



## Original Article

# Predictors of sleep disturbances in the first year of life: a longitudinal study



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## ABSTRACT

**Objective:** The aim of this study was to identify early predictors of nocturnal awakenings and short sleep duration during the first year of life, in terms of sleep habits and patterns. We also analyzed the trend of nocturnal awakenings and total sleep duration from 3 to 12 months of age.

**Methods:** The parents of 704 infants (49.3% female) were interviewed during their first year of life. The interview included questions on infant sleep (eg, sleep habits, sleep duration, number of nocturnal awakenings) and maternal perception of infant sleep difficulties.

**Results:** The study results indicate that most of the infants at risk, with three or more nocturnal awakenings or  $\leq 10$  h of total sleep duration in the early months of life, tend to display a similar pattern of sleep problems at 12 months. The main early predictors of sleep problems at 12 months were sleep duration, sleep initiation method, and nocturnal awakenings. More specifically, infants with three or more nocturnal awakenings or  $\leq 10$  h of total sleep duration at 12 months were those with a higher number of awakenings during the night and a shorter sleep duration, at both three and six months. In addition, infants at risk for sleep problems at 12 months had an independent sleep initiation method at three months, whereas these same infants had a nonindependent sleep initiation method at six months.

**Conclusions:** Our study identified the early predictors of sleep problems at 12 months. Caregivers should identify these early symptoms in infants to prevent possible sleep difficulties in later years.

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## 1. Introduction

Previous research has demonstrated that sleep problems are highly prevalent during childhood and that, in the absence of specific intervention programs, they might persist across the years [1–5]. The identification of early predictors of subsequent sleep problems and their treatment is a growing topic in the literature, with sleep problems during infancy and childhood being generally associated with different mental diseases [6–9].

More specifically, sleep disturbances in children have been related to child's mental [10] and physical [11] health difficulties, as well as to parent mental health [12,13]. Furthermore, several studies found an association between child sleep disturbances and emotional problems, such as anxiety or depression, later in life [14–16]. In particular, bedtime problems during middle childhood were significant predictors of internalizing problems during

adolescence, through the mediational role of emotional reactivity in late childhood [17]. Similarly, a recent longitudinal study found that preschoolers' sleep onset latency and difficulty sleeping alone played a role in predicting depressive and anxiety disorders across time, also after controlling for family income and psychopathology in mothers. In this study, the income-to-needs ratio was calculated as the total family income at baseline divided by the federal poverty level, according with the family size, during the period of data collection [18].

It is noteworthy that parental involvement during the night represents one of the main risk factors for infant insomnia, although very little is still known about parental perception of sleep problems. Sadeh et al. found that parents of infants with sleep problems, compared to control groups, had a lower tolerance for infant crying, which could depend on their involvement in soothing their infants to sleep; consequently, infants could develop sleep difficulties [19]. An interesting study on the early predictors of sleep patterns during preschool years demonstrated that maternal cognition regarding difficulties in limiting parental nighttime involvement at 12 months significantly predicted a fragmented sleep and parental bedtime

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involvement at four years of age [20]. The authors also found that a higher number of infant nocturnal awakenings at the age of 12 months was significantly related to lower sleep efficiency at age four years. Overall, these results suggest that improving infant sleep quality and addressing early parental perceptions of infant sleep might play a role in reducing sleep difficulties during the preschool period [20].

Therefore, parental perception of the infant sleep difficulties and correct identification of benefits of early interventions might act as protective factors in preventing early-onset sleep problems [13,21–24]. In addition, identification of predictors of sleep difficulties may lead to creation of intervention programs and prevent an increase in difficulties with sleep–wake behaviors.

Based on these premises, the aim of our study was to analyze the trend of total sleep duration and nocturnal awakenings from 3 to 12 months and to identify early predictors of nocturnal awakenings and short sleep duration at 12 months, as reported by parents. In particular, we aimed to identify the early characteristics of sleep habits and patterns of infants at risk, namely, those who had three or more nocturnal awakenings and shorter sleep duration at 12 months.

## 2. Methods

### 2.1. Participants

Participants were part of a larger project with the aim of analyzing infant sleep patterns during the first year of life [25]. The total group included 704 full-term infants (49.3% girls, 50.7% boys) from Italy; 43.9% of infants had no other siblings, 44.3% had one sibling, and 11.8% had two or more siblings. Approximately, 48.7% of fathers and 48.9% of mothers had a high school degree, 23.7% of fathers and 33.4% of mothers had a university degree or beyond, and 27.6% of fathers and 17.8% of mothers had less than a high school degree. Overall, 92.9% of mothers and 95.4% of fathers were Caucasian/white and of Italian nationality. The families of infants belonged at a low (35.8%), medium (29.1%), and high (35.1%) socioeconomic status.

Inclusion criteria were birth at full term, Apgar score >8 at 5 min, and informed consent to the interview from both parents. Exclusion criteria were as follows: presence of serious medical diseases, malformations, neurological, or psychiatric disorders, (b) intercurrent disease that would require drug treatment affecting sleep (eg, steroids, antihistamines), and (c) infants of non-Italian ethnic groups whose parents had problems understanding and speaking Italian.

### 2.2. Procedures

A total of 81 pediatricians from all over Italy participated to the project. Each of them recruited infants from health visits. Mothers, after their consent, were interviewed by trained research assistants when their infants were 1, 3, 6, 9, and 12 months of age. During the structured telephone interviews, research assistants filled out an online questionnaire for each mother. Overall, each interview lasted for approximately 15 min. Participants were not paid for their effort. For the purpose of this study, we considered only three time points: ages 3, 6, and 12 months.

### 2.3. Measures

The structured interview was composed of questions on infant sleep, waking behaviors, and maternal behaviors during infant sleep [25]. In the current study, we used questions on the following: 1) socioeconomic status (in terms of parent level of occupation and education), divided into three categories: low, middle, and high [26], 2) severity of colic (ranged on a Likert-type scale from 0 to 10), 3) type of feeding (breast fed vs bottle fed), 4) sleep habits

(nighttime sleep duration, daytime sleep duration, infant nighttime awakenings), 5) maternal perception of infant sleep difficulties (parent-reported sleep problems, difficulty in sleeping, restless during sleep) (The parental perception of sleep problems was assessed by using a Likert-type scale from 0 = no problem to 10 = severe, similarly, the difficulty in sleeping was assessed using a 10 point Likert-type scale from 0 = no difficulties to 10 = many difficulties, restlessness during sleep was evaluated as absence [coded as 0] or presence [coded as 1]), 6) sleeping arrangements (0 = own room alone/with siblings, 1 = in crib in the parent room or in parent bed), 7) sleep initiating method coded as independent (ie, pacifier and falling sleep alone) and non-independent (ie, breastfeeding, holding, rocking), and 8) maternal number of nighttime awakenings.

### 2.4. Data analysis

We first computed correlational and descriptive analyses of the nocturnal awakenings and total sleep duration at 3, 6, and 12 months. For infant nocturnal awakenings, we considered the following groups: no times per night, one or two times per night, and three or more times per night. For total sleep duration, we considered these groups:  $\leq 10$  h, 11–12 h, 13–14 h, and  $\geq 15$  h [27,28]. Next, two multinomial logistic regression analyses were performed to identify which variables (eg, nighttime and daytime sleep, sleep initiation method, type of feeding) at three and six months would discriminate the three groups of nocturnal awakenings at 12 months (no times, one or two times, and three or more times per night). Because our main aim was to evaluate how the groups with no awakenings and one or two awakenings per night were different from the group with three or more awakenings per night, we considered the group with three or more awakenings as the reference group. Similarly, we conducted two multinomial logistic regression analyses to understand which variables at three and six months would differentiate the four groups of total sleep duration at 12 months. For total sleep duration, we considered the group with  $\leq 10$  h as the reference group to understand how the groups with 11–12 h, 13–14 h, and  $\geq 15$  h were different from the reference group. In each multinomial logistic regression analysis, the socioeconomic status was entered as a covariate. The severity of colic was considered only at three months, given that no data on colic were collected at 6 and 12 months.

## 3. Results

### 3.1. Trend of number of awakenings per night from 3 to 12 months

Table 1 reports descriptive statistics (percentages and frequencies) of the sleep variables at different time points (ie, 3, 6,

**Table 1**  
Percentages and frequencies of sleep variables at 3, 6, and 12 months.

Sleep variables	3 mo	6 mo	12 mo
	% (N)	% (N)	% (N)
Nocturnal awakenings (0 times per night)	34.8 (245)	33.4 (235)	33.5 (236)
Nocturnal awakenings (one or two times per night)	56.4 (397)	46.2 (325)	49.0 (345)
Nocturnal awakenings (three or more times per night)	8.8 (62)	20.5 (144)	17.5 (123)
Total sleep duration $\leq 10$ h	19.5 (137)	18.2 (128)	15.1 (106)
Total sleep duration 11–12 h	35.2 (248)	45.9 (323)	58.9 (415)
Total sleep duration 13–14 h	26.3 (185)	29.4 (207)	23.9 (168)
Total sleep duration $\geq 15$ h	19.0 (134)	6.5 (46)	2.1 (15)

Frequencies (N) are reported in parentheses. The total sleep duration includes nighttime and daytime sleep.

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