

Risk factors for sleep problems in infants

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Abstract

Background Sleep disorders in infants can cause developmental problems, suboptimal growth, behavioral disorders, fatigue, irritability, impulsiveness, and poor mother-infant bonding.

Objective To evaluate possible risk factors for sleep disorders in infants.

Methods This cross-sectional study was conducted in healthy infants aged 3-6 months. Subjects were selected using proportional random sampling from four different primary healthcare facilities in Manado, North Sulawesi. Their parents completed the Brief Infant Sleep Questionnaire. Sleep disorder was defined as the presence of one or more conditions including sleep duration less than 9 hours at night (from 19.00 until 07.00), waking up at night (from 22.00 until 06.00) more than 3 times, and more than 1 hour waking at night.

Results Of 112 subjects, 58 (51.8%) were male. Subjects' mean age was 4.21 (SD 0.829) months and 76 (67.86%) experienced sleep disorders. Sleep disorders had significant associations with low socioeconomic status (OR 17; 95%CI 3.8 to 75.8), middle school or lower maternal education (OR 44.5; 95%CI 9.8 to 202), non-supine sleeping position (OR 8.8; 95%CI 1.9 to 39.7), parental use of electronic devices (OR 156.2; 95%CI 35.1 to 692.9), and non-exclusive breastfeeding (OR 85.2; 95%CI 21.1 to 344.2). Correlative analyses also revealed that electronic media usage had the strongest association with sleep disorders, followed by breastfeeding pattern, maternal education, socioeconomic status, and sleeping position (0.839, 0.771, 0.624, 0.433, and 0.309, respectively). However, there were no significant correlations upon multivariate analysis.

Conclusion Parental use of electronic media before sleeping is the strongest risk factor for sleep disorders among infants, followed by non-exclusive breastfeeding pattern, low maternal education, low socioeconomic status, and non-supine sleeping position. However, none of these correlations were significant upon multivariate analysis, this show that all these factors influence sleep together. [Paediatr Indones. 2020;60:186-91; DOI: 10.14238/pi60.4.2020.186-91].

Keywords: infants; sleep; questionnaires; media

Sleep is a condition of regular, reversible, and rapid rest characterized by reduced body movement and decreased awareness of the surroundings.¹ Sleep is essential, particularly in infants.¹⁻³ Sleep disorders are a series of symptoms marked by disturbances in the quantity, quality, and sleep duration.⁴ Many children suffer from inadequate sleep, both in terms of quality and quantity.⁵⁻⁷ A study found a 44.2% prevalence of sleep disorders in children under three years of age in five cities in Indonesia.⁸ Sleep disorder in infants can cause developmental problems, suboptimal growth, behavioral disorders, fatigue, irritability, impulsiveness, and can affect the relationship between a mother and her baby.⁹

Sleep disorders in infants are influenced by several factors, both internal and external. Internal factors are infants' characteristics, such as gender, history of low APGAR scores, prematurity, various neuropsychiatric disorders, and chronic diseases. External factors that can affect sleep include sleeping position, parental use of electronic devices

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and media before sleeping, not breastfeeding, as well as family and environmental conditions such as socioeconomic status, educational status, and parental characteristics.¹⁰⁻¹² The *Brief Infant Sleep Questionnaire* (BISQ) is a well-validated instrument for capturing sleep disorders in infants up to 3 years of age.^{13,14} This instrument consists of several indicators of sleep quality. A previous study reported that BISQ can be used as a screening tool for sleep disorders in infants.¹⁴ As such, we aimed to assess for risk factors for sleep disorders in infants using BISQ.

Methods

The study was conducted at Minanga, Sario, Teling Atas, and Wawonasa primary healthcare, which were randomly selected from a total of 13 primary healthcare facilities serving in Manado City, North Sulawesi Province. The inclusion criteria were healthy infants aged 3-6 months. Infants with a history of low birth weight or prematurity were excluded. The minimum required sample size was calculated using the 'rule of thumb' formula, i.e., the recommended number of subjects was 20 times the total number of independent variables to be examined. To anticipate some subjects' dropping out, the minimum required sample size was 112 subjects.

Sample collection was conducted using proportional random selection of the eligible subjects from 522 infants aged 3-6 months at the four previously selected primary healthcare centers, resulting in a total of 112 subjects. All parents/guardians of eligible infants were given explanations of the benefits and objectives of the study. If the parents/guardians agreed to participate, they were asked to sign an informed consent form. Healthy infants were considered to be babies who were in good health, free from disease conditions, able to participate in activities without any physical limitations. For our study, infants' health conditions were determined by their clinical history and physical examinations. Sleep disorders were determined by the *Brief Infant Sleep Questionnaire* (BISQ) filled by parents, the results of which were broad categories of yes and no.

Sleep disorder was defined as the presence of one or more conditions including sleep duration at

night (from 19:00 until 07:00) <9 hours, waking up at night (from 22:00 until 06:00) more than 3 times, and >1 hour of being awake at night. We aimed to investigate factors that influence sleep disorders in infants, including parental use of electronic media within one hour before going to bed in one room with their infant, socioeconomic status, maternal education, breastfeeding pattern, and sleeping position. Electronic use was defined as electronic tools that send and receive information using electronics, such as televisions, computers, video games, mobile phones, internet and others. Socioeconomic status in this study was based on the provincial minimum wage of North Sulawesi Province. Low socioeconomic status was defined as income less than 2,824,286 IDR/month. Maternal education was defined as mother's final education level and divided into high school graduate and middle school/lower graduate. Breastfeeding pattern was divided into exclusive and non-exclusive. Exclusive breastfeeding was defined as receiving breast milk only without the addition of other liquid or solid food. Sleeping position was the most frequent sleeping position and divided into supine and non-supine. During questionnaire assessment (BISQ), parents were interviewed by one of researchers.

Univariate analysis was performed to analyze the characteristics of subjects, while bivariate analysis was performed to analyze for possible correlations between each variable and sleep disorders [Chi-square test and correlation coefficient phi ($r\phi$)]. The most influential factor was shown by the magnitude of the correlation value ($r\phi$). Higher values indicated stronger associations as follows: 0=no correlation between two variables, >0 - 0.25=very weak correlation, >0.25 - 0.5=moderate correlation, >0.5 - 0.75=strong correlation, >0.75 - 0.99=very strong correlation, and 1=perfect correlation.

Significant variables were further analyzed by calculating odds ratios (OR) with 95% confidence intervals (CI). Multivariate analysis was carried out to collectively analyze the independent variables to determine which factors contributed the most to the occurrence of sleep disorders. Results with $P < 0.05$ were considered to be statistically significant. Data were analyzed using *SPSS version 25*. This study was approved by the Ethics Committee of Prof. Dr. R. D. Kandou Hospital, Manado.

Results

The characteristics of the 112 study subjects are shown in **Table 1**. Chi-square analysis revealed that low socioeconomic status was a significant risk factor for sleep disorders (OR 17.0; 95%CI 3.8 to 75.8; $P < 0.0001$), as was middle school or lower maternal

education (OR 44.5; 95%CI 9.8 to 202; $P < 0.0001$). A non-supine sleeping position had an 8.8 times higher risk of sleep disorders (OR 8.8; 95%CI 1.9 to 39.7; $P < 0.0001$). In addition, parental use of electronic media within one hour before going to bed in one room with infants (OR 156.2; 95%CI 35.1 to 692.9; $P < 0.0001$) and non-exclusive breastfeeding (OR 85.2; 95%CI 21.1 to 344.2; $P < 0.0001$) were significant risk factors for sleep disorders (**Table 2**).

Table 1 . Characteristics of subjects

Characteristics	(N=112)
Mean age (SD), months	4.21 (0.83)
Gender, n (%)	
Female	54 (48.2)
Male	58 (51.8)
Maternal occupational status, n (%)	
Working	33 (29.5)
Not working	79 (70.5)
Socioeconomic status, n (%)	
Low	40 (35.7)
Middle-high	72 (64.3)
Maternal education, n (%)	
High school graduate	55 (49.1)
Middle school/lower graduate	57 (50.9)
Sleeping position, n (%)	
Supine	84 (75)
Non-supine	28 (25)
Electronic media use, n (%)	
Yes	74 (66.1)
No	38 (33.9)
Breastfeeding pattern, n (%)	
Exclusive	31 (27.7)
Not exclusive	81 (72.3)
Sleep disorders, n (%)	
Yes	76 (67.9)
No	36 (32.1)

Correlation coefficient analysis values () revealed that parental use of electronic media had the strongest positive association with sleep disorders, followed by non-exclusive breastfeeding, middle school or lower maternal education, low socioeconomic status, and supine sleeping position (**Table 3**).

Multivariate analysis with logistic regression of the five variables revealed no significant associations between sleep disorders and socioeconomic status, maternal education level, sleep position, parental use of electronic media, and breastfeeding pattern ($P = 0.995$, $P = 0.997$, $P = 0.998$, $P = 0.995$, and $P = 0.993$, respectively).

Table 3. Correlation coefficient ($r\phi$) of factors attributed to sleep disorders

Risk factors	Correlation coefficient phi ($r\phi$)	P value
Parental electronic media use	0.839	< 0.0001
Breastfeeding pattern	0.771	< 0.0001
Maternal education	0.624	< 0.0001
Socioeconomic status	0.433	< 0.0001
Sleeping position	0.309	0.001

Table 2. Associations between various risk factors and sleep disorders in infants

Risk factors	Sleep disorder, n(%)	No sleep disorder, n(%)	Total, n(%)	Odds ratio (95%CI)	P value
Socioeconomic status					
Low	38 (95)	2 (5)	40 (100)	17 (3.8 to 75.8)	<0.0001
Middle-high	38 (52.8)	34 (47.2)	72 (100)		
Maternal education					
Middle school or lower	55 (96.5)	2 (3.5)	57 (100)	44.5 (9.8 to 202.0)	<0.0001
High school	21 (38.2)	34 (61.8)	55 (100)		
Sleeping position					
Non-Supine	26 (92.8)	2 (7.2)	28 (100)	8.8 (1.9 to 39.7)	<0.0001
Supine	50 (59.5)	34 (40.5)	84 (100)		
Parental electronic media use					
Yes	71 (95.9)	3 (4.1)	74 (100)	156.2 (35.1 to 692.9)	<0.0001
No	5 (13.2)	33 (86.8)	38 (100)		
Breastfeeding pattern					
Not exclusive	73 (90.1)	8 (9.9)	81 (100)	85.2 (21.1 to 344.2)	<0.0001
Exclusive	3 (9.7)	28 (90.3)	31 (100)		

Discussion

Sleep disorders in children are characterized by a disturbance in the quantity, quality, or sleep time.¹⁵ In the first year of life, a child's sleep patterns undergo dramatic changes. The maturation process of the circadian rhythm occurs at the age of 2-3 months, accompanied by a change in the sleep patterns. In particular, increased sensitivity to light underlies the gradual transition from polyphasic sleep patterns during the neonatal period to nighttime sleep patterns and being awake during the day.¹⁶

We evaluated for possible correlations between sleep disorders and socioeconomic status, maternal education, sleeping position, parental use of electronic media, and breastfeeding patterns. The BISQ evaluation revealed that 76 of 112 infants (67.86%) had sleep disorders. This finding was in agreement with a previous study where Asians infants and toddlers tend to experience sleep disorders compared to Caucasians with a prevalence of 51.90% and 26.30%, respectively.¹⁷

Low socioeconomic status has been associated with significant limitations in the quality of family life, such as nutritional status, health, and education. Children from low income families have higher rates of breathing problems during sleep, shorter sleep time, poorer sleep quality, and increased nap time.¹¹ In our study, infants with low socioeconomic status had 17 times higher risk of developing sleep disorders in the bivariate analysis. Similarly, a previous study reported that environmental, medical, and psychosocial factors were associated with sleep.⁷ With regards to the housing environment, families with lower socioeconomic status tend to have fewer bedrooms and more people sharing one room. Ventilation systems may be far from ideal, as high levels of allergens can affect the children's sleep quantity and quality.¹⁸

Maternal education level may affect the way mothers take care of their children. As parenting patterns are closely related to child development, higher parental education may lead to more informed and better care of children, thus positively affecting child development. Conversely, lower maternal education could negatively impact parenting patterns, hampering child development. In our study, lower maternal education had 44 times higher risk of

developing sleep disorders. A study reported that family influence on children's sleep patterns mainly centers on the attitudes and behavior of parents towards their children.¹¹ Responsive and interactive parental attitudes towards children and a conducive home environment can reduce sleep disorders in children. Specifically, regarding the lack of mental stimulation by parents, it is generally attributed to the low level of education they have so that they do not understand how important quality and quantity of sleep are correlated to a child's growth and development.¹¹

In our study, infants with non-supine sleeping positions had an 8.8 times higher risk for developing sleep disorders. A previous study reported that babies who slept in a prone position had lower metabolic rates compared to those who slept in a supine position. Although heat production decreases, on prone position, the body surface temperature would otherwise increase due to heat transfer from central to peripheral body parts. Skin vasodilation results in a decrease in the central-to-peripheral temperature gradient and an increase in heart rate. In the prone sleeping position, increased heart rate, respiratory rate, and respiratory quotient (RQ) have been noted.¹⁹

Rapid technological advancement and robust exposure to electronic media have increased our awareness and knowledge, however, they are risk factors for irregular sleep habits, shorter sleep duration, and sleep disorders, especially in older child and youth. These associations were primarily due to time spent on portable devices such as phones or tablets, rather than stationary devices such as TV or video game consoles.²⁰ A study noted that exposure to bright screens from electronic media is sufficient to inhibit melatonin production.²¹ On the other hand, room lights can also inhibit melatonin production when watching television in a bright room. Another study showed that electronic media exposure including access to media devices in the bedroom, although not actively used before bedtime, was associated with sleep disturbances disorders in children aged 6 to 19 years (OR 1.79; 95% CI 1.39 to 2.31).²² In our study, we found parental electronic use within one hour before going to bed with infants had an 152 times higher risk for developing sleep disorders. Although the mechanism of the association between parental media use and sleep disorders in infants

is unknown, studies in older children have been extensively investigated. Whether the association was through melatonin inhibition as shown in older children, still need further studies.²⁰

Exclusive breastfeeding means providing breast milk without any additional foods and drinks. Exclusive breastfeeding for the first six months of life is recommended. Melatonin is an important component of breast milk. It is secreted at night in adults, but not in infants. A previous study reported that breast milk contains melatonin in a circadian fashion, similar to levels of melatonin in blood and saliva. In human milk, melatonin levels increase at night, reaching a peak at around 3:00 in the morning, followed by undetectable levels throughout the day. Benefits of melatonin was not found in formula-fed infants. Melatonin exerts some beneficial effects in improving sleep quality of infants and can reduce infantile colic.²³ In our study, infants with non-exclusive breastfeeding had an 85 times higher risk for developing sleep disorders.

The $r\phi$ value is used to compare the influence of various risk factors. Our $r\phi$ analysis revealed that parental use of electronic media, breastfeeding patterns, maternal education, socioeconomic status, and sleeping position demonstrated robust correlations with sleep disorders ($r\phi$ values of 0.839, 0.771, 0.624, 0.433, and 0.309, respectively). However, multivariate logistic regression test revealed that none of the risk factors were significantly associated with sleep problems ($P > 0.05$). This is because each of the risk factors in this study influences the occurrence of sleep problems in infants.

The strengths of this study were that it was the first study in Indonesia regarding risk factors for sleep disorders in infants, especially for the use of electronic media in the bedroom, as well using proportional random sampling. Limitations of this study were not evaluating several factors that could influence sleep disorders, such as maternal medical condition, nutritional status, and parenting. In our study, we did not explore further type of electronic media, which in other study has found differences.²⁰ In addition, this study was cross-sectional, hence, the onset of sleep disorders could not be evaluated.

In conclusion, there are strong correlations between low socioeconomic status, low maternal education, supine infant sleep position, parental use of electronic media, and non-exclusive breastfeeding

with sleep disorders. The use of electronic media by parents in the same room as the infant before going to sleep is the strongest risk factor associated with sleep disorders, followed by breastfeeding pattern, maternal education, socioeconomic status, and sleep position. However, none of the above correlations are significant by multivariate analysis, means that each of the risk factors influences the occurrence of sleep disorders in infants.

Conflict of Interest

None declared.

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