Original Article

Sleep Quality Assessment in Adolescents with and without Type 1 Diabetes Using the Pittsburg Sleep Quality Index

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Abstract

Background and Aims: Many diseases, especially chronic diseases, can lead to sleep disturbances. Our study aimed to evaluate sleep characteristics and the relationship between sleep disorders and diabetes-related variables in type 1 diabetes adolescents and to compare these results with a non-diabetic group of similar age and gender. **Methods:** This cross-sectional study collected data from 40 healthy adolescents and 50 patients of the same age group with type 1 diabetes mellitus from January 2019 to June 2019. Subjects were asked to complete the Pittsburgh Uyku Kalitesi Anketi (PUKA). Patients who had nocturnal hypoglycemia in the preceding one month were excluded. **Results:** Total scores for PUKA were not significantly different between the two groups ($P = 0.197$). No significant relationship was found between sleep quality, duration of diabetes, and HbA1c levels in the diabetes group ($P = 0.59$, $P = 0.41$, respectively). Poor sleep quality (PUKA score ≥5) in girls without diabetes was higher (95% confidence interval: 1.26–11.61) than in the diabetes group ($P = 0.031$). **Conclusion:** In our study, the prevalence of sleep disorders in T1D patients was not higher than the non-diabetic population. However, the girls in the non-diabetic group had significant poor sleep quality. We hypothesize that this may be due to diabetes management bringing order and discipline to an adolescents life.

Keywords: Adolescents, diabetes mellitus, sleep quality

Introduction

Sleep disorders such as resistance to bedtime or difficulty sleeping, night waking and inadequate sleep are quite common in adolescents[1] Many diseases, especially chronic diseases, can lead to sleep disturbances. A recent meta-analysis found sleep duration was shorter in children and adolescents with type 1 diabetes (T1D) than in controls.[2] In children with T1D, sleep disorders may be due to night waking for hypo/hyperglycemia and parental diabetes care behaviors,[3] in addition to blood glucose monitoring, fear of night hypoglycemia, and need for snacks may make life difficult and affect sleep quality in adolescents with T1D. Some studies have demonstrated that short sleep duration and poor quality of sleep contribute to problems related to treatment adherence and glycemic control in adolescents and adults with diabetes.[4,5] In this study, we evaluated sleep characteristics and the possible relationship between sleep disorders and diabetes-related variables in T1D adolescent patients.

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Methods

The T1D group consisted of 58 adolescents (28 girls, 30 boys) following up in the XXX University Department of Pediatric Endocrinology. Adolescents were eligible for the study if: (1) they were between the ages of 13–17 years; (2) T1D duration was at least 12 months; (3) they had not been diagnosed with any sleep disorders; and (4) they were able to read/speak Turkish. Patients who had nocturnal hypoglycemia in the preceding one month were excluded. Forty healthy adolescents (18 girls, 22 boys) who met these criteria and did not have diabetes were selected as the control

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group. Confounding variables related to sleep such as obesity, adenoid hypertrophy, or computer/smartphone use were not evaluated in our study.

After providing informed consent, participants completed questionnaires of the Pittsburgh Sleep Quality Index (PSQI) in the Turkish version.[6] Our protocol was approved by the Trakaya University Review Board (protocol number 2018/150).

Glycemic control was measured with hemoglobin A1C (HbA1c). HbA1C values were checked on the day of the questionnaire, and diabetes durations were calculated from the day they filled out the questionnaire.

Data were analyzed by using SPSS Statistics for Windows, Version 22.0. Chi-square test and percentage distributions were used in the evaluation of the data, in the comparison of qualitative variables. Mean values are shown with standard deviation. Logistic regression analysis was applied to determine the risk factors affecting the PSQI scores. In statistical comparisons, the alpha error level was considered significant as $P < 0.05$.

PSQI

PSQI was developed in 1989 by Buysse *et al*.[7] and adapted to Turkish by Ağargün *et al*.[6] PSQI is a 19-item self-report scale that evaluates sleep quality and disturbance in the past month. It consists of 24 questions, 19 questions are self-report questions, 5 questions are questions to be answered by the spouse or roommate. The 18 scored questions of the scale consist of 7 components. Each component is evaluated over 0–3 points. The total score of the 7 components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction) gives the scale total score. The total score ranges from 0 to 21. A total score greater than 5 indicates "poor sleep quality".

The time spent in bed is calculated from bedtime (question 1) and waking time (question 2). With question 4, the duration of sleep is determined and the usual sleep efficiency is calculated with the formula: *Conventional sleep efficiency (%) = total hours of sleep × 100/time spent in bed*. The participant gets zero points if the sleep efficiency is above 85%, and 4 points if it is less than 65%.[7]

Results

The general characteristics of the participants are presented in Table 1. The mean ages and proportion of boys and girls in the T1D and control groups were comparable.

No significant relationship was found duration of diabetes and HbA1c levels between sleep quality in the T1D group ($P = 0.59$, $P = 0.41$, respectively).

The mean duration of sleep in the T1D and control groups was not statistically significant ($P = 0.31$). The total sleep time of men (8.4 ± 1.2 h) in the control group was longer than women (7.6 ± 1.7 h), but the overall total sleep time per night did not differ significantly between boys and girls ($P = 0.053$).

As shown in Table 2, there were some differences in the some subitem scores. Sleep efficiency was significantly worse in the T1D group. Although the frequency of poor sleep quality (31%) was lower in the T1D group compared to the control group (47.5%), the difference was not significant ($P = 0.19$).

PSQI total scores did not differ between the two groups by gender ($P = 0.045$). Within each group, when compared by gender, no difference in score was found in the diabetes group ($P = 0.94$), but the girls in the control group (PSQI = 5.5) had significantly worse sleep quality than boys (PSQI = 3) ($P = 0.002$) [Table 3].

The mean score of PSQI in girls without diabetes was higher than the T1D group ($P = 0.016$). The risk of poor sleep quality (PSQI ≥ 5) in girls without diabetes was 3.87 times higher than the T1D group ($P = 0.031$). There was no difference between the boys of both groups) [Table 4].

Discussion

While sleep disorders have biological, circadian and neurodevelopmental causes, they are also influenced by environmental and behavioral factors that can be altered.[8] Insufficient and poor-quality sleep is associated with behavior problems in the general pediatric population, and with

Table 1: Comparison of general characteristics between T1D and control groups

Factors	T1D (*n*=58)	Control (*n*=40)	*P*
Age mean (±SD)	14.3±1.7	14.1±1.9	0.65
Gender: *n* Female (Male)	28 (30)	22 (18)	0.65
Gender: % Female (Male)	48.3 (51.7)	55 (45)	
Duration of diabetes (years)	4.8±2.7		
HbA1c level (%)	8.8±1.9		
Sleep duration (h) mean (± SD)	8.3±1.3	8.02±1.54	0.31

SD, standard deviation

Table 2: Comparison of PSQI parameters between control and T1D groups

PSQI parameters Mean (± SD)	T1D group (*n*=58)	Control group (*n*=40)	*P*
Overall sleep quality	0.86±0.58	0.85±0.7	0.886
Sleep latency	1.02±0.87	1.05±0.88	0.915
Duration of sleep	0.26±0.55	0.49±0.79	0.136
Sleep efficiency	0.03±0.26	0.55±0.90	<0.001
Sleep disturbance	1.12±0.42	1.2±0.72	0.467
Medication to sleep	0.00±0.00	0.00±0.00	1.000
Sleep dysfunction due to sleepiness	0.52±0.68	0.63±0.84	0.717
PSQI Total score	3.81±1.91	4.72±2.88	0.197

PSQI, Pittsburgh Sleep Quality Index; SD, standard deviation.

Table 3: Comparison of PSQI parameters between genders

PSQI parameters	T1D Group (*n*=58)			Control Group (n=40)		
	Female	Male	*P*	Female	Male	*P*
(mean±SD)	(28)	(30)		(22)	(18)	
Overall sleep quality	0.90±0.60	0.80±0.5	0.47	1.09±0.75	0.55±0.51	0.02
Sleep latency	0.90±0.70	1.06±0.90	0.70	1.13±0.94	0.94±0.80	0.58
Duration of sleep	0.25±0.58	0.26±0.52	0.68	0.66±0.91	0.27±0.57	0.14
Sleep efficiency	0.00±0.00	0.06±0.03	0.33	0.86±1.08	0.16±0.38	0.01
Sleep disturbance	0.00±0.00	1.13±0.43	0.81	1.31±0.83	1.05±0.53	0.22
Medication to sleep	0.00±0.00	0.00±0.00	1.00	0.04±0.21	0.00±0.00	0.36
Sleep dysfunction due to sleepiness	0.57±0.69	0.46±0.68	0.50	0.86±0.94	0.33±0.59	0.07
PSQI Total score	3.82±1.94	3.30±1.90	0.99	5.86±3.01	3.33±2.02	0.02

PSQI, Pittsburgh Sleep Quality Index; DM, diabetes mellitus; SD, standard deviation

Table 4: Comparison between the gender of sleep quality

	Female			Male		
	T1D (*n*=28)	Control (*n*=22)	*P*	T1D (*n*=30)	Control (*n*=18)	*P*
PSQI score	4.05±2.25	5.86±3.01	0.016	3.76±1.98	3.33±2.03	0.358
PSQI ≥5 Poor Sleep Quality	14 (%35.9)	15 (%68.2)	0.031 OR=3.87 (%95 CI: 1.26-11.61)	13 (%31.7)	4 (%22.2)	0.668 OR=0.62 (%95 CI: 0.17-2.24)

PSQI, Pittsburgh Sleep Quality Index; DM, diabetes mellitus; OR: Odds Ratio, CI: Confidence Interval; Mean±Standard Deviation

decreased insulin sensitivity and lower glycemic control in adolescents and adults with T1D.[9] Turner *et al*.[10] observed that low sleep quality increased self-regulatory failures and increased the risk of hyperglycemia, suggesting that adequate and quality sleep contributes to the maintenance of optimal glycemic control for children and adolescents with T1D. Schnurbein *et al*.[11] reported that the quality of sleep was significantly associated with HbA1c in adolescents, this relationship was stronger in men and migrant children, and sleep habits were clinically significant. In contrast, we observed no significant relationship between sleep quality and HbA1 can indicator of glycemic control.

Jaser and Ellis studied[12] 159 adolescents with T1D, and found mean sleep duration of 7.4 h, below the recommended of 8–10 h for this age, with poor sleep duration associated with poorer diabetes management. Reported better sleep quality was significantly correlated with better glycemic control in men, and no significant correlation was found in women.[12] On the contrary, we found adequate mean sleep time of 8.3 ± 1.3 h in the T1D group and 8.02 ± 1.54 h in the controls, with quality of sleep among girls and boys similar in the T1D group. It was the girls in the control group who had impaired quality of sleep.

Niral *et al*.[13] reported an average PSQI score of 5.37 (above the clinical cut for poor sleep quality) in 65 adolescents with T1D, with actigraphy data revealing average total sleep time of 6h 54 min. They reported variability in sleep time was significantly associated with HbA1c, frequency of glucose monitoring, and mean blood glucose value, while total sleep time and self-reported sleep quality were not significantly associated with compliance or glycemic control. We found satisfactory total PSQI score in the T1D (3.81 ± 1.91) and control groups.

Interestingly, a detailed cross-sectional study of 154 adolescents with T1DM and 154 age-range-matched non-diabetic controls, using PSQI and several other validated questionnaires: Sleep Disturbance Scale for Children (SDSC), Adolescent Sleep-Wake Scale (ASWS), Epworth Sleepiness Scale (ESS), found the prevalence of sleep disorders in T1D adolescents no higher than in the nondiabetic population. They also reported fewer patients than controls had excessive daytime sleepiness.[14] This is similar to our results of similar total PSQI scores in patients and controls. In fact the sleep efficiency score C4) was significantly higher in the control group. As a reason for this difference, we thought that individuals with diabetes had a regular bedtime and waking routines due to the need for insulin injections and medical training. Because bedtime and waking time are used for calculating the sleep efficiency score (C4).[7]

Sleep plays an important role in the academic outcomes of young people with T1DM, including school absenteeism, standardized test scores and grade point average.[15] Perfect and colleagues[5] also found that more delayed weekend bed hours reported by adolescents with T1DM were associated with lower grade point average as well as lower scores in standard reading, writing, and mathematical assessments. In this study, we did not evaluate the relationship between sleep and neurocognitive, psychosocial and academic achievement. Further research is needed to determine the effect of sleep disorders on psychosocial and cognitive functions in adolescents with T1DM.

Our study's limitations were: we used self-report methodology, and have no data on usage of pumps or not, CGMS or not, smartphone usage, obesity, adenoidal hypertrophy, and several other factors which can affect sleep. However, to our knowledge, this was the first study in Turkey to examine sleep scores in adolescents with T1D vs. non-diabetic controls.

Although we did not encounter sleep problems in adolescents with diabetes in our study, there are studies showing that possible sleep disorders affect diabetes management negatively. Therefore, larger studies should be conducted on sleep problems in adolescents and children with diabetes.

As suggested in this study, we think it would be beneficial for physicians to receive regular information about sleep duration and sleep disorder symptoms, educate patients with T1D and their families about sleep, and/or refer them to sleep specialists when necessary.[16]

Conclusion

The present study shows that sleep quality may not always be affected negatively in adolescents with diabetes. On the contrary, diabetes management can be a reason for discipline in an adolescent's life and positively affect sleep patterns. Further studies are needed to support these results.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. Owens J. Classification and epidemiology of childhood sleep disorders. Prim Care 2008;35:533-46.
2. Reutrakul S, Thakkinstian A, Van Cauter E, Anothaisintawee T. Sleep characteristics in type 1 diabetes and associations with glycemic control: Systematic review and meta-analysis. Sleep Med 2016;23:26-45.
3. Monaghan MC, Hilliard ME, Cogen FR, Streisand R. Nighttime caregiving behaviors among parents of young children with type 1 diabetes: Associations with illness characteristics and parent functioning. Fam Syst Health 2009;27:28-38.
4. Chontong S, Saetung S, Reutrakul S. Higher sleep variability is associated with poorer glycaemic control in patients with type 1 diabetes. J Sleep Res 2016;25:438-44.
5. Perfect MM, Patel PG, Scott RE, Wheeler MD, Patel C, Griffin K. Sleep, glucose, and daytime functioningin youth with type 1 diabetes. Sleep 2012;35:81-8.
6. Ağargün MY, Kara H, Anlar O. Pittsburgh uyku kalitesi indeksi'nin geçerliği ve güvenirliği. Turk Psikiyatri Derg 1996 7:101-6.
7. 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;28:193-213.
8. O'Brien LM. The neurocognitive effects of sleep disruption in children and adolescents. Child Adolesc Psychiatr Clin N Am 2009;18:813-23.
9. Miller KM, Foster NC, Beck RW, Bergenstal RM, DuBose SN, DiMeglio LA, *et al*. Current state of type 1 diabetes treatment in the U.S.: Updated data from the T1D exchange clinic registry. Diabetes Care 2015;38:971-8.
10. Turner SL, Queen TL, Butner J, Wiebe D, Berg CA. Variations in daily sleep quality and type 1 diabetes management in late adolescents. J Pediatr Psychol 2016;41:661-9.
11. von Schnurbein J, Boettcher C, Brandt S, Karges B, Dunstheimer D, Galler A, *et al*. Sleep and glycemic control in adolescents with type 1 diabetes. Pediatr Diabetes 2018;19:143-9.
12. Jaser SS, Ellis D. Sleep in Adolescents and young adults with type 1 diabetes: Associations with diabetes management and glycemic control. Health Psychol Behav Med 2016;4:49-55.
13. Niral JP, Kimberly LS, Sachini NK, Beth AM, Lauren AW, Lochbihler G, *et al*. Sleep habits in adolescents with type 1 diabetes: Variability in sleep duration linked with glycemic control. Pediatr Diabetes 2018. doi: 10.1111/pedi. 12689.
14. Adler A, Gavan MY, Tauman R, Phillip M, Shalitin S. Do children, adolescents, and young adults with type 1 diabetes have increased prevalence of sleep disorders? Pediatr Diabetes 2017;18:450-8.
15. Perfect MM. The relations of sleep and quality of life to school performance in youth with type 1 diabetes. J App Sch Psychol 2014;30:7-28.
16. Perez KM, Hamburger ER, Lyttle M, Williams R, Bergner E, Kahanda S, *et al*. Sleep in type 1 diabetes: İmplications for glycemic control and diabetes management. Curr Diab Rep 2018;18:5.