



Sleep Characteristics of Pediatric Burn Patients

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ABSTRACT

Aim: Soft tissue injuries which happen because of high heat, chemicals etc. are called burns. Sleep is a complex behavior regulated by the interaction of anatomical and neurochemical areas in the central nervous system. After being burnt; patients are exposed to many stressors that cause sleep interruption and decrease sleep quality. The purpose of this study was to determine sleep characteristics, sleeplessness and sleep habits in pediatric burn patients.

Materials and Methods: This descriptive study was carried out on 96 children who were 2-6 years old in the pediatric surgery department/ burn unit for a period of between 2-7 days. For data collection, a demographic data collection form and a sleep problems characteristics and identification survey, which was created by the researchers, were used. Data were collected via face to face interviews with mothers. Questions were asked in order to compare pre- and post- burn sleep quality.

Results: Of the children, 53.1% were male and their mean age was 3.36 ± 1.39 years. There was a significant difference between pre- and post-burn periods on children's sleeping and waking hours, total and night sleep duration, total daily sleep duration, existence of sleep interruption and number of interruptions, trouble of falling asleep and sleep latency, being tired in the morning, forcing the children to wake up and also the duration of waking up.

Conclusion: With the knowledge about the importance of sleep, attention should be paid to the sleep of children that we are providing care to. Supportive environmental regulations should be made to improve the quality of sleep in hospitals.

Keywords: Pediatrics, burn, sleep

Introduction

Pediatric burns are the third most common cause of accident-induced mortality following motor vehicle accidents and drowning (1). In the United States of America, approximately 300 children are admitted to the hospital for burn treatment and two of them die each day (2). Burn injuries lead to sudden changes in the metabolism including hypermetabolism and catabolism (3). The reasons for the increase in the metabolic rate are the effects of inflammation on the thermoregulation system after being burnt and heat loss caused by evaporation (4). If 5% or more of the total body surface area is burned in

adults, this leads to an increase in the metabolic rate from 118% to 210% (5).

As in all traumas, children are more vulnerable to burn injuries than adults, which is due to physiological and anatomical differences between adults and children. Neurological systems that have not completed their development in children may not tolerate the increase in the level of norepinephrine, one of the main neurotransmitters. Children's total body surface area is more than that of adults. Accordingly, their metabolic rates are higher. Due to their thinner dermis and larger body surface area compared to those of adults, they are at

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a greater risk of developing complications in burn traumas (6).

After suffering a burn, patients are exposed to many stressors that lower sleep quality and interrupt sleep (7). Treatment-associated factors such as fixation methods, physiological factors, therapeutic interventions, diagnostic procedures, mechanical ventilation, sedatives, analgesic and anesthetic drugs are known to affect sleep. Burn patients are exposed to many environmental stimuli such as light, wound dressings, treatment alarm sounds of the devices, and sounds from infusion pumps, phones, pagers and televisions which disrupt their daily routine (8). Thermal injuries cause an increase in sleeplessness, and significant reductions in non-REM sleep (stage 3 and 4) and REM sleep (9). Typically, in burn patients, increases are observed in the metabolic rate, protein degradation and weight loss (10). Sleeplessness can increase metabolic rate and catabolism as well (11). Catabolic hormones like catecholamine and cortisol increase after the burn or sleeplessness (10). Post-burn or with sleeplessness, impaired glucose tolerance can occur too (12,13); however, the amount of growth hormone decreases (14).

Although there are a lot of studies about the effects of insomnia and burns on the metabolic variables, there are only limited studies to determine sleep characteristics, sleeplessness and sleep habits. This present study was planned to determine sleep characteristics, sleeplessness and sleep habits in pediatric burn patients.

Materials and Methods

Type of Study: The study was designed as a descriptive one.

Setting: The study comprised 96 children hospitalized in the pediatric burn unit of a university hospital. As the children's burn-induced pain was intense in the first days post-burn, and because they were not expected to overcome the burn shock immediately, the data were gathered at one time between the 2nd and 7th days of their stay in the hospital.

Inclusion Criteria: Patients who were hospitalized at the burn clinic (but not in burn intensive care unit) for a minimum of 2 and a maximum of 7 days, between the ages of 24 and 72 months, and who had no surgery because of the burn, were conscious and whose parents volunteered to participate in the study were included in the study.

Implementation of the Study: The data of the study was collected between April 2015 and April 2016. All the parents gave their written consent before the study was started. Data were obtained with the survey method through face-to-face interviews with mothers. In order to determine the effect of the burn on sleep, the child's sleep patterns before and after burn injuries were compared. When the data were

collected, questions on sleep problems were asked in such a way as to compare the child's condition prior to the burn at home, and post-burn in the hospital.

Data Collection Tools

Sociodemographic Characteristics Questionnaire:

The socio-demographic Characteristics Questionnaire was developed by the researchers to collect socio-demographic data about the children in the study. The questionnaire has 28 items questioning the characteristic of the burn and the child's age.

Sleep Characteristics and Problems Identification

Survey: Questions on the children's sleeplessness were prepared by the researcher through a literature review (15-18). In this survey, questions about sleep duration, the number of sleep disturbances, the causes of insomnia, the possibility of drowsiness and sleeping habits of the child were asked. The questions in the survey were asked both to determine the child's previous situation prior to the burn and post-burn. Thus, it was hoped to determine whether or not the child had a sleeping problem prior to the burn.

Ethics: This study's procedure was approved by the Institutional Review Board of İzmir Katip Çelebi University Non-interventional Clinical Studies Institutional Review Board (approval no: 2015/112). All voluntary participants were informed that they could withdraw from the study at any time at the beginning of the study. A consent form was filled out by all participants.

Statistical Analysis

The data obtained from the study were analyzed using the SPSS version 21 (2012). Participating patients' socio-demographic characteristics were given as number and percentage distributions. To analyze the mean scores obtained from the patients and their parents according to their socio-demographic characteristics, the compliance with normal distribution analysis was performed, and the dependent t-test, Friedman test and McNemar's test were used. Statistical significance was established as a p value <0.05.

Results

The participating children's mean age was 3.36 ± 1.39 and of the children 53.1% (n=51) were male (Table I). The part of the body exposed to burns most in the children participating in the study (10.4%, n=10) was the "hands". Of the children participating in the study, 79.2% (n=76) had second-degree burns. The mean percentage of burns was $8.12\% \pm 5.61$ (minimum: 1%, maximum 30%). Of the causes of burns in children, 47.9% were (n=46) hot water (Table II).

There was a statistically significant difference between the durations of night sleep ($t=13.644$, $p<0.001$), the times

the children woke up ($t=10.023$, $p<0.001$) and the duration of sleeps per day on pre-post burn periods ($t=8.715$, $p<0.001$) (Table III).

There was a statistically significant difference between the times the children went to sleep ($F: 12.938$, $p<0.001$) and the number of the children who had interruptions of sleep ($p<0.001$) and the number of the sleep interruptions in the pre- and post-burn periods ($F: 55.000$, $p<0.001$). There was a statistically significant difference between falling asleep patterns ($p<0.001$), and the durations of falling asleep in the pre- and post-burn periods ($F: 22.349$, $p<0.001$) and mothers' thoughts about having trouble while awakening the children ($p<0.001$) and in the terms of the mothers' statements that their children had sleep problems ($p<0.001$) (Table IV).

The sleep habits of the children in the pre-post burn periods were shown, and the pre-post burn periods were

Socio-demographic characteristics			
Socio-demographic characteristics		n	%
Gender	Girl	45	46.9
	Boy	51	53.1
Age, Mean: 3.36±1.39, Min: 2, max: 6	2 years	40	41.7
	3 years	21	21.9
	4 years	17	17.7
	5 years	3	3.1
	6 years	15	15.6

Min: Minimum, Max: Maximum

Characteristics		n	%
Location of burn	Hands	10	10.4
	Genital Area	9	9.4
	Feet	8	8.3
	Legs	7	7.3
	Arms	5	5.2
	Head	5	5.2
	Torso	3	3.1
	More than one body part	49	51.1
Degree of the burn	2 nd degree	76	79.2
	3 rd degree	20	20.8
Percentage of the burn Mean: 8.12%±5.61% Min: 1% Max: 30%	1%-10%	74	77.1
	11%-20%	18	18.8
	21%-30%	4	4.2
Burn factor (cause of the burn)	Water	46	47.9
	Oil	2	2.1
	Electricity	1	1.0
	Stove	4	4.2
	Flame	6	6.3
	Tea	30	31.3
	Food	4	4.2
	Others	3	3.1

Min: Minimum, Max: Maximum

		Mean	SD	Min-max values	t	p value
Wake up time in the morning	Pre-burn	8.48 a.m.	1.14	Min: 5 Max: 11	10.023	<0.001
	Post-burn	6.96 a.m.	1.09	Min: 1 Max: 9		
Duration of night sleep	Pre-burn	10.83 hours	1.13	Min: 6 hours Max: 12 hours	13.644	<0.001
	Post-burn	7.44 hours	1.79	Min: 3 hours Max: 12 hours		
Duration of daytime sleep	Pre-burn	1.46 hours	1.07	Min: 0 hours Max: 3 hours	-1.307	0.194
	Post-burn	1.67 hours	1.01	Min: 0 hours Max: 6 hours		
Duration of daily sleep	Pre-burn	11.56 hours	1.40	Min: 8 hours Max: 15 hours	8.715	<0.001
	Post-burn	9.13 hours	2.07	Min: 4 hours Max: 15 hours		

SD: Standard deviation, Min: Minimum, Max: Maximum

compared from this aspect. There were statistically significant differences between the children's pre- and post-burn period sleep habits in the following circumstances: having difficulty falling asleep at night ($p<0.001$), having difficulty falling asleep at night again after waking up ($p<0.001$), taking relaxants when he/she wakes up at night ($p=0.004$), craving for food or drink during the night ($p<0.001$), fear of sleeping alone ($p<0.001$), fear of sleeping in the dark ($p<0.001$), being anxious and restless during the day because of not having enough sleep during the previous night ($p<0.001$), willing to be read books or listen to a lullaby before going to sleep ($p<0.001$), feeling restless while sleeping

($p<0.001$), waking up screaming, crying, and waking up due to a nightmare ($p<0.001$) (Table V).

Discussion

In this study, it was found that children's mean duration of night sleep altered in the post-burn period and they went to sleep later than usual in the hospital. Similarly; Bisogni et al. (19) determined that while the number of the children who slept less than 5 hours at home increased by 4.7% after hospitalization, the number of the children who slept 9-11 hours at home decreased by 5.9% after hospitalization (19). In the same study, the mothers put their children to sleep later in the hospital. While

		Pre-burn		Post-burn			p value
		n	%	n	%		
What time does the child to go to sleep?	7.00 p.m.-9.59 p.m.	8	8.3	12	12.5	12.938**	<0.001
	10.00 p.m.-11.59 p.m.	78	81.3	43	44.8		
	After 12 midnight	10	10.4	41	42.7		
Does the child have interruptions of sleep?	Yes	61	63.5	92	95.8	*	<0.001
	No	35	36.5	4	4.2		
How many times does the child have interruptions of sleep?	Once	32	32.5	5	5.2	55.000**	<0.001
	Twice	16	26.2	13	14.1		
	3 times	13	21.3	22	23.9		
	4 or more times	-	-	52	56.5		
Does the child have trouble falling asleep?	Yes	52	54.2	79	82.3	*	<0.001
	No	44	45.8	17	17.7		
How long does it take the child to fall asleep?	Less than 15 minutes	24	25.0	17	20.7	22.349**	<0.001
	15-30 minutes	25	26.0	13	15.9		
	30-45 minutes	4	4.2	31	37.8		
	45-60 minutes	4	4.2	19	23.2		
	More than 60 minutes	-	-	2	2.4		
Does the child wake up tired in the morning?	Yes	12	12.5	58	60.4	*	<0.001
	No	84	87.5	36	38.3		
Does the mother have trouble awakening the child in the morning?	Yes	33	34.4	55	57.3	*	<0.001
	No	63	65.6	41	42.7		
How long does it take to awaken the child?	Less than 15 minutes	22	66.7	16	16.7	15.000**	<0.001
	15-30 minutes	9	27.3	34	35.4		
	30-45 minutes	2	6.1	6	6.3		
	45-60 minutes	-	-	2	2.1		
Does the mother think that the child has sleep problems?	Yes	35	36.5	78	81.3	*	<0.001
	No	61	63.5	18	18.8		

*Analysis was performed with the McNemar's test. **Analysis was performed with the Friedman test

Table V. Comparison of pre-post burn sleep habits

	Pre burn				Post burn				p value
	Never occasionally		Frequently every night		Never occasionally		Frequently every night		
The child;	n	%	n	%	n	%	n	%	
Has trouble falling asleep (needs a parent)	69	71.9	27	28.1	12	12.5	84	87.5	<0.001
Has trouble falling asleep at night again after waking up	67	69.8	29	30.2	16	16.7	80	83.3	<0.001
Wants a pacifier when he/she wakes up at night; wants his/her parent to put the pacifier back to his/her mouth	66	68.8	30	31.3	53	55.2	43	44.8	0.004
Wants to drink something overnight (Sucking Mother's Breast or bottle)	86	89.6	10	10.4	68	70.8	28	29.2	<0.001
Is afraid of sleeping alone	75	78.1	21	21.9	30	31.3	66	68.8	<0.001
Is afraid of sleeping in the dark	79	82.3	17	17.7	46	47.9	50	52.1	<0.001
Hugs an object while falling asleep (blanket, toy, bottle etc.)	70	72.9	26	27.1	71	74.0	25	26.0	>0.05
Is anxious and restless during the day because of not having enough sleep at the previous night	80	83.3	16	16.7	30	31.3	66	68.8	<0.001
Wants to be read books or listen to a lullaby before going to sleep	74	77.1	22	22.9	54	56.3	42	43.8	<0.001
Feels restless while sleeping	95	99.0	1	1.0	20	20.8	76	79.2	<0.001
Wakes up screaming, crying, wakes up due to a nightmare	95	99.0	1	1.0	23	24.0	73	76.0	<0.001

the number of the children who went to sleep between 9.00 p.m. and 10.00 p.m. at home decreased by 9.8% in the hospital, the number of children who went to sleep between 10.00 p.m. and 11.00 p.m. at home increased by 10.1% in the hospital.

In this study, the participating children went to bed later, had a greater number of sleep interruptions and woke up earlier in the morning in the hospital than they did at home. Similarly, in a study by Meltzer et al. (20), children went to bed later and had more sleep interruptions in the hospital than they did at home. However, in Meltzer et al. (20) study, the children woke up later and their total sleep time increased, which was different from the results of the present study. In Setoyama et al. (21) study conducted in 2016, the parameters such as durations of the whole-day sleep, time to go to bed, wake up time, time spent in bed, sleep efficiency, sleep onset latency, the number of night waking, duration of sleep after falling asleep in the hospital were compared with those at home, and significant differences were determined between duration of sleep at night and time they spent in bed, which was similar to the results of the present study. Although statistically insignificant, when they were in the hospital, the children woke up earlier, and the duration of daytime sleep and the total daily sleep times were longer.

In this study, 82.3% of the children had trouble falling asleep after suffering a burn, and it took 37% of them 30-45 minutes to fall asleep. Similarly, in Linder and Christian

(22) study of hospitalized children, 60% of the children experienced delays in falling asleep although they had no trouble going to bed.

In this study, 36.5% of the mothers said that their children had sleep problems at home whereas 81.3% stated that their children had sleep problems in the hospital. Similarly, in their study conducted in 2014, Orme et al. (23) compared the children's sleep characteristics at home and in the hospital, and based on the parents' statements, they determined that the children's quality of sleep was better at home.

Study Limitations

In this study, the participants were not investigated in terms of the stages of sleep. In a study conducted by Armour et al. (9), they determined that thermal burns led to increases in sleeplessness and significant decreases in non-REM sleep (stage 3 and 4) and REM sleep.

The second limitation of this study was that sleep quality indicators such as fatigue etc. were not investigated by gender. In a study by Perdikaris et al. (24), they determined that fatigue levels of hospitalized children varied by gender, and that girls' fatigue scores were higher.

The third limitation was that the relationship between sleep quality parameters and the age of the children was not investigated in the present study. In a study conducted by Price et al. (25), the duration of daytime sleep and whole day sleep decreased as the children's age increased. The other limitation was that because the children's burn-

induced pain was intense in the first days post-burn, and because they were not expected to have overcome the burn shock immediately, the data were collected between the 2nd and 7th days of their stay in the hospital.

The last limitation was about the percentages of the burns. The number of patients with a percentage of burns greater than 20% during data collection was low. Different results may be obtained when studying patients with a higher percentage of burn.

Conclusion

In the current study, significant differences were determined between the participating children's pre- and post-burn conditions.

Burns cause major changes in the body metabolically. These changes generally show similar characteristics with the changes brought about by sleep deprivation. Nurses should be aware of the importance and benefits of sleep, should pay attention to sleep habits and characteristics of children they give healthcare to and make environmental arrangements to improve the quality of sleep in clinics in first week post-burn, which can minimize the triggering effect of staying in hospital on sleep disorders. It is recommended to carry out studies on the promotion of the sleep quality of hospitalized children and on changes in the effectiveness of Non-REM and REM sleep in children with burns.

Key Points

- There was a significant difference between pre-and post-burn periods on children's sleeping pattern.
- Children with a high degree of burn were shown to take longer to wake up in the morning.
- Supportive environmental regulations should be made to improve the quality of sleep in hospitals.

Ethics

Ethics Committee Approval: This study's procedure was approved by the Institutional Review Board of İzmir Katip Çelebi University Non-interventional Clinical Studies Institutional Review Board (approval number: 2015/112).

Informed Consent: A consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: H.Y.S., E.A.A., Design: H.Y.S., Data Collection or Processing: E.A.A., Analysis or Interpretation: H.Y.S., E.A.A., Literature Search: E.A.A., Writing: H.Y.S., E.A.A.

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