge eating and loss of control while eating among the most consistently identified contributors [3]. These findings have directed attention to the preoperative identification of eating pathology.

Night eating syndrome (NES) is characterised by evening hyperphagia, food consumption during nocturnal awakenings, morning anorexia and insomnia, and is currently classified within the Other Specified Feeding or Eating Disorders category of the DSM-5 [4, 5]. Reported prevalence varies widely across MBS samples, from 6% to 64% [6], with recent studies converging on approximately one third of candidates and postoperative patients [7, 8]. Patients with NES presenting for obesity treatment show elevated eating disorder pathology and more frequent depressive symptoms [9], and night eating has been linked to less favourable surgical outcomes: night eating scores were higher in patients with recurrent weight gain after MBS [10] and were associated with lower percentage total weight loss six months after sleeve gastrectomy [11].

ADHD is a neurodevelopmental condition characterised by inattention, hyperactivity and impulsivity, with a pooled adult prevalence of 3.10% [12]. Among adults receiving obesity treatment, 27.4% met ADHD criteria, rising to 42.6% at a body mass index of 40 kg/m² or higher [13], whereas a recent meta-analysis of MBS candidates reported pooled prevalence estimates of 8.94% to 9.90%, depending on the case definition applied [14]. ADHD may also be relevant to surgical outcomes: a meta-analysis found no difference in postoperative body

mass index but poorer postoperative follow-up attendance in patients with ADHD [15], and adolescents with ADHD followed for ten years after MBS showed lower weight loss, a return of binge eating to preoperative levels and higher attrition [16].

Individuals with ADHD appear prone to binge-type and loss-of-control eating, and the impulsivity inherent in the disorder may contribute to disordered eating behaviours [17]. Adults with ADHD show elevated rates of night eating syndrome and disordered eating attitudes [18], and university students meeting NES criteria were four times more likely to report a lifetime ADHD diagnosis [19]. Impulsivity scores were higher in MBS candidates with elevated night eating scores [8], and impulsivity predicted night eating in a study of 210 university students [20].

Sleep may link the two conditions. NES is conceptualised as a circadian misalignment in which food intake is delayed relative to the sleep wake cycle, with insomnia part of its defining picture [4, 21]. Poorer sleep quality has been repeatedly associated with night eating in adults [22] and predicts night eating in preoperative MBS candidates independently of body mass index and physical activity [23]. In ADHD, delayed sleep phase disorder is reported in 73% to 78% of children and adults [24, 25], and low dose melatonin advanced the circadian phase and reduced ADHD symptoms by 14% in a randomised trial [26]. These findings raise the possibility that disturbed sleep is a shared pathway through which ADHD symptoms translate into night eating, a question not previously examined in candidates for MBS.

The present study therefore had three aims: to determine the prevalence of NES and the rate of ADHD screening positivity among candidates for MBS; to examine the association between ADHD symptoms and night eating behaviour in this population; and to test whether sleep quality statistically accounted for part of this cross-sectional association. We hypothesised that both conditions would be more prevalent than in the general adult population, that ADHD

symptoms would be positively associated with night eating, and that sleep quality would account for a substantial part of this association.

2. Methods

Ethical approval for this study was obtained from the institutional non-invasive clinical research ethics committee. The study sample consisted of 75 patients who applied to the psychiatry outpatient clinic of a university hospital for pre-operative evaluation for MBS. Eligible participants were MBS candidates aged 18 to 65 years with a body mass index (BMI) of 30 kg/m^2 or higher, in good general medical condition, who provided written informed consent. Patients were excluded if they had intellectual disability, dementia or another cognitive impairment, were currently in an acute psychotic episode, or were pregnant.

2.1.Measures

The Night Eating Questionnaire (NEQ), developed by Allison et al., is a 14-item screening tool with skip logic for participants who do not report nocturnal awakenings or nocturnal snacking [27]. The Turkish validity and reliability study was conducted by Atasoy et al.; using a cut-off score of 18, the Turkish version demonstrated 90.7% sensitivity and 73.8% specificity [28].

Adult ADHD symptoms were screened using the 18-item Adult ADHD Self-Report Scale (ASRS) v1.1 Symptom Checklist, a self-report measure based on the 18 DSM-IV Category A symptoms. The Turkish version of the scale was translated and adapted by Doğan et al. Items are rated on a 5-point Likert scale ranging from 0 (*never*) to 4 (*very often*). Inattention scores were calculated from items 1–4 and 7–11, whereas hyperactivity/impulsivity scores were calculated from items 5, 6, and 12–18. A total score of 24, the cut-off established for the original version of the scale, was used to identify a positive ADHD screen [29, 30].

The Montgomery-Asberg Depression Rating Scale (MADRS) consists of 10 items covering the core symptoms of depression; the Turkish validity and reliability study was conducted by Özer et al. [31]. Scores were analysed dimensionally and not categorised into severity bands.

The Pittsburgh Sleep Quality Index (PSQI), developed by Buysse et al. and adapted into Turkish by Ağargün et al., assesses subjective sleep quality [32, 33]. Global scores are the sum of the seven subscale scores, and a global score greater than 5 distinguishes poor from good sleepers.

The Eating Attitudes Test (EAT-40), developed by Garner and Garfinkel and adapted into Turkish by Savaşır and Erol, screens for disordered eating attitudes; the original cut-off is 30 [34, 35]. The sociodemographic form and the EAT-40 are part of the routine preoperative screening battery administered to MBS candidates at our centre; the PSQI and the MADRS were added for this study to assess sleep disturbance and depressive symptoms as potential confounders.

2.2.Procedure

All study procedures were conducted between March 28, 2024, and April 15, 2025. The sociodemographic data form and the MADRS were administered and scored by the interviewing clinician; the remaining instruments were self-administered.

2.3.Statistical Analysis

Descriptive statistics were computed for all variables; there were no missing data. Normality was assessed using the Shapiro-Wilk test. Because several variables deviated from normality, groups with and without night eating syndrome were compared using Mann-Whitney U and Fisher's exact tests; effect sizes are reported as rank-biserial correlations with bootstrapped 95% confidence intervals (5,000 resamples) and as odds ratios. Bivariate associations among continuous variables were examined using Pearson correlations; because PSQI subscale scores

are ordinal, subscale associations were examined using Spearman correlations, Bonferroni-corrected for 14 comparisons.

A four-step hierarchical multiple regression analysis predicted night eating symptoms (NEQ total score), entering demographic variables (age, sex, BMI) in Step 1, ADHD symptoms (ASRS total score) in Step 2, sleep quality (PSQI) in Step 3, and depressive symptoms (MADRS) and eating attitudes (EAT-40) in Step 4; this ordering examined whether the ADHD-night eating association was attenuated once sleep quality was taken into account. Regression coefficients are reported with heteroscedasticity-consistent (HC3) standard errors and confidence intervals.

Mediation analyses examined whether sleep quality accounted for part of the association between ADHD symptoms and night eating; depressive symptoms and eating attitudes were tested as additional mediators in separate models. Indirect, direct and total effects were estimated using the mediation package in R, with bias-corrected and accelerated 95% confidence intervals based on 5,000 bootstrap resamples. All analyses were performed in R (version 4.x); significance was set at $p < .05$ (two-tailed).

3. Results

The sample comprised 75 patients (60 women, 80.0%) with a mean age of 41.45 years (SD = 12.65) and a mean BMI of 43.23 kg/m² (SD = 7.48) (Table 1). Based on the predefined cut-offs, 25 participants (33.3%) met criteria for night eating syndrome, 29 (38.7%) screened positive for ADHD, 36 (48.0%) were classified as poor sleepers, and 21 (28.0%) scored above the clinical threshold on the EAT-40.

Participants with and without NES did not differ in age, BMI, sex, or employment status (all $p > .18$). The NES+ group scored higher on the ASRS ($p = .005$), PSQI ($p = .001$) and EAT-40 ($p = .005$) and were more frequently poor sleepers (72.0% vs. 36.0%); depressive symptoms did not differ significantly ($p = .072$; Table 1).

Table 1

Sociodemographic, Clinical, and Psychometric Characteristics of the Total Sample and by Night Eating Syndrome Status

Variable	Total (*N* = 75)	NES− (*n* = 50)	NES+ (*n* = 25)	p	Effect size [95% CI]
Age (years)	41.45 ± 12.65	40.14 ± 12.81	44.08 ± 12.15	.183	−0.19 [−0.46, 0.08]
BMI (kg/m²)	43.23 ± 7.48	43.62 ± 8.09	42.45 ± 6.16	.732	0.05 [−0.24, 0.33]
Male, *n* (%)	15 (20.0)	10 (20.0)	5 (20.0)	1.000	1.00 [0.24, 3.76]
Employed, *n* (%)	32 (42.7)	22 (44.0)	10 (40.0)	.808	0.85 [0.28, 2.49]
Education, *n* (%)					
Primary/secondary	30 (40.0)	19 (38.0)	11 (44.0)	—	—
High school	24 (32.0)	18 (36.0)	6 (24.0)	—	—

Variable	Total (*N* = 75)	NES− (*n* = 50)	NES+ (*n* = 25)	p	Effect size [95% CI]
University	20 (26.7)	13 (26.0)	7 (28.0)	—	—
NEQ	16.37 ± 7.86	—	—	—	—
ASRS total	20.97 ± 12.95	18.22 ± 13.02	26.48 ± 11.12	.005	−0.40 [−0.64, −0.14]
ASRS inattention	7.17 ± 4.84	6.10 ± 4.53	9.32 ± 4.82	.007	−0.38 [−0.62, −0.13]
ASRS hyperactivity	13.80 ± 8.76	12.12 ± 9.10	17.16 ± 7.06	.011	−0.36 [−0.60, −0.10]
ADHD screen positive, *n* (%)	29 (38.7)	15 (30.0)	14 (56.0)	.044	2.92 [0.98, 9.03]
PSQI	6.15 ± 3.65	5.18 ± 3.43	8.08 ± 3.34	.001	−0.47 [−0.68, −0.25]
Poor sleepers, *n* (%)	36 (48.0)	18 (36.0)	18 (72.0)	.006	4.47 [1.45, 15.28]
MADRS	6.89 ± 7.73	5.54 ± 7.15	9.60 ± 8.29	.072	−0.25 [−0.53, 0.03]
EAT-40	24.95 ± 13.34	21.82 ± 11.39	31.20 ± 14.94	.005	−0.40 [−0.66, −0.10]
EAT-40 ≥ 30, *n* (%)	21 (28.0)	8 (16.0)	13 (52.0)	.002	5.53 [1.68, 19.58]

Note. Values are M ± SD unless otherwise indicated. ASRS = Adult ADHD Self-Report Scale; BMI = body mass index; CI = confidence interval; EAT-40 = Eating Attitudes Test; MADRS = Montgomery–Åsberg Depression Rating Scale; NEQ = Night Eating Questionnaire; NES =

night eating syndrome; PSQI = Pittsburgh Sleep Quality Index. NES was defined as NEQ ≥ 18, ADHD screening positivity as ASRS ≥ 24, poor sleep as PSQI > 5, and disordered eating attitudes as EAT-40 ≥ 30. Continuous variables were compared with Mann–Whitney U tests and categorical variables with Fisher's exact tests. Effect sizes are rank-biserial correlations for continuous variables, with the NES− group as the reference, and odds ratios for categorical variables; confidence intervals for rank-biserial correlations are bootstrapped (5,000 resamples).

3.1. Correlations Among Study Variables

NEQ scores were positively correlated with ASRS total scores (r = .33, 95% CI [.11, .52]), PSQI scores (r = .43, 95% CI [.23, .60]), MADRS scores (r = .39) and EAT-40 scores (r = .29). ASRS total scores were also correlated with PSQI scores (r = .43). Neither age nor BMI was correlated with NEQ scores (Table 2).

Table 2

Pearson Correlations Among Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. Age	—								
2. BMI	.09	—							
3. NEQ	.13	−.02	—						
4. ASRS total	−.06	−.19	.33**	—					
5. ASRS inattention	−.04	−.17	.32**	.91***	—				

Variable	1	2	3	4	5	6	7	8	9
6. ASRS hyperactivity	−.08	−.18	.31**	.97***	.80***	—			
7. MADRS	.12	.18	.39***	.22	.23*	.20	—		
8. EAT-40	.14	−.04	.29*	.17	.10	.20	−.02	—	
9. PSQI	.19	−.06	.43***	.43***	.40***	.41***	.39***	.24*	—

Note. N = 75. ASRS = Adult ADHD Self-Report Scale; BMI = body mass index; EAT-40 = Eating Attitudes Test; MADRS = Montgomery–Åsberg Depression Rating Scale; NEQ = Night Eating Questionnaire; PSQI = Pittsburgh Sleep Quality Index. * p < .05. ** p < .01. *** p < .001.

3.2. Hierarchical Regression Predicting Night Eating Symptoms

Demographic variables entered in Step 1 did not explain significant variance in NEQ scores (R^2 = .020). ASRS total scores entered in Step 2 accounted for an additional 11.6% of the variance (b = 0.211, p = .012). When sleep quality was added in Step 3, the ASRS coefficient decreased by 43% and was no longer significant (b = 0.121, p = .148), whereas PSQI scores emerged as a significant predictor (b = 0.715, p = .002). In the final model, only MADRS scores remained significant (b = 0.303, p = .014), and the full model accounted for 32.2% of the variance (Table 3).

Table 3

Hierarchical Regression Analysis Predicting NEQ Scores

Predictor	B	SE	95% CI	p
Step 1 (R^2 = .020)				
Age	0.083	0.067	[−0.049, 0.214]	.219
Sex (male)	0.825	2.653	[−4.376, 6.025]	.756

Predictor	B	SE	95% CI	p
BMI	−0.041	0.137	[−0.309, 0.227]	.763
Step 2 (R^2 = .135, ΔR^2 = .116)				
Age	0.093	0.066	[−0.036, 0.221]	.159
Sex (male)	1.167	2.401	[−3.538, 5.873]	.627
BMI	0.023	0.133	[−0.238, 0.285]	.862
ASRS total	0.211	0.083	[0.047, 0.374]	.012
Step 3 (R^2 = .219, ΔR^2 = .084)				
Age	0.049	0.065	[−0.078, 0.176]	.450
Sex (male)	0.442	2.294	[−4.054, 4.939]	.847
BMI	0.027	0.123	[−0.214, 0.269]	.825
ASRS total	0.121	0.083	[−0.043, 0.284]	.148
PSQI	0.715	0.234	[0.257, 1.173]	.002
Step 4 (R^2 = .322, ΔR^2 = .103)				
Age	0.024	0.074	[−0.121, 0.169]	.748
Sex (male)	2.009	2.284	[−2.468, 6.485]	.379
BMI	−0.046	0.129	[−0.298, 0.206]	.722
ASRS total	0.091	0.080	[−0.066, 0.247]	.259
PSQI	0.370	0.211	[−0.043, 0.784]	.079
MADRS	0.303	0.124	[0.060, 0.546]	.014
EAT-40	0.146	0.084	[−0.019, 0.311]	.083

Note. N = 75. The dependent variable is the Night Eating Questionnaire total score. Unstandardized coefficients are reported with heteroscedasticity-consistent (HC3) standard

errors and confidence intervals. ASRS = Adult ADHD Self-Report Scale; BMI = body mass index; CI = confidence interval; EAT-40 = Eating Attitudes Test; MADRS = Montgomery–Åsberg Depression Rating Scale; PSQI = Pittsburgh Sleep Quality Index.

3.3. Mediation Analysis

The total effect of ASRS scores on NEQ scores was significant (b = 0.199, p = .002). Of the three mediators tested in separate models, only sleep quality produced a significant indirect effect (b = 0.092, 95% CI [0.042, 0.170], p < .001), which corresponded to approximately 46% of the total effect; the direct effect in this model was not significant (b = 0.107, p = .096). The indirect effects through depressive symptoms and eating attitudes did not reach significance, and in both of these models the direct effect of ASRS scores remained significant (Table 4). Given the modest sample size, the proportion mediated should be interpreted with caution, and the non-significant direct path should not be taken as evidence against a direct association.

Table 4

Mediation Analyses of the Association Between ADHD Symptoms and Night Eating

Effect	Estimate	95% CI	p
Total effect (c)	0.199	[0.065, 0.360]	.002

Effect	Estimate	95% CI	p
Mediator: PSQI			
Direct effect (c′)	0.107	[−0.012, 0.280]	.096
Indirect effect (ACME)	0.092	[0.042, 0.170]	< .001
Mediator: MADRS			
Direct effect (c′)	0.155	[0.035, 0.310]	.015
Indirect effect (ACME)	0.045	[0.002, 0.140]	.076
Mediator: EAT-40			
Direct effect (c′)	0.174	[0.049, 0.340]	.010
Indirect effect (ACME)	0.026	[−0.002, 0.100]	.162

Note. N = 75. The independent variable is the ASRS total score and the dependent variable is the NEQ total score. Each mediator was tested in a separate model, so the total effect is identical across models and is reported once. Estimates are unstandardized. Confidence intervals are bias-corrected and accelerated bootstrap intervals based on 5,000 resamples. ACME = average causal mediation effect; ASRS = Adult ADHD Self-Report Scale; EAT-40 = Eating Attitudes Test; MADRS = Montgomery–Åsberg Depression Rating Scale; NEQ = Night Eating Questionnaire; PSQI = Pittsburgh Sleep Quality Index.

3.4. Exploratory Analyses: PSQI Subscales

ASRS scores were associated with subjective sleep quality, sleep latency, sleep disturbance and daytime dysfunction, and NEQ scores with subjective sleep quality and sleep disturbance; all of these associations survived Bonferroni correction for 14 comparisons. Neither sleep duration nor habitual sleep efficiency was associated with either measure (Table 5).

Table 5

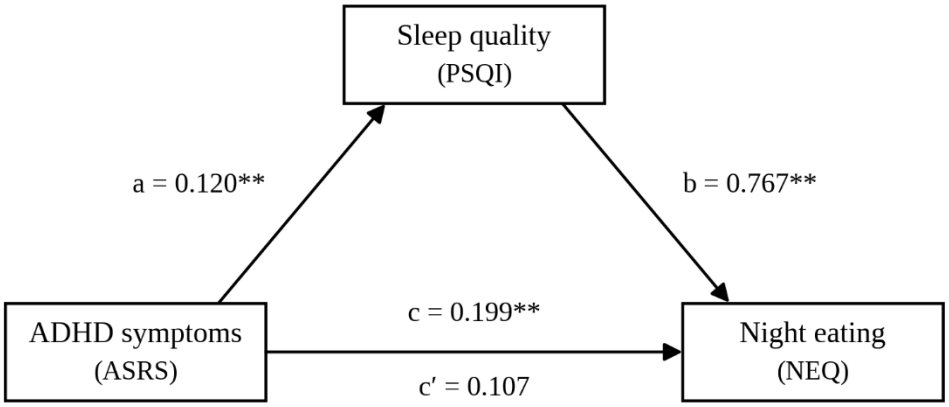
Spearman Correlations Between PSQI Subscale Scores and Night Eating and ADHD Symptoms

PSQI subscale	NEQ ρ	p	Adjusted p	ASRS ρ	p	Adjusted p
Subjective sleep quality	.42	< .001	.002	.41	< .001	.003
Sleep latency	.33	.004	.052	.39	< .001	.008
Sleep duration	.20	.083	1.000	.22	.064	.893
Habitual sleep efficiency	−.00	.999	1.000	.08	.476	1.000
Sleep disturbance	.35	.002	.034	.45	< .001	.001
Use of sleep medication	.29	.010	.147	.06	.627	1.000
Daytime dysfunction	.26	.026	.365	.37	.001	.016

Note. N = 75. Adjusted p values are Bonferroni-corrected for 14 comparisons. ASRS = Adult ADHD Self-Report Scale; NEQ = Night Eating Questionnaire; PSQI = Pittsburgh Sleep Quality Index.

Figure 1

Sleep Quality as a Mediator of the Association Between ADHD Symptoms and Night Eating



Note. N = 75. Values are unstandardized regression coefficients. The a path represents the effect of ASRS scores on PSQI scores, the b path the effect of PSQI scores on NEQ scores controlling for ASRS scores, c the total effect of ASRS scores on NEQ scores, and c′ the direct effect controlling for PSQI scores. The indirect effect was 0.092, 95% CI [0.042, 0.170]. ASRS = Adult ADHD Self-Report Scale; NEQ = Night Eating Questionnaire; PSQI = Pittsburgh Sleep Quality Index. ** $p < .01$.

4. Discussions

This study examined night eating syndrome, ADHD symptoms and sleep quality in MBS candidates. One third of the sample met screening criteria for NES and 38.7% screened positive for ADHD. ADHD symptoms were associated with night eating, but this association was substantially attenuated once sleep quality was taken into account, and sleep quality carried a significant indirect effect. The demographic profile (80% women, mean age 41.45 years, mean BMI 43.23 kg/m²) closely matched pooled estimates from 52 MBS studies [36].

In general population surveys the core NES behaviours are uncommon (1.5% evening hyperphagia and 2.6% nocturnal ingestion) [37], and community NEQ-based estimates range from 8.8% to 18.2% [38]. The 33.3% observed here is markedly elevated and closely matches recent MBS reports: 33.8% among post-MBS patients [7] and approximately one third of surgical candidates in a Turkish sample [8].

The ADHD screening rate of 38.7% was considerably higher than the pooled estimates of 9% to 10% in MBS candidates [14], but consistent with severe obesity: ADHD prevalence increased stepwise across obesity severity classes, highest in Obesity III (42.6%), the class corresponding to our sample's mean BMI [13]. In addition, several ASRS items overlap with features common in severe obesity and depressive states, which may inflate self-report screening rates relative to interview-based estimates. Evidence for a direct link has begun to accumulate: in a clinical biobank, NES was associated with ADHD and with insomnia [39], and among Turkish medical students, those with probable NES scored higher on both ASRS subscales and the PSQI, and ADHD symptoms and impulsivity mediated the relationship between chronotype and night eating [40]. Our findings extend this literature to MBS candidates.

Sleep quality alone carried a significant indirect effect, accounting for approximately 46% of the total effect; the indirect effects through depressive symptoms and eating attitudes did not.

This fits with the sleep disturbance reported on both sides of the association: insomnia disorder has been reported in 44.4% of adults with ADHD [41], and insomnia severity partially mediated the relationship between ADHD traits and quality of life [42]. In NES, insomnia forms part of the defining clinical picture [43], and night eating scores are higher among evening-type than morning-type individuals [44].

In the subscale analyses, neither night eating nor ADHD scores were associated with self-reported sleep duration or habitual sleep efficiency; the associations that were present involved perceived sleep quality and reported sleep disturbance, suggesting that subjective sleep disturbance, rather than short sleep duration, might connect ADHD symptoms to night eating in this population.

ADHD is not currently part of routine preoperative protocols, whereas eating disorders and depression are, despite its associations with poorer follow-up attendance and, in adolescents, lower weight loss [15, 16]. A brief instrument such as the ASRS would add little burden to a protocol that already includes several questionnaires. Nearly half the sample were poor sleepers, and sleep quality showed the largest correlation with night eating. Because much of the ADHD-night eating association was carried by sleep quality, whether targeting subjective sleep disturbance improves either outcome requires prospective study. Among 427 MBS candidates, 30.8% reported clinically significant insomnia, and preoperative sleep assessment with cognitive behavioural therapy for insomnia has been recommended [45]; our subscale findings suggest such interventions should address perceived sleep disturbance rather than duration. Given the associations of night eating with recurrent weight gain and poorer weight loss after surgery [10, 11], addressing these factors preoperatively may contribute to better long term outcomes, although this requires prospective testing.

This study has several limitations. The cross-sectional design does not allow the temporal ordering and causal relationship implied by the mediation model to be established. With the

exception of the MADRS, which was administered by a psychiatrist, the measures were self-report screening instruments, so ADHD, NES and poor sleep represent screening status rather than diagnoses, and the ADHD screening threshold has not been validated in a Turkish sample. The sample was drawn from a single centre and was 80% female. Finally, with 75 participants, statistical power was limited for all analyses, and non-significant results should be interpreted with this in mind.

5. Conclusion

Night eating syndrome and ADHD symptoms were both common among candidates for MBS, and the association between them was largely accounted for by sleep quality, specifically by its qualitative rather than quantitative dimensions. These results indicate that ADHD and sleep screening merit consideration in preoperative assessment. Whether subjective sleep disturbance is a useful therapeutic target alongside night eating itself remains to be established. Prospective studies incorporating objective sleep measures, chronotype assessment and postoperative weight outcomes are needed to test whether intervening on this pathway improves surgical results.

List of Abbreviations

ACME: average causal mediation effect

ADHD: Attention-Deficit/Hyperactivity Disorder

ASRS: Adult ADHD Self-Report Scale

BMI: Body Mass Index

CI: Confidence Interval

DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition

DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition

EAT-40: Eating Attitudes Test-40

HC3: Heteroscedasticity-Consistent Standard Error Estimator (Type 3)

M: Mean

MADRS: Montgomery–Åsberg Depression Rating Scale

MBS: Metabolic And Bariatric Surgery

NEQ: Night Eating Questionnaire

NES: Night Eating Syndrome

PSQI: Pittsburgh Sleep Quality Index

SD: Standard Deviation

SE: Standard Error

Declarations

Ethics approval and consent to participate

The study was approved by the Kocaeli University Non-Invasive Clinical Research Ethics Committee (approval date: 28 March 2024; project no. 2024/174). All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants.

Consent for publication: Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author on reasonable request. They are not publicly available because of privacy restrictions on patient information**.**

Competing interests: The authors declare that they have no competing interests.

Funding: No funding was received for this study.

Authors' contributions: ET and STFB conceived and designed the study. BT and STFB collected the data. BSK and STFB performed the statistical analysis and interpreted the results. BSK and STFB wrote the manuscript. ET and BT critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements: Not applicable.

6. References

1. Cui B, He J, Yao H. Effects of metabolic bariatric surgery on weight loss and diabetes remission over 10 years: a network meta-analysis of randomized controlled trials. Obes Surg. 2026;36(4):1786-96.
2. Pipek LZ, Moraes WAF, Nobetani RM, Cortez VS, Condi AS, Taba JV, et al. Surgery is associated with better long-term outcomes than pharmacological treatment for obesity: a systematic review and meta-analysis. Sci Rep. 2024;14(1):9521.
3. Athanasiadis DI, Martin A, Kapsampelis P, Monfared S, Stefanidis D. Factors associated with weight regain post-bariatric surgery: a systematic review. Surg Endosc. 2021;35(8):4069-84.
4. Muscatello MRA, Torre G, Celebre L, Dell'Osso B, Mento C, Zoccali RA, et al. 'In the night kitchen': a scoping review on the night eating syndrome. Aust N Z J Psychiatry. 2022;56(2):120-36.
5. Salman EJ, Kabir R. Night eating syndrome. [Updated 2022 Sep 14]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-.
6. Lavery ME, Frum-Vassallo D. An updated review of night eating syndrome: an under-represented eating disorder. Curr Obes Rep. 2022;11(4):395-404.
7. Almuammar S, Aljaaly E, Alqarni L, Alazwari H, Alsubhi R, Alatawi N. Evaluating night-eating syndrome in bariatric surgery patients: a cross-sectional study. BMC Res Notes. 2024;17(1):118.

8. Şahin Can M, Çay F. Frequency of night eating syndrome and its relationship with impulsivity in bariatric surgery candidates. J Transl Pract Med. 2023;2(2):64-8.
9. Kaur J, Dang AB, Gan J, An Z, Krug I. Night eating syndrome in patients with obesity and binge eating disorder: a systematic review. Front Psychol. 2022;12:766827.
10. Ünal Ş, Sevinçer GM, Maner AF. Prediction of weight regain after bariatric surgery by night eating, emotional eating, eating concerns, depression and demographic characteristics. Turk Psikiyatri Derg. 2019;30(1):31-41.
11. Ivezaj V, Lawson JL, Lydecker JA, Duffy AJ, Grilo CM. Examination of night eating and loss-of-control eating following bariatric surgery. Eat Weight Disord. 2022;27(1):207-13.
12. Ayano G, Tsegay L, Gizachew Y, Necho M, Yohannes K, Abraha M, et al. Prevalence of attention deficit hyperactivity disorder in adults: umbrella review of evidence generated across the globe. Psychiatry Res. 2023;328:115449.
13. Altfas JR. Prevalence of attention deficit/hyperactivity disorder among adults in obesity treatment. BMC Psychiatry. 2002;2:9.
14. Caci H, Chierici A, Iannelli A. Attention-deficit/hyperactivity disorder in adolescent and adult candidates for metabolic and bariatric surgery: a systematic review and meta-analysis. Obes Rev. 2024;25(10):e13802.
15. Mocanu V, Tavakoli I, MacDonald A, Dang JT, Switzer N, Birch DW, et al. The impact of ADHD on outcomes following bariatric surgery: a systematic review and meta-analysis. Obes Surg. 2019;29(4):1403-9.
16. Björk A, Dahlgren J, Gronowitz E, Bruze G, Wentz E, Flodmark CE, et al. Attention-deficit/hyperactivity disorder, self-reported mental health, and weight loss 10 years after metabolic-bariatric surgery during adolescence. Obes Facts. 2025. doi:10.1159/000550210.

17. Ziobrowski H, Brewerton TD, Duncan AE. Associations between ADHD and eating disorders in relation to comorbid psychiatric disorders in a nationally representative sample. Psychiatry Res. 2018;260:53-9.
18. Gürbüzer N, Ceyhun HA, Öztürk N, Kasali K. The relationship between eating-attitudes and clinical characteristics, agouti-related peptide, and other biochemical markers in adult-attention deficit hyperactivity disorder. J Atten Disord. 2023;27(4):394-409.
19. Runfola CD, Allison KC, Hardy KK, Lock J, Peebles R. Prevalence and clinical significance of night eating syndrome in university students. J Adolesc Health. 2014;55(1):41-8.
20. Sevincer GM, Ince E, Taymur I, Konuk N. Night eating syndrome frequency in university students: association with impulsivity, depression, and anxiety. Klin Psikofarmakol Bul. 2016;26(3):238-47.
21. Blouchou A, Chamou V, Eleftheriades C, Poulimeneas D, Kontouli KM, Gkiouras K, et al. Beat the clock: assessment of night eating syndrome and circadian rhythm in a sample of Greek adults. Nutrients. 2024;16(2):187.
22. Sakthivel SJ, Hay P, Mannan H. A scoping review on the association between night eating syndrome and physical health, health-related quality of life, sleep and weight status in adults. Nutrients. 2023;15(12):2791.
23. Costa RLV, Carvalhal MMdL, Conceição EM, Silva SECd, Freire SCV, Souza YDdES, et al. Sleep quality and suggestive behaviors of night eating syndrome in candidates for bariatric surgery. Bariatr Surg Pract Patient Care. 2026;21(2):101-7.
24. Bijlenga D, Vollebregt MA, Kooij JS, Arns M. The role of the circadian system in the etiology and pathophysiology of ADHD: time to redefine ADHD? Atten Defic Hyperact Disord. 2019;11(1):5-19.

25. Bondopadhyay U, Diaz-Orueta U, Coogan AN. The role of the circadian system in attention deficit hyperactivity disorder. Adv Exp Med Biol. 2021;1344:113-27.
26. van Andel E, Bijlenga D, Vogel SW, Beekman AT, Kooij JS. Effects of chronotherapy on circadian rhythm and ADHD symptoms in adults with attention-deficit/hyperactivity disorder and delayed sleep phase syndrome: a randomized clinical trial. Chronobiol Int. 2021;38(2):260-9.
27. Allison KC, Lundgren JD, O'Reardon JP, Martino NS, Sarwer DB, Wadden TA, et al. The Night Eating Questionnaire (NEQ): psychometric properties of a measure of severity of the night eating syndrome. Eat Behav. 2008;9(1):62-72.
28. Atasoy N, Saraçlı Ö, Konuk N, Ankaralı H, Güriz SO, Akdemir A, et al. Gece Yeme anketi-Türkçe formunun psikiyatrik ayaktan hasta popülasyonunda geçerlilik ve güvenilirlik çalışması. Anadolu Psikiyatri Derg. 2014;15(3):238-47.
29. Kessler RC, Adler L, Ames M, Demler O, Faraone S, Hiripi E, et al. The World Health Organization Adult ADHD Self-Report Scale (ASRS): a short screening scale for use in the general population. Psychol Med. 2005;35(2):245-56.
30. Doğan S, Öncü B, Varol Saraçoğlu G, Küçükgöncü S. Erişkin dikkat eksikliği hiperaktivite bozukluğu kendi bildirim ölçeği (ASRS-v1.1): Türkçe formunun geçerlilik ve güvenilirliği. Anadolu Psikiyatri Derg. 2009;10(2):77-87.
31. Özer SK, Demir B, Tuğal Ö, Kabakçı E. Montgomery-Åsberg depresyon değerlendirme ölçeği: değerlendiriciler arası güvenilirlik ve geçerlik çalışması. Turk Psikiyatri Derg. 2001;12(3):185-94.
32. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.

33. Ağargün MY, Kara H, Anlar Ö. The validity and reliability of the Pittsburgh Sleep Quality Index. Turk Psikiyatri Derg. 1996;7:107-15.
34. Garner DM, Garfinkel PE. The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. Psychol Med. 1979;9(2):273-9.
35. Savasir I, Erol N. Eating attitude test: anorexia nervosa symptom index. Psikoloji Derg. 1989;7:19-25.
36. Dawes AJ, Maggard-Gibbons M, Maher AR, Booth MJ, Miake-Lye I, Beroes JM, et al. Mental health conditions among patients seeking and undergoing bariatric surgery: a meta-analysis. JAMA. 2016;315(2):150-63.
37. Matsui K, Komada Y, Okajima I, Takaesu Y, Kuriyama K, Inoue Y. A cross-sectional study of evening hyperphagia and nocturnal ingestion: core constituents of night eating syndrome with different background factors. Nutrients. 2021;13(11):4179.
38. Tzischinsky O, Latzer Y. Night eating syndrome prevalence and its association with sleep quality, eating patterns, and psychopathology in an Israeli community sample. Soc Psychiatry Psychiatr Epidemiol. 2025;60(12):2859-69.
39. Wilcox H, Saxena R, Winkelman JW, Dashti HS. Clinical and genetic associations for night eating syndrome in a patient biobank. J Eat Disord. 2024;12(1):211.
40. Yucel M, Uzdil EK, Batur B, Ozkan Yaman N, Oksuz Z, Kose Kaya B, et al. Investigating the prevalence of probable night eating syndrome among preclinical medical students and the mediating role of impulsivity in its relationship with chronotype. Chronobiol Int. 2025;42(2):270-81.
41. Fadeuilhe C, Daigre C, Richarte V, Grau-López L, Palma-Álvarez RF, Corrales M, et al. Insomnia disorder in adult attention-deficit/hyperactivity disorder patients: clinical, comorbidity, and treatment correlates. Front Psychiatry. 2021;12:663889.

42. Nair S, Deshpande N, Hill C, Cortese S, Van Someren EJ, Chellappa SL. Associations of ADHD traits, sleep/circadian factors, depression and quality of life. BMJ Ment Health. 2025;28(1):e301625.
43. Townsend AB. Night eating syndrome. Holist Nurs Pract. 2007;21(5):217-21.
44. Kurnaz S, Kandeger A. Do chronotype differences and night eating syndrome affect dental health? Int J Dent Hyg. 2020;18(4):378-83.
45. Salwen-Deremer JK, Schreyer C, Hymowitz GF, Montanari A, Smith MT, Coughlin JW. Sleep disturbance and insomnia in individuals seeking bariatric surgery. Surg Obes Relat Dis. 2020;16(7):940-7.