


Predictors of Sleep Habits in Premature Infants: A Cross-Sectional Study

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ABSTRACT

Objectives: Despite the significant frequency of sleep disorders in premature infants, the specific causes remain unclear. Thus, pediatricians and other caregivers may be able to prevent the onset of sleep disorders in children. Accordingly, the present study aimed to assess the predictors of sleep habits among preschoolers born preterm.

Materials & Methods: This cross-sectional, retrospective study included 174 preterm infants from the Semnan clinic in Iran between 2019 and 2020. All children between the ages of four and seven years old who were born before 37 weeks were included. Information on demographic variables and the Children's Sleep Habits Questionnaire (CSHQ) was collected from the participants. The Research Ethics Committee of the Semnan University of Medical Sciences, Semnan, Iran (IR. SEMUMS.REC.1396.235).

Results: The average age of children and mothers were 5.7 ± 0.96 and 32.14 ± 2.02 years old, respectively. The probability of familial conflict (OR = 2.73, 95% CI = 0.97-7.71, and P = 0.041), sleepwalking (OR=2.56, 95% CI=1.30-5.06, and p=0.006) and seclusion increased (OR=2.68, 95% CI=0.91-5.13, and P=0.034) in CSHQ $1 <$ to 2 compared with CSHQ >2 in adjusted model History of psychological disorder, sleep drugs use, withdrawn and previously diagnosed sleep disorders, depression, nightmares, and sleeping alone no had significant association with CSHQ score.

Conclusion: The study concluded that stress factors, such as family conflicts, behavioral changes like increased seclusion, as well as internal issues like sleepwalking, should be regularly investigated in children referred to clinics for sleep problems. Healthcare professionals need to assess how these symptoms may worsen or impact the effectiveness of treatment.

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Introduction

The improvements in pregnancy and neonatal care allowed for the survival of very low birth weight

newborns (1, 2). Premature births account for one of every ten live births (3), and more than 85% (11 million neonates) occur in Asia and Africa (4). Preterm birth rates are 10.6% globally and 6.4% in Iran (5).

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Preterm infant need a neonatal intensive care unit (NICU) to survive and their organ development (6). Compared to the previous 30 years, the death rate for this newborn, particularly those with extremely low birth weight, has significantly decreased, in addition to the rise in the occurrence of premature birth (2, 7, 8).

Advancements in fetal and neonatal care have significantly reduced mortality rates and increased survival. Key factors include the development of specialized care units, administering corticosteroids between 28 and 32 weeks of pregnancy, promptly prescribing surfactants after birth, and employing strategies such as minimizing intubation in the delivery room and enhancing the use of Continuous Positive Airway Pressure (CPAP) (9-11).

Although the NICU's specialized treatment boosts preterm newborns' chances of survival, environmental and clinical factors such as intermittent light and constant noise, frequent experiences of pain, and parental deprivation can change the dimensions of this group's life. It renders them more vulnerable to significant difficulties while they are young (12). The disturbance of the organization and development of the sleep and wakefulness pattern is one of the most significant issues (13).

Less than 37 weeks in preterm newborns, fetal sleep and wakefulness states continue to develop with a delay from the third trimester of pregnancy (14). The pattern of sleep and wakefulness is reactive and impaired in response to numerous therapeutic interventions and environmental circumstances (15).

For preterm newborns, proper sleep and wakefulness are crucial for developing the central nervous system (16). Additionally, the quality and quantity of sleep have an impact on how children and adolescents develop their cognitive, academic, and social functions, as well as their behavior, attention, safety system, health, and general quality of life (17). Decreased brain mass, lowered pain threshold, increased incidence and severity of the disease, impaired sensory development, awareness disorders, cognitive impairments, physiological disorders, impaired psychological and social development, increased risk of sudden infant death syndrome, and increased risk of attention deficit hyperactivity disorder are just a few of the negative effects of sleep and wakefulness disturbances in preterm infants (15, 18-20).

Despite the significant frequency of sleep disorders in premature infants, the factors contributing to these issues remain unclear. Furthermore, familial variables may contribute to childhood sleep habits. By identifying these risk factors in infants born prematurely, pediatricians and other caregivers may be able to stop the onset of sleep disorders in children.

Therefore, this cross-sectional study aimed to assess the predictors of sleep habits among preschoolers born preterm.

Materials & Methods

Study design

Preterm infants were included in this cross-sectional retrospective study from the Semnan clinic in Iran between 2019 and 2020. The selection of the children was done through convenience sampling. All children between the ages of four and seven years old who were born before 37 weeks were included. Other requirements for inclusion were women having the physical, cognitive, and speaking abilities to complete the questionnaires, as well as no other stressful life events, such as divorce, a child's death, and the like, in the previous six months for the first-degree family member.

The exclusion criteria included the use of sedative, opioid, and hypnotic drugs, as well as a history of mental illnesses, significant abnormalities, and attention-deficit/hyperactivity disorder (ADHD). Participants who did not complete questionnaires in full were also excluded. The multiple regression analysis involved a sample of 174 children aged 4 to 7 years. This analysis was conducted with the assumption of having predictive variables in the regression model. The significance level was set at 0.05, the power at 0.9, and the effect size at 0.15. Out of 190 mothers invited to participate in the study, 16 were excluded due to incomplete or unreturned questionnaires. Consequently, data from 174 mothers were analyzed. Data collection was performed by a neonatologist and general pediatrician, using a pre-designed checklist and Children's Sleep Habits Questionnaire. The moms filled out the surveys in a quiet room for 10 to 15 minutes after providing informed consent. The sample window covered June 2019 until June 2020. The sampling period lasted from June 2019 to June 2020.

The following data collection tools were used

1. Demographic variables included gestational age, history of child's age, length of the child's hospital stay, the mother's employment, the number of gestations, sex of child, the child's birth order, the mother's education level, and the type of insurance the child had. Additionally, a history of psychological disorder, withdrawal, and previously diagnosed sleep disorders, depression, familial conflict, relationship quality to parents, and sleepwalking, nightmares, and sleeping alone were investigated by dichotomous scoring questions.

2. The Children's Sleep Habits Questionnaire (CSHQ), developed by Owens et al. (21) in 2000, focuses on sleep quality for a typical week and is based

on frequent clinical symptom presentations of the most common pediatric International Classification of Sleep Disorders diagnosis. Bedtime resistance, sleep start delay, sleep length, sleep anxiety, night wakings, parasomnias, sleep disordered breathing, and daytime drowsiness are the eight subscales the questionnaire uses to assess the child’s sleep. Forty-eight elements total, of which 15 are directly relevant to clinical diagnosis. Last but not least, there is a questionnaire with 33 items that are assessed on a three-point Likert scale as follows: Usually (i.e., 5-7 times in the previous week), Occasionally (i.e., 2-4 times in the last week), and Seldom (i.e., never or 1 time within the past week). Items 1, 2, 3, 10, 11, and 26 received incomplete scores. This instrument has been employed in several studies of Iranian communities (22). The psychometric analysis of its Persian translation shows that it is both reliable and consistent, with reliability scores of R=0.97, 0.79, and 0.77. The CSHQ index categorizes scores as follows: 0 to 1 indicates a severe sleep disorder, 1 to 2 indicates a mild sleep disorder, and 2 to 3 signifies a normal sleep state in children. All statistical analyses were performed using SPSS, version 16. The data were described as frequencies and

percentages for categorical variables, by measures of central tendency (mean or medians) and measures of dispersion [standard deviation (SD) or interquartile range (IQR)] for numerical variables. The Shapiro-Wilk test was applied to check data normality. A variable was considered to have a normal distribution if the P-value < 0.05 and an asymmetrical distribution if the P-value > 0.05. Continuous variables were compared using multiple linear regression (for assessing the variables associated with mothers’ resilience), Pearson’s and Spearman’s correlation (for determining associations between variables), t-test, and one-way ANOVA.

Results

In this study, 174 mothers of preschool children aged 4-7 years old (44.3% girls (n = 77) and 55.7% (n = 97) boys) were analyzed. The average age of children and mothers was 5.7 ± 0.96 and 32.14 ± 2.02, respectively. The majority of mothers were housewives (86%), about 19.5% of children had a weak socioeconomic status, and 53.4% of them were the first child of the family (Table 1).

Table1. Characteristics of subjects across tertiles of CSHQ

Variable ¹	CSHQ			P _{value} ²
	2< N=139	1< to 2 N=29	≤1 N=6	
Sex of children, n (%)				
male	78(80.4)	18(18.6)	1(1.0)	0.46
female	61(79.2)	11(14.3)	5(6.5)	
Gestational age, Mean (SD)	27.6 (1.0)	30.1 (0.9)	34.4(0.4)	0.04
Mother's Occupation				0.34
Home wife	120(79.5)	25(16.6)	6(4.0)	
Employee	19(82.6)	4(17.4)	0(0)	
birth rank				0.041
1	78(80.4)	15(15.5)	4(4.1)	
2	42(82.2)	8(15.7)	1(2.01)	
3	15(78.9)	3(15.8)	1(5.3)	
SES				0.049
Weak	23(67.6)	10(29.4)	1(2.9)	
Moderate	97(81.5)	18(15.1)	4(3.4)	
Strong	19(90.5)	1(4.8)	1(4.8)	

SES, socioeconomic status

¹ Values are n(%) and mean ± SD

² P-values were calculated by ANOVA for continuous variables and χ^2 for categorical variables.

A few children belonged to the at-risk group based on CSHQ norms for the sleep problems scale (n = 6). The CSHQ was higher by 2 points for 139 children and between 1 and 2 points for 29 children. The gestational age was lower in CSHQ>2 compared to CSHQ<1 (P = 0.04). When birth rank is lower, CSHQ is higher (P = 0.041), and when socioeconomic status is moderate,

CSHQ is higher (P = 0.049). No difference between the sex of children or the mothers’ occupation was observed (Table 1).

The probability of familial conflict (OR = 2.73, 95% CI = 0.97-7.71, and P = 0.041), sleepwalking (OR = 2.56, 95% CI = 1.30-5.06, and p = 0.006), and seclusion increased (OR = 2.68, 95% CI = 0.91-5.13, and

P=0.034) in CSHQ 1< to 2 compared with CSHQ >2 in the adjusted model (Table 1). History of psychological disorder, sleep drugs use, withdrawal, and previously

diagnosed sleep disorders, depression, nightmares, and sleeping alone had no significant association with CSHQ score (Table 1).

Table 2. Odds ratio by 95% confidence interval for sleep problem, by tertiles of CSHQ

Variable ¹	CSHQ			P _{value} ²
	2< N=139	1< to 2 N=29	≤1 N=6	
history of psychological disorder	1	1.47	1.19	0.57
Sleep medication		1.90	1.08	0.23
withdrawn and previously diagnosed sleep disorders	1	1.74	1.43	0.28
depression	1	1.35	0.92	0.77
familial conflict	1	2.73	0.65	0.041
sleep-walking	1	2.56	1.01	0.006
nightmares	1	1.87	0.89	0.30
sleeping alone	1	1.10	0.85	0.71
Seclusion	1	2.68	0.97	0.034

¹Data are odds ratio (95% confidence interval)

²P values are P for trend resulted from logistic regression adjusted for sex, age, birth rank and socioeconomic status.

Discussion

Parents throughout the world report sleeping difficulties in 10%–75% of children, ranging from transient behavioral issues to more severe and permanent conditions such as syndromes of sleep apnea (23-25). Poor sleep quality and associated issues (such as changes in cognitive function, academic performance, baby behavior and emotional regulation, and body weight) directly impact children's health and may extend to parents' daily activities (26). Most of these issues may be effectively treated or prevented thanks to accurate diagnosis, identification, and prevention of associated risk factors. Compared to infants born at term, children born severely preterm have an increased risk of sleep disturbance (27). In daily medical practice, concerns about the quality of these patients' sonograms are prevalent; nevertheless, understanding of the causes of these concerns is still in its infancy. As the main finding of this study, this study discovered that family conflict, seclusion increased, and sleepwalking are risk factors that negatively affect the quality of a child's speech who was born prematurely.

In conclusion to Segundo Manti et al. (26, 28), emotional behavior disorders and stress factors should be routinely investigated in children referred to clinics for sleep problems. Their findings indicated that the impact of stressful life events and internalizing problems could predict sleep habits in children. Psychological factors, such as anxiety, stress, and depression, are among the most important and have a significant impact on the cycle of sono-vigilance (29).

According to estimates, 5.8 million children aged 3 to 17 were diagnosed with anxiety, and 2.7 million were diagnosed with depression between 2016 and

2019. These children, up to 20% have symptoms of insomnia, with concomitant medical disorders putting people at higher risk (30). The same is seen in anxiety problems (31).

Preoccupation and fear contribute to a state of neuronal hyperexcitability, regarded as a critical contributor to insomnia (32). Problems with sleep can become an additional source of worry, causing anticipatory anxiety at bedtime that makes sleeping difficult (33). Among the therapeutic options, reducing prenatal anxiety through physical activity may alleviate symptoms of anxiety caused by biochemical and psychological factors (34).

Sedentary behavior has been identified as a significant public health issue in the baby population, interfering with various aspects of development, from induction to maintenance. A few hypotheses exist for this association, one of which is that exposure to screens, particularly at night, increases alertness and physical excitement, directly influencing sleep (35). Aside from that, artificial light from screens, particularly blue light, can cause a decrease in melatonin production, a hormone essential for sleep induction and the maintenance of an appropriate circadian rhythm (36, 37).

Finally, the increase in sedentary behavior leads to a reduction in daily sunlight exposure. Exposure to natural light, particularly during the day, is one of the most important factors regulating circadian rhythms and promoting deeper, more restorative sleep (38).

This research encountered some limitations. The study's transversal outline allows us to investigate the association between variables, but does not allow us to assess the causes of the discovered associations. In addition, this study used convenience samples, which

may not be entirely representative of the population despite their geographic and socioeconomic diversity. On the other hand, one of the study's strengths is that the CSHQ has already been used in schools (17, 39, 40) however, as far as we know, this is the first study to investigate parents' perceptions of their children's health in hindsight, focusing just on children born prematurely (37 weeks). This study concluded that stressful factors (familial conflict), behavioral disturbances (seclusion increased), and internalizing problems (sleepwalking) should be investigated frequently in children referred to clinics for sleep problems. Medical professionals must evaluate how these symptoms may exacerbate or interfere with treatment.

Acknowledgment

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approved the study protocol (IR. SEMUMS.REC. 1396.235). All participants were informed of the study objectives and signed a written informed consent form. They were also assured of the confidentiality of their personal information and the voluntary nature of participation.

Authors' Contributions

Shamsolah Nooripour and Ghazal Zahed and Somaye Fatahi. contributed to the conception, design, and statistical analysis. Abbas Ziari., Amir fazel Hallaj pour, and , Nathalia Sernizon Guimarães contributed to data collection and manuscript draft. Shamsolah Nooripour and Ghazal Zahed supervised the study. All authors contributed to the manuscript draft and critical revision. All authors approved the final version of the manuscript.

Conflicts of Interest

The authors declare that have no conflicts of interests.

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