

# Examination of Sleep Disturbance and Sleep-Related Problems in Children with Type 1 Diabetes

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## Abstract

**BACKGROUND/AIMS:** This research aimed to investigate the sleep disorders and sleep problems of children with Type 1 Diabetes.

**MATERIALS AND METHODS:** The research is descriptive and cross-sectional. The research was conducted with 105 parents of children with Type 1 Diabetes who were admitted to an training and research hospital between June and August 2022. In the collection of research data, the Introductory Information Form and the Sleep Disorder Scale for Children (SDSC) were used.

**RESULTS:** As a result of our research, the average total score of SDSC was found to be  $47.60 \pm 12.740$ . According to this result, the level of sleep disorders of the children participating in the study is below the average score. Significant differences were found in the sub-dimensions of Wakefulness Reactions Disorders, Sleep-Wakefulness Transition Disorders, Excessive Sleepiness Disorders.

**CONCLUSION:** Parents participating in the study evaluated their children's sleep disorder level as below the average score. Since the sleep disorders of children with Type 1 Diabetes are affected by familial characteristics and factors related to the disease, it is recommended to conduct other studies to identify sleep disorders and influencing factors to improve these conditions, and to provide educational and counseling services to parents on these issues.

**Keywords:** Type 1 diabetes, children, sleep, sleeping disturbance

## INTRODUCTION

Type 1 Diabetes (T1D) disease occurs as a result of the autoimmune destruction of insulin-producing  $\beta$  cells of the pancreas. Although the exact cause is not known, genetic and environmental factors are effective in accelerating the disease.

<sup>1</sup> T1D is an important subtype of diabetes and occurs mostly at childhood. <sup>2</sup> The incidence of T1D in childhood is increasing

globally. <sup>3</sup> Although it is often diagnosed during adolescence, the highest increase occurred in young children <sup>4</sup> and about 15-20% of new cases were diagnosed in children aged five years or younger. <sup>5</sup>

Sleep health has been defined as “a multidimensional sleep-wake model that supports physical and mental well-being, adapted to individual, social and environmental influences”.

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Healthy sleep is characterized by adequate sleep duration, sleep efficiency, the subjective feeling of satisfaction, proper timing and constant alertness during waking hours.<sup>6</sup> Children with chronic diseases, including T1D, have a higher risk of showing sleep-related problems such as insufficient sleep and daytime sleepiness than healthy children. Children with T1D are susceptible to sleep disturbance due to the effect of glucose and insulin on the central nervous system and an increased response to bodily stress.<sup>7</sup>

The interactions between sleep and T1D are reciprocal; disrupted sleep negatively affects glycemic control, while uncontrolled blood sugar can also affect sleep.<sup>8,9</sup> In addition, nocturnal hypoglycemia and the need for intervention can affect the amount of time spent in bed and the duration of sleep.<sup>10</sup> Nocturnal hypoglycemia is one of the most feared conditions that psychologically negatively affects the child and parent and leads to impaired sleep.<sup>11</sup> Since parents often wake up their children at night to prevent nocturnal hypoglycemia, it is inevitable that children with T1D will have sleep problems and their parents will experience various difficulties in this regard.<sup>12</sup> Young people with T1D experience more sleep disturbance and a shorter sleep duration than their healthy peers.<sup>9,13</sup> Poor sleep quality also negatively affects diabetes management skills and overall well-being.<sup>14,15</sup>

This study aims to determine the sleep disturbance and sleep-related problems of children with T1D.

## MATERIALS AND METHODS

The research was conducted as a descriptive and cross-sectional study. The research was conducted with the parents of children with T1D who were admitted to an training and research hospital for routine check-ups between June and August 2022. The G-power 3.1.9.4 analysis program was used to calculate the sample size of the study. It was determined that at least 97 parents should participate in the sample of the study with an effect size of 0.30, a margin of error of 0.05%,  $df=96$  and 90% power (power). One hundred five parents participated in the study.

### Data Collection Tools

The “Introductory Information Form” and the “Sleep Disturbance Scale for Children” were used as the data collection tools in the research. The “Introductory Information Form” contains information about demographics, illness, the living environment and sleep. The form was prepared by the researchers within the scope of the literature<sup>16,17</sup> “The Sleep Disturbance Scale for Children” (SDSC) was developed by Bruni et al. (1996). And validity and reliability studies have been conducted in many languages.<sup>18</sup> The validity and reliability study of the scale in Turkish was conducted by Ağadayı et al. (2020).<sup>19</sup> The scale is a Likert type

scale that investigates sleep disturbance. In this scale, the child’s sleep disturbance is questioned in 26 items with 6 sub-dimensions. This sub-dimensions are initiation and persistence of sleep disturbance (UBSB; item 1,2,3,4,5,10 and 11), respiratory disturbance during sleep (USB; item involving chromosomes 13,14 and 15), reactions and alertness disturbance (URB; item 17,20 and 21), sleep-wake transition disturbance (UUGB; item 6,7,8,12,18 and 19), disturbance of excessive sleepiness (AUB; item 22,23,24,25 and 26) and excessive sweating during sleep (UAT; item 9 and 16). The total score can fall in the range of 26-130. The answers to the questions were between never (1 point) and always (5 points). A minimum score of 26 and a maximum score of 130 could be obtained from the scale. High scores are interpreted in favor of sleep disturbance. The Cronbach alpha value of the scale was 0.79.<sup>19</sup> In this study, it was found 0.84.

### Collecting Data

The research data were collected by interviewing the parents who visited an training and research hospital. After the parents were informed about the purpose and content of the research, the data collection forms were filled out using a face-to-face interview method with the parents who agreed to participate in the research. The completion time of the data collection forms was about 20 minutes.

### Analysis of the Data

The data obtained in the study were evaluated using the SPSS 20 statistical software package. In the definition of the data, number, percentage, average, standard deviation and minimum and maximum values were used. The conformity of continuous variables to a normal distribution was evaluated using Kolmogorov-Smirnov normality analysis. The Mann Whitney-U Test was used in binary groups to determine the differences between variables, the Kruskal Wallis H Test was used in groups of three or more, and Spearman’s Rank correlation analysis was used to determine the relationship status. Our research has limitations. Our research sample size was small and our findings need to be generalized to the larger child population.

## RESULTS

Table 1 shows the demographic characteristics of the parents that participated in the study. According to the table, 72.4% of the participants in the study were mothers and 27.6% were fathers. 86.7% of the participants were married, 55.3% were primary school graduates and 57.1% were working. The proportion of participants whose income was less than their expenses was 61%.

The duration of diagnosis of diabetes in 31.4% of their children was between 1 and 3 years. 43.8% of the participants lived in the province. 63.8% of the participants had a nuclear family and 65.7% of their children had more than two siblings. The

average age of the parents that participated in the study was 39.32 years and the average age of their children was 10.95 years (Table 1).

Table 2 shows the distribution of characteristics related to diabetes and sleep. According to the table, 57.1% of the children slept with their siblings in separate rooms. 52.4% of the children consumed liquids before going to sleep. 17.1% of the children slept during the day, 41% did not sleep and 41.9% slept sometimes. 84.8% of the children had a digital tool (phone, tablet, computer, etc.) that they used and 65.7% of them slept after 10 p.m. o'clock at night. 88.6% of parents make insulin to their children before going to sleep, 60% of children take blood sugar drops during sleep and 61.9% of

children have a snack before going to sleep. Finally, 51.4% of the parents believed that diabetes has an effect on sleep (Table 2).

Table 3 shows the descriptive statistics of the individuals participating in the study belonging to the "The Sleep Disturbance Scale for Children" and its sub-dimensions. As a result of the analysis, the average total score of the SDSC was  $47.60 \pm 12.740$ . When reviewing the sub-dimensions of the scale, "Sleep Initiation and Persistence Issues (SIPI)" the average score of the size of the sub ( $14,27 \pm 4,156$ ), "Respiratory Disturbance During Sleep (RDDS)" sub of the size of the average score ( $4,29 \pm 1,911$ ) and "Vigilance Reactions (VR)" the average score of the size of the sub ( $4,09 \pm 1,522$ ), "Sleep-Wake Transition Disturbance (SWTD)" the average score of the size of the sub ( $10,75 \pm 3,965$ ), "Disturbance of Excessive Sleepiness (DES)" sub of the size of the average score ( $9,75 \pm 4,300$ ) and "Excessive Daytime Sleepiness (EDS)" sub of

**Table 1. Distribution of demographic characteristics of the individuals participating in the study**

Variables		n	%
Parent	Mother	76	72,4
	Father	29	27,6
Marital Status	Married	91	86,7
	Single	14	13,3
Education Level	Primary	58	55,3
	High School	27	25,7
	Bachelor	20	19,0
Employment Status	Employed	60	57,1
	Unemployed	45	42,9
Income Status	Less Income than Expense	64	61,0
	Income Equal to the Expense	33	31,4
	More Income Than Expenses	8	7,6
Duration of Child's Diagnosis	Less than 1 Year	31	29,5
	1-3 Year	33	31,4
	4-6 Year	17	16,2
	More than 6 Years	24	22,9
Living place	Village/Town	24	22,9
	District	35	33,3
	City	46	43,8
Type of Family	Elementary Family	67	63,8
	Extended Family	38	36,2
Number of Sibling	No Sibling	4	3,9
	One Sibling	16	15,2
	Two Sibling	16	15,2
	More than 2 Sibling	69	65,7
Parent Age		39,32±7,388	
Child Age		10,95±4,128	
Total		105	100,0

**Table 2. Distribution of the child's characteristics related to illness and sleep**

Variables		n	%
The Child's Sleeping Place	In The Same Bed With The Parent	3	2,9
	Same Room With Parents, Separate Bed	25	23,8
	Alone In A Separate Room	17	16,2
	In A Separate Room With His Brothers	60	57,1
Fluid Consumption Before Sleep	Yes	55	52,4
	No	50	47,6
Daytime Sleeping Condition	Yes	18	17,1
	No	43	41,0
	Sometimes	44	41,9
Spending Time with Digital Devices Before Sleep	Yes	89	84,8
	No	16	15,2
Child's Sleep Time	Between 20 pm and 22 pm	36	34,3
	After 22 pm	69	65,7
The Way of Taking Insulin at Night	Before Sleep	93	88,6
	Wake up	9	8,6
	Pump	3	2,8
The Situation of Snacking Something Before Sleep	Yes	65	61,9
	No	40	38,1
The State of Blood Sugar Drop During Sleep	Yes	63	60,0
	No	42	40,0
The Effect of Diabetes on Sleep Status	Yes	54	51,4
	No	51	48,6
Total		105	100,0

the size of the average score ( $4,43 \pm 2,507$ ) has been identified as (Table 3).

Table 4 shows the results of the analysis conducted to compare the average scores of the “The Sleep Disturbance Scale for Children (SDSC) “ and its sub-dimensions according to the demographic characteristics of the parents that participated in the study. According to the results of the analysis, a significant difference was found in the total of the “The Sleep Disturbance Scale for Children (SDSC) “ according to the income status variable of the parents ( $p < 0.05$ ). According to this significant difference, the average score of the parents whose income was more than their expenses was lower than the average score of the parents whose income was less than their expenses and the average score of the parents whose income was equal to their expenses.

A significant difference was found in the “Sleep Initiation and Maintenance Problems (SIMP)” sub-dimension according to the parents’ educational status ( $p < 0.05$ ). According to this significant difference, the average score of the parents with a bachelor’s degree was lower than the average score of the parents with elementary or high school education.

A significant difference was found in the “Sleep Wake Transition Disturbance (SWTD)” sub-dimension according to the parents’ income status ( $p < 0.05$ ). According to this significant difference, the average score of the parents whose income was more than their expenses was lower than the average score of the parents whose income was less than their expenses and the average score of the parents whose income was equal to their expenses.

**Table 3. Minimum, maximum, average and standard deviation values obtained from the sleep disturbance scale and its sub-dimensions for children**

	Min.	Max.	Mean	Std. Dev.
Problems with Sleep Initiation and Maintenance (PSIM)	8,00	28,00	14,27	4,156
Respiratory Disturbance During Sleep (RDDS)	3,00	13,00	4,29	1,911
Wakefulness Reactions (WR)	3,00	11,00	4,09	1,522
Sleep Wakefulness Transition Disturbance (SWTD)	6,00	26,00	10,75	3,965
Excessive Sleepiness Disturbance (ESD)	5,00	24,00	9,75	4,300
Excessive Sweating During Sleep (ESDS)	2,00	10,00	4,43	2,507
The Sum of the Scale	29,00	85,00	47,60	12,740

min: minimum, max: maximum, M: mean, Std: standard deviation

**Table 4. Comparison of the average scores of the sleep disturbance scale and sub-dimensions for children according to the descriptive characteristics of the individuals participating in the study**

Değişkenler	PSIM	RDDS	WR	SWTD	ESD	ESDS	Sum Scale
	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS
<b>Parent</b>							
Mother	14,56±4,45	4,44±2,00	4,09±1,44	10,69±4,04	10,02±4,34	4,38±2,47	48,21±13,44
Father	13,51±3,19	3,89±1,61	4,10±1,73	10,89±3,81	9,03±4,16	4,58±2,62	46,03±10,72
<b>TEST</b>	U= 984,5 p>.05	U= 911,5 p>.05	U= 1080,0 p>.05	U= 1047,5 p>.05	U= 938,5 p>.05	U= 1041,5 p>.05	U= 1054,5 p>.05
<b>Marital Status</b>							
Married	14,16±4,11	4,34±2,00	4,06±1,54	10,80±4,10	9,61±4,13	4,47±2,54	47,46±12,54
Single	15,00±4,52	4,00±1,10	4,28±1,38	10,42±3,03	10,64±5,34	4,21±2,32	48,57±14,41
<b>TEST</b>	U= 562,5 p>.05	U= 631,5 p>.05	U= 540,5 p>.05	U= 635,5 p>.05	U= 586,5 p>.05	U= 613,5 p>.05	U= 630,0 p>.05
<b>Education Level</b>							
(1)Primary	14,43±4,52	4,62±2,29	4,24±1,53	11,36±4,54	10,08±4,44	4,56±2,62	49,31±14,56
(2)High School	15,51±3,65	3,81±1,38	4,22±1,78	9,96±3,05	9,92±4,77	4,44±2,57	47,88±11,14
(3)Bachelor	12,15±2,81	4,00±,91	3,50±,88	10,05±2,98	8,55±2,99	4,05±2,08	42,30±6,56
<b>TEST</b>	<b>KW= 10,247</b> <b>p&lt;.05</b> <b>1&gt;3</b> <b>2&gt;3</b>	KW= 3,042 p>.05	KW= 4,010 p>.05	KW= 1,471 p>.05	KW= 1,365 p>.05	KW= ,251 p>.05	KW= 2,486 p>.05

Table 4. Continued

Değişkenler	PSIM	RDDS	WR	SWTD	ESD	ESDS	Sum Scale
	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS
<b>Employment Status</b>							
Employed	14,10±4,02	4,18±1,79	3,90±1,44	10,85±3,90	9,20±,02	4,58±2,46	46,81±12,00
Unemployed	14,51±4,36	4,44±2,06	4,35±1,59	10,62±4,09	10,48±4,58	4,24±2,57	48,66±13,72
<b>TEST</b>	U= 1284,5 p>.05	U= 1256,0 p>.05	U= 1123,0 p>.05	U= 1294,0 p>.05	U= 1110,5 p>.05	U= 1187,5 p>.05	U= 1262,0 p>.05
<b>Income Status</b>							
Less Income than Expense	14,73±4,39	4,54±2,21	4,17±1,57	11,26±3,60	10,31±4,70	4,75±2,58	49,78±13,19
Income Equal to the Expense	13,63±3,79	3,87±1,31	4,12±1,55	10,27±4,69	9,06±3,60	4,03±2,36	45,00±12,23
More Income Than Expenses	13,25±3,49	4,00±,75	3,37±,51	8,62±2,66	8,12±2,85	3,62±2,32	41,00±5,87
<b>TEST</b>	KW= 1,186 p>.05	KW= 1,877 p>.05	KW= 1,569 p>.05	<b>KW= 6,108</b> <b>p&lt;.05</b> <b>1&gt;3</b> <b>2&gt;3</b>	KW= 2,665 p>.05	KW= 3,522 p>.05	<b>KW= 5,961</b> <b>p&lt;.05</b> <b>1&gt;3</b> <b>2&gt;3</b>
<b>Duration of Diagnosis</b>							
Less than 1 Year	13,90±4,12	4,06±1,36	4,22±1,74	10,48±3,31	8,45±3,60	4,32±2,53	45,45±10,75
1-3 Year	14,18±3,81	4,30±2,31	4,03±1,42	11,00±4,38	10,27±3,95	4,66±2,68	48,45±11,84
4-6 Year	14,76±4,61	5,05±2,41	4,17±1,38	11,64±4,15	10,35±4,52	4,17±2,27	50,17±14,44
More than 6 Years	14,54±4,52	4,04±1,42	3,95±1,51	10,12±4,11	10,29±5,23	4,45±2,50	47,41±15,18
<b>TEST</b>	KW= ,554 p>.05	KW= 3,301 p>.05	KW= 1,026 p>.05	KW= 2,015 p>.05	KW= 5,070 p>.05	KW= ,325 p>.05	KW= 1,674 p>.05
<b>Living place</b>							
Village/Town	13,33±3,37	4,33±1,78	4,00±1,28	10,00±3,81	9,45±4,19	4,20±2,51	45,33±11,88
District	14,54±4,53	4,51±2,42	3,91±1,31	10,60±3,54	10,17±4,55	4,80±2,81	48,54±13,25
City	14,56±4,24	4,10±1,50	4,28±1,77	11,26±4,33	9,58±4,22	4,28±2,26	48,08±12,90
<b>TEST</b>	KW= 1,346 p>.05	KW= ,428 p>.05	KW= ,792 p>.05	KW= 1,547 p>.05	KW= ,617 p>.05	KW= ,558 p>.05	KW= 1,313 p>.05
<b>Type of Family</b>							
Elementary Family	14,20±4,15	4,14±1,76	4,05±1,57	10,76±3,44	9,52±4,51	4,50±2,57	47,20±12,35
Extended Family	14,39±4,22	4,55±2,13	4,15±1,44	10,73±4,79	10,15±3,91	4,31±2,40	48,31±13,53
<b>TEST</b>	U= 1236,5 p>.05	U= 1111,0 p>.05	U= 1175,0 p>.05	U= 1156,5 p>.05	U= 1081,0 p>.05	U= 1236,0 p>.05	U= 1227,0 p>.05
<b>Number of Sibling</b>							
(1) No	11,50±2,38	3,50±,57	5,00±4,00	11,00±2,16	7,00±1,41	3,75±,95	41,75±6,60
(2) One	14,87±4,78	4,62±2,15	4,00±1,21	11,93±3,29	9,25±3,10	5,00±2,94	49,68±11,90
(3) Two	15,25±4,21	4,37±2,70	4,06±1,34	10,81±3,39	11,37±6,10	4,68±2,77	50,56±13,98
(4) More Than Two	14,07±4,04	4,24±1,69	4,07±1,43	10,44±4,29	9,65±4,08	4,28±2,41	46,78±12,89
<b>TEST</b>	KW= 3,288 p>.05	KW= 1,604 p>.05	KW= ,255 p>.05	KW= 4,132 p>.05	KW= 2,533 p>.05	KW= ,816 p>.05	KW= 3,067 p>.05
<b>Parent Age<sup>r</sup></b>	-,004	-,027	-,050	-,070	,032	-,017	-,028
<b>Child Age<sup>r</sup></b>	,073	,106	,067	-,026	,218*	-,085	,050

Note: \* = p<.05, <sup>r</sup> = Spearman Rank Correlation

Kw=Kruskal Wallis H Testi, U= Mann Whitney U Testi

A positive and decently significant relationship was found between the “Excessive Sleepiness Disturbance (ESD)” sub-dimension and the age of the children. In other words, as the ages of the children increase, excessive sleepiness disturbance also increases (Table 4).

Table 5 shows the results of the analysis conducted to compare the average scores of the “The Sleep Disturbance Scale for Children” scale and its sub-dimensions according to the information about the disease and sleep. According to the results of the analysis, a significant difference was found in the sum of the “The Sleep Disturbance Scale for Children” scale according to the variables of the child’s daytime sleeping status, their state of blood sugar drop during sleep and the negative effect of diabetes on their sleep ( $p < 0.05$ ). According to these significant differences, the average score of the parents whose child(ren) slept during the day was higher than the average score of the parents whose child did not sleep during the day. The mean scores of parents who stated that blood sugar negatively affected sleep in children were higher than the mean scores of parents who stated that blood sugar did not negatively affect sleep in children.

A significant difference was found in the “Wakefulness Reactions Disturbance (WRD)” sub-dimension according to daytime sleeping status and snacking before going to sleep ( $p < 0.05$ ). According to these significant differences, the average score of the parents whose child slept during the day and the parents whose child sometimes slept was higher than the average score of the parents whose child did not sleep during the day. The average score of the parents of the children who snack before going to sleep is lower than the average score of the parents of the children who do not snack before going to sleep.

A significant difference was found in the “Sleep Wakefulness Transition Disturbance (SWTD)” sub-dimension according to the variables of daytime sleepiness, blood sugar drop during sleep, and the negative effect of diabetes on sleep ( $p < 0.05$ ). According to these significant differences, the average score of the parents whose child slept during the day and the parents whose child sometimes slept was higher than the average score of the parents whose child did not sleep during the day. The average score of the parents whose child’s blood sugar dropped during sleep was higher than the average score of the parents whose child’s blood sugar did not drop during sleep. The average score of the parents who indicated that blood sugar had a negative effect on sleep

**Table 5. Comparison of the score averages of the sleep disturbance scale and sub-dimensions for children according to information about illness and sleep**

Variables	PSIM X±SS	RDDS X±SS	WR X±SS	SWTD X±SS	ESD X±SS	ESDS X±SS	Sum scale X±SS
In The Same Bed With The Parent	13,33±1,15	4,00±1,00	3,33±,57	11,00±2,00	8,33±2,30	3,33±,57	43,33±2,30
Same Room With Parents, Separate Bed	14,12±4,42	4,60±2,46	4,12±1,36	11,56±4,44	9,00±4,41	5,24±3,01	48,64±14,06
Alone In A Separate Room	13,94±5,04	3,70±,91	4,41±2,23	9,64±2,99	10,35±5,18	4,35±2,69	46,41±13,62
In A Separate Room With His Brothers	14,48±3,92	4,35±1,88	4,03±1,37	10,71±4,05	9,96±4,08	4,18±2,23	47,73±12,38
<b>TEST</b>	KW= ,883 p>.05	KW= 1,294 p>.05	KW= ,909 p>.05	KW= 2,091 p>.05	KW= 2,802 p>.05	KW= 2,476 p>.05	KW= ,680 p>.05
<b>Fluid Consumption Before Sleep</b>							
Yes	14,52±4,43	4,36±1,89	4,27±1,71	11,25±4,11	10,18±4,59	4,76±2,65	49,36±13,74
No	14,00±3,85	4,22±1,94	3,90±1,26	10,20±3,75	9,28±3,93	4,08±2,30	45,68±11,35
<b>TEST</b>	U= 1298,5 p>.05	U= 1295,5 p>.05	U= 1249,5 p>.05	U= 1180,5 p>.05	U= 1224,5 p>.05	U= 1162,5 p>.05	U= 1189,0 p>.05
<b>Daytime Sleeping Condition</b>							
(1) Yes	14,88±5,42	4,61±2,68	4,94±2,26	11,88±4,61	11,33±6,13	5,44±3,31	53,11±17,09
(2) No	13,65±3,44	4,23±1,92	3,58±,87	9,46±3,07	8,55±3,81	4,39±2,44	43,88±9,98
(3) Sometimes	14,63±4,22	4,22±1,52	4,25±1,49	11,54±4,18	10,27±3,59	4,06±2,11	49,00±12,29
<b>TEST</b>	KW= ,850 p>.05	KW= ,262 p>.05	<b>KW= 6,637</b> <b>p&lt;.05</b> <b>2&lt;1</b> <b>2&lt;3</b>	<b>KW= 6,860</b> <b>p&lt;.05</b> <b>2&lt;1</b> <b>2&lt;3</b>	<b>KW= 6,709</b> <b>p&lt;.05</b> <b>2&lt;1</b>	KW= 1,611 p>.05	<b>KW= 6,183</b> <b>p&lt;.05</b> <b>2&lt;1</b>

Table 5. Continued							
Variables	PSIM	RDDS	WR	SWTD	ESD	ESDS	Sum scale
	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS	X±SS
<b>Spending Time with Digital Devices Before Sleep</b>							
Yes	14,46±4,30	4,26±1,76	4,10±1,42	11,03±4,04	10,10±4,36	4,43±2,50	48,40±12,92
No	13,25±3,08	4,43±2,65	4,06±2,04	9,18±3,18	7,81±3,44	4,43±2,60	43,18±10,98
<b>TEST</b>	U= 609,5 p>.05	U= 658,0 p>.05	U= 648,5 p>.05	U= 508,5 p>.05	<b>U= 455,00</b> <b>p&lt;.05</b>	U= 711,0 p>.05	U= 508,5 p>.05
<b>Child's Sleep Time</b>							
Between 20 and 22	14,27±3,97	4,27±2,03	4,22±1,75	10,91±3,57	9,16±3,98	4,44±2,48	47,30±11,66
After 22	14,27±4,27	4,30±1,85	4,02±1,39	10,66±4,17	10,05±4,45	4,43±2,53	47,76±13,34
<b>TEST</b>	U= 1220,0 p>.05	U= 1220,5 p>.05	U= 1199,0 p>.05	U= 1144,5 p>.05	U= 1082,5 p>.05	U= 1215,0 p>.05	U= 1197,5 p>.05
<b>The Way of Taking Insulin at Night</b>							
Before Sleep	14,19±4,22	4,26±1,88	4,11±1,53	10,69±3,84	9,95±4,34	4,49±2,46	47,73±12,53
Wake up	15,44±4,06	5,00±2,34	4,11±1,69	12,22±5,28	8,55±4,12	4,33±3,31	49,66±16,05
Pump	13,33±2,30	3,00±,00	3,33±,57	8,00±1,73	7,00±2,00	3,00±1,00	37,66±3,51
<b>TEST</b>	KW= ,995 p>.05	KW= 5,499 p>.05	KW= ,721 p>.05	KW= 2,399 p>.05	KW= 3,302 p>.05	KW= 1,457 p>.05	KW= 2,866 p>.05
<b>The Situation of Snacking Something Before Sleep</b>							
Yes	14,13±4,19	4,26±1,97	3,83±1,23	10,86±4,10	10,03±4,33	4,63±2,57	47,75±12,80
No	14,50±4,13	4,35±1,81	4,52±1,83	10,57±3,76	9,30±4,26	4,12±2,39	47,37±12,79
<b>TEST</b>	U= 1235,5 p>.05	U= 1221,0 p>.05	<b>U= 1024,5</b> <b>p&lt;.05</b>	U= 1281,0 p>.05	U= 1144,0 p>.05	U= 1125,0 p>.05	U= 1232,0 p>.05
<b>The State of Blood Sugar Drop During Sleep</b>							
Yes	14,66±4,45	4,63±2,22	4,25±1,70	11,63±4,10	10,96±4,75	4,71±2,59	50,87±13,92
No	13,69±3,63	3,78±1,15	3,85±1,18	9,42±3,38	7,92±2,64	4,02±2,34	42,71±8,81
<b>TEST</b>	U= 1167,0 p>.05	<b>U= 1033,5</b> <b>p&lt;.05</b>	U= 1181,0 p>.05	<b>U= 872,5</b> <b>p&lt;.05</b>	<b>U= 782,5</b> <b>p&lt;.05</b>	U= 1107,5 p>.05	<b>U= 846,5</b> <b>p&lt;.05</b>
<b>The Effect of Diabetes on Sleep Status</b>							
Yes	14,70±4,78	4,59±2,20	4,09±1,44	11,59±4,23	11,12±5,08	4,94±2,80	51,05±14,70
No	13,82±3,35	3,98±1,50	4,09±1,61	9,86±3,48	8,29±2,61	3,90±2,04	43,96±9,05
<b>TEST</b>	U= 1287,0 p>.05	U= 1175,5 p>.05	U= 1358,0 p>.05	<b>U= 1036,5</b> <b>p&lt;.05</b>	<b>U= 930,0</b> <b>p&lt;.05</b>	U= 1110,5 p>.05	<b>U= 999,0</b> <b>p&lt;.05</b>

Kw=Kruskal Wallis H Testi, U= Mann Whitney U Testi

was higher than the average score of the parents who indicated that blood sugar had no negative effect on sleep. A significant difference was found in the "Excessive Sleepiness Disturbance (ESD)" sub-dimension according to the variables of daytime sleepiness, spending time with a digital tool before sleep, blood sugar drop during sleep and the negative effect of diabetes on sleep ( $p<0.05$ ). According to these significant differences, the average score of the parents whose child slept during the day was higher than the average score of the parents whose child did not sleep during the day. The average score of the parents whose child spent time with a digital tool before sleep was higher than the average score of the parents whose child did not spend time

with a digital tool before sleep. The average score of the parents whose child's blood sugar dropped during sleep was higher than the average score of the parents whose child's blood sugar did not drop during sleep. The average score of the parents who indicated that blood sugar had a negative effect on sleep was higher than the average score of the parents who indicated that blood sugar had no negative effect on sleep (Table 5).

Table 6 shows the distributions of the children's sleeping times at night and the time they fell asleep after going to bed. According to the table, 33.3% of the children slept between 8 and 9 hours per night. In addition, 39% of the children fell asleep between 15 and 30 minutes after going to bed (Table 6).

**Table 6. Distributions of night sleeping time and falling asleep time of the children participating in the study**

Questions	n	%	
How many hours does your child sleep most nights?	9-11 hours	30	28,6
	8-9 hours	35	33,3
	7-8 hours	32	30,4
	5-7 hours	7	6,7
	Less than 5 hours	1	1,0
How long does your child usually fall asleep after going to bed?	Less than 15 minutes	39	37,1
	Between 15-30 minutes	41	39,0
	Between 30-45 dk minutes	8	7,6
	Between 45-60 dk minutes	7	6,7
	More than 60 minutes	10	9,5
<b>Total</b>	<b>105</b>	<b>100,0</b>	

## DISCUSSION

Sleep greatly affects people's health and quality of life. Sleep is a concept with social, psychological and physiological dimensions.<sup>20</sup> Sleep disturbance in children and adolescents with T1D can often be disrupted due to hypoglycemia, hyperglycemia and their parents' diabetes care behaviors.<sup>15</sup> Sleep disturbance can both negatively affect the progression of the disease and cause the development of complications.<sup>17</sup>

As a result of this research, the average total score of the SDSC was  $47.60 \pm 12.740$ . According to this result, the level of sleep disturbance of the children that participated in the study was below the average score. In other words, the children that participated in the study had a low level of sleep disturbance. In the study of Ağadayı et al.<sup>19</sup> the average total score of the SDSC answered by mothers was  $40.9 \pm 10.1$ , while the total score average of the scale answered by fathers was  $40.2 \pm 10.3$ .<sup>19</sup> The results of the present research are in parallel with the literature. Six sub-dimensions of the SDSC were used within the scope of the research. According to the demographic characteristics of the surveyed parents, "The Sleep Disturbance Scale for Children (SDSC)" on the comparison of the dimensions and sub points in an average of the results of the analysis when we look at "Sleep-Wake Transition Disturbance (SWTD)" the size of the parents according to the income of the state variable sub a significant difference was detected ( $p < 0.05$ ). The average score of the parents whose income was more than their expenses was lower than the average score of the parents whose income was less than their expenses and whose income was equal to their expenses. A significant difference was found in the "Sleep Initiation and Maintenance Problems (SIMP)" sub-dimension according to the parents' educational status ( $p < 0.05$ ). According to the results of this research, the average score of the parents who graduated with a bachelor's degree was lower than the average score of parents who graduated from elementary school and high school. From the literature, a study conducted with the parents of 299

primary school students in Turkey found significant differences between the family's income status, education status, bedtime resistance and sleep duration.<sup>21</sup> In the present research a significant relationship was found between the "Excessive Sleepiness Disturbance (ESD)" sub-dimension. In other words, as the age of the children increases, the excessive sleepiness disturbance also increases. From a study found in the literature, according to the parent group having the SDSC sleep problem, were reported, the average score of the subscale with the highest UUGB SWTD trace of sleep during the day in elementary school and it is reported to be related to be culturally accepted.<sup>17</sup> A significant difference was found in the "Wakefulness Reactions Disturbance (WRD)" sub-dimension according to daytime sleep status and snacking before going to sleep ( $p < 0.05$ ). A significant difference was found in the "Excessive Sleepiness Disturbance (ESD)" sub-dimension according to the variables of the child's daytime sleeping status, the state of spending time with a digital tool before sleep, the state of blood sugar drop during sleep and the negative impact of diabetes on sleep ( $p < 0.05$ ). According to these significant differences, the average score of the parents whose child slept during the day was higher than the average score of the parents whose child did not sleep during the day. The average score of the parents whose child spent time with a digital tool before sleep was higher than the average score of the parents whose child did not spend time with a digital tool before sleep. Sleep problems are affected by television, bedtime resistance, delay in starting to sleep are anxiety during sleep and thus shortened sleep duration<sup>22</sup>. From the literature, total sleep time and total duration of TV viewing in a study of non different between the two groups of respondents and 51% are reported to have a TV set in each child's bedroom and children with a TV in the room, "night terrors", "nightmares", "sleep talking" and "tired of being on WakeUp" responses, it was stated that showed significantly higher score.<sup>23</sup>

Children with T1D may be especially vulnerable to sleep disturbance as parents may delay bedtime if their blood sugar



levels are outside the target point and they often wake children up during the night to monitor their blood sugar and treat episodes of hypoglycemia or hyperglycemia.<sup>24</sup> In the present research, the average score of the parents whose child's blood sugar dropped during sleep was higher than the average score of the parents whose child's blood sugar did not drop during sleep. The average score of the parents who indicated that blood sugar had a negative effect on sleep was higher than the average score of the parents who indicated that blood sugar had no negative effect on sleep. In a study consisting of 75 children with T1D and 49 controls, 65.3% of all participants in both groups had sleep problems; children with T1D slept less and experienced more daytime sleepiness problems compared to the controls.<sup>25</sup> In the present study, a significant difference was found in the "Sleep Wakefulness Transition Disturbance (SWTD)" sub-dimension of the SDSC according to the variables of daytime sleepiness, blood sugar drop during sleep and the negative effect of diabetes on sleep ( $p < 0.05$ ). In another study, SWTD was the subscale with the highest average score.<sup>17</sup> The results of the present research are similar to the literature. In the present research, 33.3% of the children slept between 8 and 9 hours per night. In addition, 39% of the children fell asleep between 15 and 30 minutes after going to bed. In a study conducted with 111 participants with T1D similar to the sample of the present study, the children slept below the recommended amount of sleep for this age group of children by approximately nine hours and were found to be in poor glycemic control, which showed that less sleep is associated with poor management and glycemic control. In the same study, it was reported that especially later bedtimes and a greater social jetlag may be associated with poor glycemic control.<sup>26</sup> In another study, 60 people formed the control of the experimental group significantly more adolescents with 60 T1D delay starting to sleep, non-REM sleep and sleep efficiency, and arousal index significantly lower compared to the controls to have sleep rapid eye activity are stated.<sup>27</sup> In addition to the direct physiological effect of sleep on glycemic control, insufficient and poor quality sleep has an indirect, behavioral effect on diabetes management. Sleep disturbance, including bedtime resistance and nighttime waking, have been associated with greater behavioral problems in school-age children.<sup>28</sup> In the present research, most children also slept late. According to Monzon et al. (2019) as sleep duration decreases, due to increased frequency of waking up at night, parental stress due to night care, anxiety about illness, and constant monitoring, cortisol levels rise and glycemic control poors.<sup>13</sup> In Farabi's study (2016)<sup>17</sup> with 130 people, it was reported by parents that 45.1% of their children's sleep duration was 8-9 hours per night.<sup>17</sup> The results of the research are in line with the literature.

## CONCLUSION

As a result of this research, the parents that participated in the study evaluated the level of sleep disturbance of their children as below the average score. The SDSC was affected in the dimensions of Wakefulness Reactions Disturbance and Sleep-Wakefulness Transition Disturbance, Excessive Sleepiness Disturbance, and significant differences were found in these sub-dimensions. When the source of the sleep problems of children with T1D was examined, it was seen that the sleep of these children was affected by their conditions. Since the sleep disturbance of the children with T1D are affected by familial characteristics and factors related to the disease, it is recommended to conduct other studies to identify sleep disturbance and influencing factors to improve these conditions, and to provide educational and counseling services to parents on these issues.

## MAIN POINTS

Main points of the study is to investigate of sleep disturbance and sleep-related problems in children with type 1 diabetes;

- Diabetes has a negative effect on sleep.
- Sleep problems of children with chronic diseases are affected by familial characteristics.
- Parent education is important for the sleep health of children with diabetes.

## ETHICS

Ethical Committee Approval: Approval was obtained from the Ethical Committee of a Training and Research Hospital Non-Interventional Clinical Researches that the study was in compliance with ethical principles (Ethical committee no: 12 date: 2022/14-05).

**Informed Consent:** Informed consent was obtained from all individual participants included in this study.

## Authorship Contributions

Concept: Z.K., F.K.Ö., D.Ç.B., Design: Z.K., F.K.Ö., D.Ç.B., Supervision: F.K.Ö., Data Collection and/or Processing: Z.K., G.G., C.K., S.Y., Analysis and/or Interpretation: F.K.Ö., D.Ç.B., Literature Search: F.K.Ö., D.Ç.B., Writing: F.K.Ö., D.Ç.B.

## DISCLOSURES

**Conflict of Interest:** No conflict of interest was declared by the authors.

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