Original Article

Night sleep duration trajectories and associated factors among preschool children from the EDEN cohort

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ABSTRACT

Objective: Sleep duration may vary both interindividually and intraindividually over time. We aimed to identify night-sleep duration (NSD) trajectories among preschoolers and to study associated factors.
Methods: NSD was collected within the French birth-cohort study EDEN at ages 2, 3, and 5—6 years through parental questionnaires, and were used to model NSD trajectories among 1205 children. Familial socioeconomic factors, maternal sociodemographic, health and lifestyle characteristics, as well as child health, lifestyle, and sleep characteristics at birth and/or at age two years were investigated in association with NSD using multinomial logistic regressions.
Results: Five distinct NSD trajectories were identified: short (SS, <10 h, 4.9%), medium-low (MLS, <11 h, 47.8%), medium—high (MHS, ≈11.5 h, 37.2%), long (LS, ≥11.5 h, 4.5%) and changing (CS, ie, ≥11.5 h then <11 h, 5.6%) NSD trajectories. Multivariable analyses showed in particular that compared to the MHS trajectory factors associated with increased risk for the SS trajectory were male gender, first child, maternal age and working status, night-waking, parental presence when falling asleep, television-viewing duration, as well as both "Processed and fast foods" and the "Baby food" dietary patterns at age two years. Factors positively associated with the CS trajectory were maternal smoking, feeding at night, and the Processed and fast foods dietary pattern at age two years, whereas child's activity and emotionality scores at age one year were negatively associated.
Conclusion: We identified distinct NSD trajectories among preschoolers and associated early life factors. Some of them may reflect less healthy lifestyles, providing cues for early multi-behavioral prevention interventions.

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1. Introduction

Sleep is of vital importance for children's health and well-being. There is now accumulating evidence that insufficient quantity and/or quality of sleep has a negative impact on children's physical and mental health development, cognitive function, behavior, and academic success [1—4]. Sleep disorders and short sleep duration in childhood have also been suggested as predictors of sleep disorders

and short sleep duration in adolescence and adulthood [5,6]. Investigating early determinants of sleep durations may help to better understand physiopathology as well as develop prevention interventions of unhealthy sleep patterns.

A British longitudinal cohort study interested in factors associated with normal sleep duration variation among more than 11,000 children aged six months to 11 years showed that girls consistently slept longer than boys, and that older mother (age >35 years) was associated with shorter sleep duration [7]. Studies focusing on short sleep with age-specific cut-offs also showed that girls were less likely to be short sleepers [8—10]. Other factors associated with short sleep were identified as lower socio-economic status, non-Caucasian/nonwhite ethnic group, maternal stress and/or depression, prematurity, low birth weight, care outside the home,

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television (TV)/screen viewing especially before going to sleep, and late bedtime [7,8,10,11]. Parental behavior at bedtime (eg, parental presence until sleep onset, feeding), especially among toddlers, is an additional important risk factor for fragmented sleep and consequently shorter sleep duration [12–15].

A decrease in children's total sleep duration has been reported in the last few decades [16,7], suggesting that a growing number of children may now sleep for a shorter duration than what is needed. The American Academy of Sleep Medicine recently recommended a total mean sleep duration of 10–13 h per 24 h among preschoolers [17]. Galland et al., and Blair et al., reported that the standard deviation of the means varies between 1 and 2 h among preschoolers [7,16], and the sleep duration mean may not correctly reflect the variety of sleep durations during childhood. Furthermore, longitudinal sleep patterns or trajectory may also be of interest. Previous research concerning Canadian preschoolers identified four sleep trajectories between 2.5 and 5 years: (1) short persistent (<9 h/night); (2) short increasing (<9 h up to 3.5 years old and then around 10.5 h); (3) 10-h persistent pattern; and (4) 11-h persistent pattern [18,19]. The authors showed an increased risk of externalizing problems [18] and high hyperactivity scores [19] in six-year-old children with short sleep duration trajectory (ie, short-persistent vs 11 h-persistent sleepers). In addition, they reported that risk factors associated with both short sleep trajectory and high hyperactivity scores were male gender, low household income, low maternal education, and parental presence during night awakening [19]. However, they did not search for factors associated with the short sleep trajectory by itself or with other sleep trajectories. Moreover, European preschoolers tend to sleep longer on average than North American preschoolers [14,20] and may not display the same sleep patterns over time or the same associated factors.

This first longitudinal study on children' sleep duration in a French birth-cohort aimed to do the following: (1) to identify sleep duration trajectories between 2 and 5–6 years; and (2) to identify factors associated with each sleep duration trajectory.

2. Methods

2.1. Study design

The EDEN study aims at investigating the pre- and postnatal determinants of child health and development. Details of the EDEN study protocol have been previously published [21]. Briefly, pregnant women under 24 weeks of amenorrhea were recruited between 2003 and 2006 in the Poitiers and Nancy university hospitals. Those less than 18 years of age, unable to give informed consent, functionally illiterate in French, with a history of diabetes, planning on changing address, or without social security coverage were excluded from the cohort. Multiple pregnancies were also excluded. Among the 3758 women invited to participate, 2002 (53%) agreed to enroll in the study. Due to miscarriages, stillbirths and attrition, 1899 children were enlisted at birth. Written informed consent was obtained twice from parents, both at enrollment and after the child's birth. The study was approved by the ethics research committee of Bicêtre Hospital (Comité Consultatif de Protection des Personnes dans la Recherche Biomédicale) and by the Data Protection Authority (Commission Nationale de l'Informatique et des Libertés).

2.2. Data collection

Data were collected using parental self-administered questionnaires and during clinical examinations, including anthropometric measurements of each child. Sleep items were study-designed.

2.2.1. Main measure: night sleep duration

Night sleep durations were collected at ages 2, 3, and 5–6 years of age and were calculated based on the answers to the following questions: "Usually, at what time does your child go to bed?" and "Usually, at what time does your child wake up?" Responses were recorded in hours and minutes.

2.2.2. Predictors

Household socio-economic and demographic factors, as well as maternal characteristics, were collected at study inclusion. Household income was divided into three categories: below €1500 per month (≈ French threshold of poverty for a family); between €1500 and €3000 per month; and above €3000 per month (≈ 10th upper percentile of French income distribution). Education level was also defined in three categories, using the highest level reached by one of the parents: below high-school diploma, high-school diploma, and above. Single parenting was defined as a mother living without the child's father, another companion, or another adult family member. Mothers reported information on age at delivery and tobacco consumption during and after pregnancy (coded as never, only after pregnancy, and always [during ± after pregnancy]). The mother's depressive symptoms during pregnancy were assessed by the French version of the Center of Epidemiologic Studies Depression Scale (CES-D). Mothers with a CES-D score of ≥23 were considered to present with depressive symptoms [22]. Body mass index (BMI) before pregnancy was calculated using reported height and weight. The maternity ward of recruitment (Nancy/Poitiers) and the mother's working status at the child's age of two years were also taken into account.

The child's characteristics and anthropometrics were collected at birth from self-reported questionnaires and medical records, including gender, first child (yes/no), ponderal index (defined by birth weight in kilograms divided by the cube of birth length in meters), and preterm birth (<37 weeks of amenorrhea). Breastfeeding duration was collected in months from prospective self-administered questionnaires. Temperamental traits, namely, activity, shyness, emotionality, and sociality were assessed at age one year using the Emotionality Activity and Sociability scale (EAS) [23].

At two years of age, data were collected for several sleep characteristics. Nap duration was assessed through two questions: "Does your child regularly take a nap?" "If yes, what is the mean duration of a nap?" Responses were recorded in hours and minutes. Children who did not nap were coded as 0 h 0 min. Frequent night awakenings at the age of two years were defined as waking every other night or more (yes/no) over the week preceding the self-questionnaire completion, in the absence of acute illness. Parental presence when falling asleep was also collected through questions on sleeping habits (place [eg, living room], parental interaction [eg, holding hands] and bed sharing). A child was considered to sleep without parental presence when parents reported that he/she fell asleep in his/her own bed without any adult interaction.

At two years of age, we collected the number of hours per day spent in physical activity (walking, playing outside) and watching television or other screens during a usual week separately for weekdays, Wednesdays (weekday without preschool in France), and weekend days. As expected, the mean number of hours per day spent in physical activity was statistically different according to the season when the self-questionnaire was completed. We therefore split this variable into quartiles according to each season at which the questionnaire was completed. As this was not the case for the number of hours spent watching TV, the latter was analyzed continuously. We also assessed care arrangement (in large collective settings like preschool or day care centers vs home care). Feeding at night (bottle- or breastfeeding, yes/no) was collected at two and three years of age. The child's BMI−z-score