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Relationship Between Sleep Disorders and Attention Deficit-Hyperactivity Disorder Symptoms in University Students

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SUMMARY

Objective: Sleep disorders increase the symptoms of attention deficit hyperactivity disorder (ADHD). The aim of this study was to investigate whether or not sleep related problems give rise to symptoms of attention deficit and hyperactivity-impulsivity in university students.

Methods: The 252 university students between the ages of 18-25 years included in the study were assessed on the Pittsburgh Sleep Quality Index (PSQI), the Adult Attention-Deficit Hyperactivity Disorder Scale, the Beck Depression Inventory (BDI) and the Beck Anxiety Inventory (BAI).

Results: The participants of the study comprised 38.5% males and 61.5% females with a mean age of 22.39 (±1.93) years. The mean score data were 5.78 (± 2.72) on the PSQI, 41.77 (± 20.38) on the Adult Attention-Deficit Hyperactivity Disorder Scale, 8.53 (± 6.97) on the BDI and 9.05 (± 7.92) on the BAI. The total score and the scores on the attention-deficit and the general problems subsections of the Adult Attention-Deficit Hyperactivity Disorder Scale were significantly higher in participants with poor sleep quality (P<0.001). The PSQI and the Adult Attention-Deficit Hyperactivity Disorder Scale scores were significantly above the cut-off values in the participants with depression and anxiety symptoms as compared to those without these symptoms (P<0.001). The PSQI total score positively correlated with the Adult Attention-Deficit Hyperactivity Disorder Scale total score (P<0.001).

Conclusion: University students with sleep disorder have more ADHD symptoms and poor quality of sleep increase ADHD sypmtoms. Therefore it's important to evaluate quality of sleep in young people suffering from attention problems in terms of treatment approaches and interventions.

Keywords: Attention deficit-hyperactivity disorder, sleep disorder, sleep quality

INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is the most frequently diagnosed neuropsychiatric disorder in children (Feldman and Reiff, 2014). The incidences of childhood ADHD symptoms persisting to adulthood have been reported to vary in the 4%–60% range (Biederman et al. 2000, Rasmussen and Gillberg 2000, Kessler et al. 2006).

Sleep problems are comorbid with ADHD from infantility to adulthood (Rasmussen and Gillberg 2000; Kessler et al. 2006, Lin et al.2016, Snitselaar et al. 2017). A meta-analysis reported that problems of sleep onset difficulties, daytime sleepiness and breathing related sleep disorders are common in children and adolescents diagnosed with ADHD (Cortese et al.2009). Prolonged latency of sleep onset and difficulties associated with maintaining sleep, waking up late in the morning and circadian rhythm disturbances are reported to be common in patients diagnosed with adult ADHD (Snitselaar et al.2017).

There are reports in the literature on the relationship between symptoms of attention deficits and sleep disturbance in the non-clinical members of the general population. Significant relationship was found between ADHD symptoms and insomnia in 148 university students (Kass et al. 2003). Significant relationship between hyperactivity and poor sleep quality, long sleep onset latency, short sleep duration and more sleeping medication use was also shown in university students by other researchers (Berker et al. 2014). A community based study on the relationship between sleep problems and

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ADHD reported shortened sleep duration and time spent in bed, delay in sleeping hours, prolonged sleep onset latency and increased incidence of waking up during the night in adolescents with high ADHD scores and frequent complaints of sleepiness and fatigue symptoms (Hysing et al.2016).

Just as sleep problems are frequently met in ADHD, sleep problems also cause the emergence or increase of ADHD symptoms (Owens 2005). Studies have been undertaken to assess the effect of sleep problems on the attention and hyperactivity-impulsivity dimensions of ADHD. A significant majority of these studies have shown that sleep deprivation increases symptoms of ADHD or impairs neurobehavioral functions (Cassoff et al. 2012, Maskive Kothare 2013). Sleep deprivation was found to cause attention deficit in children with ADHD (Gruber et. 2011). More recent studies reported that poor sleep quality in children with ADHD predicted poor performance in sustaining attention (Knight and Dimitriou, 2019) and that shortened sleep time caused daytime sleepiness and impaired attention (Becker et al 2019). Although most data reported in the literature are on children and adolescents, there are also studies demonstrating ADHD symptoms of attention deficit and hyperactivity in adults resulting from the effects of shortened sleep duration and insomnia (Voinescuve ark. 2012, Wynchankve ark. 2018).

It has been aimed in this research to investigate the factors affecting sleep and the relationship between sleep problems and symptoms of attention deficit and hyperactivity-impulsiveness in a large population of university students. The hypothesis of study was that university students with poor sleep quality had more ADHD symptoms and that problems in attention area were more prominent than hyperactivity and impulsivity in students with poor sleep quality.

METHOD

Participants

A total of 252 students aged between 18 and 25 years, reading at Hacettepe University Faculty of Medicine and Karadeniz Technical University Faculty of Medicine were recruited for the study between May-July 2017. Exclusion criteria were not stipulated. Informed written consent was obtained from all the included participants. A questionnaire prepared by the researchers was used to record the sociodemographic features of the participants. All participants completed the Pittsburgh Sleep Quality Index (PSQI), the Adult Attention-Deficit Hyperactivity Disorder-DSM-IV based-Diasnogtic Screening and Rating Scale (ADD/ADHD-DSM-IV-DSRS), the Beck Depression Inventory (BDI) and the Beck Anxiety Inventory (BAI). The study was approved by the Ethics Committee of the Hacettepe University.

Data Acquisition Tools

1. The Demographic and Clinical Information Questionnaire (DCIQ): This questionnaire was prepared by the researchers for recording the sociodemographic and clinical features including age, gender, accomodation, internal and psychiatric diseases and sleeping habits of the participants. A separate form was attached for assessing the factors affecting sleep patterns.

2. The Pittsburgh Sleep Quality Index (PSQI): The PSQI provides information on sleep quality and the type and severity of existing sleep disturbances within the previous 1 month. The scale comprises 24 items 19 of which are self-rated and 5 items are answered by the bed partner (if any) and not included in the scoring. The 19 items, used to assess the 7 different subdimensions on subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction, are each scored between 0 (no distress) and 3 (severe distress). The sum of the scores on the 7 subdimensions gives the total PSQI score varying between 0 and 21. A total score of ≤5 is considered as good sleep quality (Buysse et al. 1989). The validity and reliability of the Turkish age version of the PSQI was reported by Ağargün and collageaus (1996).

3. The Adult Attention-Deficit Hyperactivity Disorder Scale: The scale in the Turkish language was formed by Turgay (1995) and validity and reliability study of this was conducted by Günay and collageaus (2005). Scores <3 on the attention-deficit (ADHD-1) and the hyperactivity (ADHD-2) subscales indicate low-level symptoms; scores between 3.01 and 10.99 indicate moderate-level symptoms and scores >11 indicate high-level symptoms. Scores on the ADHD and ADHD related characteristics subscale (ADHD-3) between 0 and 12.99 indicate low level of problems, scores between13 and 35 indicate moderate level of problems and scores between 35 and 75 indicate high level of problems. Total scores <20, between 20 and 59 and >59 are considered, respectively, as low-level, moderate-level high-level ADHD.

4. The Beck Depression Inventory (BDI): The BDI was developed by Beck and collageaus (1961) to assess desymptom severity. The Turkish language version was validated by Hisli (1989). The BDI consists of 21 questions each scored between 0 and 3. The total score varies between 0 and 63, with a cut-off score 17 and higher scores indicate increasing severity of depressive symptoms (Hisli 1989).

5. The Beck Anxiety Inventory (BAI): The BAI was developed by Beck and collageaus. (1988) to assess anxiety symptom severity. The Turkish language version was validated by Ulusoy et al. (1988). The BAI consists of 21 questions each scored between 0 (none) and 3 (serious degree). The total score varies between 0 and 63, and scores above 10 indicate presence of anxiety symptoms (Julian 2011).

Statistical Analysis

The SPSS 22 package software was used for statistical evaluaton of the data. Normality of the continuous variables was assessed by the Kolmogorov Smirnov test. Homogeneity of the variances was tested by the Levene test. Descriptive analyses were carried out. Assessment of the intergroup differences was made by the independent sample t-test and the Mann-Whitney U test for, respectively, the normally and the non-normally distributed continuous variables. The correlations between the categorical variables were examined by the chi-square or the Fisher's exact test. The Spearman correlation analysis was used to evaluate the relationship of PSQI and Adult ADHD subscale scores with total scores. A P value <0.05 was accepted to indicate statistical significance.

RESULTS

The study was carried out with a total of 252 pariticpants consisting of 155 (61.5%) females and 97 (38.5%) males, with a mean age of 22.39 (±1.93) years. The participants resided in their homes (67.9%), in student residences (28.6%) or in other premises (3.6%); among which 69% had their own room, 22% shared their room with one other person, 5.6% shared their room with two other people and 3.2% shared their room with three people. One person reported that he had consulted a psychiatrist because of sleep problems in the past, and 4 (1.6%) had used medication for ADHD diagnosis. None of the participants were on regular medication for sleep disorder or ADHD at the time of the study but 15 reported using paroxetine, escitalopram or fluoxetine for depression and anxiety disorders. Habits and other factors affecting sleep are shown in Table-1

Table 1. Habits and Other Factors Affecting Sleep

	Yes (%)	No (%)
Smoking	44 (17.5)	208 (82.5)
Alcohol use	75 (29.8)	177 (82.5)
Substance use	3 (1.2)	249 (98.8)
Coffee consumption	209 (82.9)	43 (17.1)
Tea consumption	226 (89.7)	26 (10.3)
Regular exercise	74 (29.4)	178 (70.6)
Physical illness	47 (18.7)	205 (81.3)
Uncomfortable bed and/or pillow	120 (47.6)	132 (52.4)
Unventilated room	114 (45.2)	138 (54.8)
Too much light in room	116 (46)	136 (54)
Dark room	13 (5.2)	239 (94.8)
Room too hot or cold	144 (57.1)	108 (42.9)
Crowded room	80 (31.7)	172 (68.3)
Being alone in the room	8 (3.2)	244 (96.8)
Someone entering and exiting the room frequently	117 (46.4)	135 (53.6)
Environmental noise	129 (51.2)	123 (48.8)

The mean total scores of the participants on the PSQI and the ADHD scale were, respectively, 5.78±2.72 and 41.77±20.38. The mean ADHD-1, ADHD-2 and ADHD-3 subscale scores were, respectively, 8.70±5.04, 27.09±5.51 and 26.05±13.21. The mean BDI and BAI scores were, respectively, 8.53±6.97 and 9.05±7.92.

Gender based differences were not determined between the female and male scores on the PSQI (t=-0.831; P=0.40), ADHD (t=-0.236; P=0.813), BDI (t=-1.438; P=0.152) and the BAI (t=-1.155; P=0.249). Statistically significant gender based differences were not determined between the groups with and without sleep related problems (c2=1.146; P=0.284).

Whereas 69 of the 91(75%) participants without sleep disorders had scored ≥20 on the ADHD scale, 153 (95%) of the 161 participants with sleep disorders scored ≥20 on ADHD scale, indicative of moderate-high symptom level on the ADHD scale. Participants with sleep disorders had significantly higher scores in ADHD scale attention deficit section (t=-4,149; P<0,001), ADHD and ADHD related characteristics section (t=5,668; P<0,001) and total (t=5.220; P<0,001) compared with participants without sleep disorder.

Statistically significant differences between the participant subgroups with and without sleep disorders were not determined with respect to tea, coffee, cigarette, alcohol consumption, regular exercise/sports and other factors affecting sleep. Comparison of the 13 participants with sleep disorders and low level of attention deficit symptoms with the 148 participants with sleep disorders and moderate-high level of attention deficit symptoms with respect to tea, coffee, cigarette, alcohol consumption, regular exercise/sports and other factors affecting sleep also did not yield statistically significant differences.

Table 2. Relationship Between Sleep Quality Scores and Attention-Deficit Hyperactivity Scores

Adult ADHD PSQI	ADHD-1 (Attention deficit)	ADHD-2 (Hyperactivity-impulsivity)	ADHD-3 (ADHD related characteristics)	ADHD total
Subjective sleep quality	0.213**	0.110	0.325**	0.290**
Sleep latency	0.157**	0.108	0.255	0.239**
Sleep duration	0.051	0.026	0.059	0.059
Sleep efficiency	0.097	0.036	0.35*	0.104
Sleep disturbance	0.201**	0.111	0.282**	0.252**
Use of sleeping medications	–0.029	–0.030	0.042	0.002
Daytime dysfunction	0.320**	0.169**	0.415**	0.400**
PSQI total	0.295**	9.178	0.425**	0.400**

PSQI: Pittsburg Sleep Quality Index, ADHD: Attention Deficit-Hyperactivity Disorder
**p<0.001

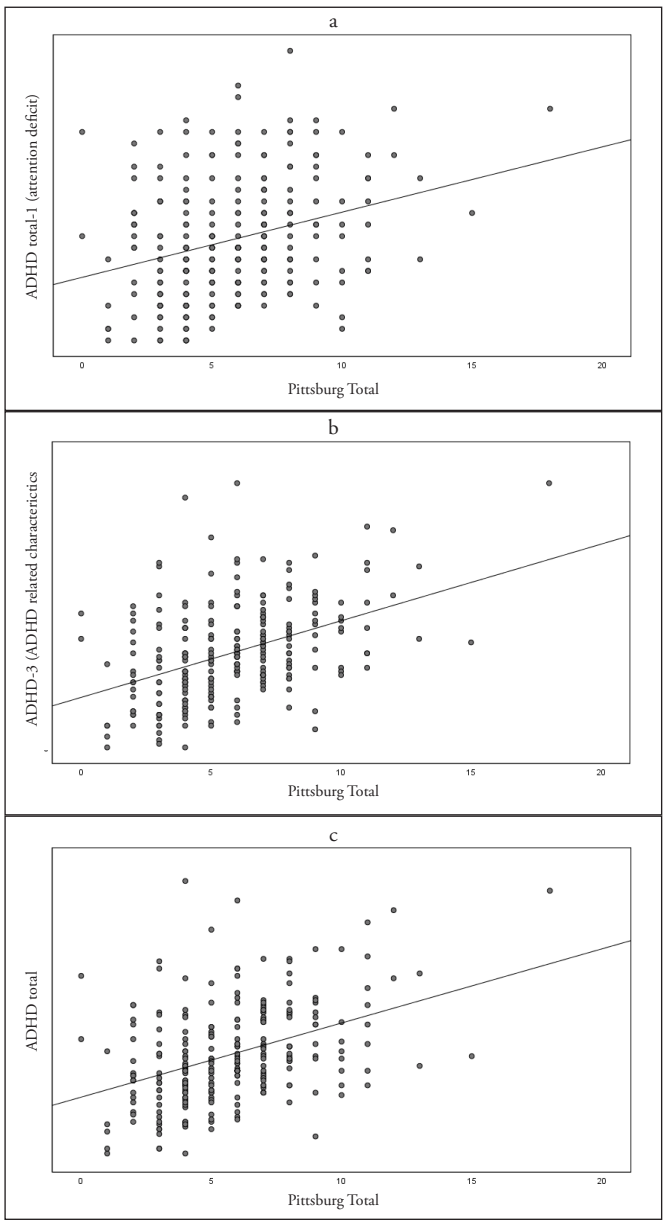

Figure 1. Relationship Between the Pittsburgh Sleep Quality Index Total Score and the ADD/ADHD Attention-Deficit Subscale and Total Scores
PSQI: Pittsburg Sleep Quality Index, ADHD: Attention Deficit-Hyperactivity Disorder

The mean total scores on the PSQI and the ADHD scale correlated significantly and positively (r=0.400; P<0.001). The correlations between the total and subscale scores on the PSQI and the ADHD scale are presented in Table-2 and Figure 1.

In this study, 31 participants scored ≥17 on the BDI, and 89 participants scored ≥10 on the BAI. The mean total scores on the PSQI and the ADHD Scale were, respectively, 8.35±2.39 and 64±24.14, for the participants with BDI scores above the cut-off point. Also, the mean total scores on the PSQI and the ADHD Scale were, respectively, 7.08±2.76 and 54.01±19.45 for the participants with BAI scores above the cut-off point. The mean total PSQI (z=-4.630; P<0.001) and ADHD (z=5.485; P<0.001) scores of the participants with BDI and BAI scores above the respective cut off points, were significantly higher as compared to the participants with BDI and BAI scores below the respective cut-off points.

Correlation analysis carried out by controlling the effects of depression and anxiety scores showed that the correlation between sleep quality and ADHD symptoms retained its significance (r:0.144; P=0.023).

DISCUSSION

It was aimed in this study to investigate the relationships between sleep problems and the ADHD symptoms in university students by hypothesising that students with poor sleep quality would have distinctly increased ADHD symptoms with predominance of the attention deficit problems. Indeed, it was determined that among students with sleep disorders, the total score and the scores on the attention-deficit (ADHD-1) and the ADHD related characteristics (ADHD-3) subscales on the Adult ADHD Scale were significantly higher as compared to students without sleep problems.

Various studies reported that 25–50% of children and adolescents diagnosed with ADHD had sleep problems (Picchietti and Picchietti 2008, Gruber et al. 2011) and experienced different sleep problems complicated especially with difficulties in initiating and maintaining sleep, waking up during the night, non-relaxing sleep a decreased total sleep duration, difficulty of waking up in the morning and daytime sleepiness (Owens et al. 2009). ADHD is a disorder that affects individuals at various stages of development from early childhood to advanced adulthood (Cassoff et al. 2012). Research indicated that similarly to the sleep problems seen in children and adolescents diagnosed with ADHD, sleep problems occur in ≥83% of adults evaluated for ADHD (Doddon et al. 1999, Kooij et al. 2001, Philipsen et al. 2005, Philipsen et al. 2006, Schredl et al. 2007). In our study, the significant positive correlation determined between the ADHD symptoms and sleep problems among participants in early adulthood is consistent with the current literature. Studies in this field have shown that sleep disorders are similar in adults and children diagnosed with ADHD, indicating that sleep problems persist lifelong in individuals with ADHD (Cassoff et al. 2012). Next to the reports in the literature that attention deficit problems are more common in sleep deprivation, there are also observations on increased symptoms of hyperactivity and impulsiveness (Touchette et al. 2007, Gruber et al. 2011, Knight and Dimitriou 2019). Also, it has been reported that childhood problems of fragmented sleep, insomnia and resistance to sleep time are associated with the onset of ADHD symptoms (Gregory and O'Connor 2002, O'Callaghan et al. 2010). The correlation between poor sleep quality and attention-deficit symptoms determined in this study are consistent with the relationship of sleep disorders and ADHD symptoms reported in the literature. Therefore, it seems important to assess sleep quality and factors affecting sleep in young people complaining of attention problems.

On the other hand, querying sleep disorders before the diagnosis of ADHD is important in clinical practice as ADHD-like symptoms have been observed to improve gradually following appropriate surgical intervention in patients with breathing related sleep problems. Hence, overdiagnosis of ADHD has become questionable (Chervin et al. 2006, Knight and Dimitriou, 2019) since ADHD secondary to sleep disorders may be diagnosed as primary ADHD on clinical grounds and offered treatment applications accordingly.

Several underlying mechanisms have been proposed to explain the comorbidity of sleep disorders and ADHD symptoms or the relationship between them. For example, involvement of the potential connections between prefrontal cortex functions, dopamine and the circadian systems has been proposed (Cassoff et al. 2012). The role of the prominent biological mechanism involving the hypothalamo–pituitary–adrenal axis, which plays an important regulatory role in attention, movement and sleep–wake cycle has also been considered. Changes in cortisol levels have been reported to be associated with ADHD and impaired sleep patterns (Imeraj et al. 2012).

A relatively poorer quality of sleep has been observed in female university students and a relationship between quality of sleep and gender has been argued for (Cheng ve ark. 2012, Becker ve ark. 2018), which has not been supported by our results or those of others (Choueiry et al. 2016). Various habits have negative effects on sleep quality, one being excessive caffeine consumption (Shimura et al. 2020). The excessive caffeine consumption by the participants of our study was not found to be effective on sleep quality. Evaluation of these results should also take into account the frequency and amount of caffeine consumption. It was shown that tea consumption did not have a negative effect on sleep during night despite its stimulant effect during the day (Hindmarchve ark. 2000), and that it has a protective effect on sleep (Alghwiri et al. 2020). In agreement with the literature, this study did not find high level of tea consumption to be a negative factor on sleep quality. Sleep problems are common in children with anxiety and depression symptoms (Alfano et al. 2006) and are associated with concomitant depression in adolescents with ADHD (Stein et al. 2002). In the present study, the ADHD and PSQI scores of the pariticipants with depression and anxiety symptoms were higher than the others.

Having a large and homogenous group of participants in comparison to previously made similar studies are strengths of the present study. However, not having made a structured interview wth the participants and leaving all evaluations to the subjective self-evaluations of the participants by using self-report psychometric tests should be considered among its limitations. Considering the coincidence of the final exams of the students with the time of implementing the study may be a factor affecting sleep quality. Not having controlled this factor may also be a limitation of the study.

In conclusion, this study demonstrates that university students with sleep disorder have higher levels of ADHD symptoms. In this respect, questioning sleep patterns and factors affecting sleep in young people complaining of attention problems appear to be important for the approaches to improve quality of sleep.

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