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Original Article

A different rhythm of life: sleep patterns in the first 4 years of life and associated sociodemographic characteristics in a large Brazilian birth cohort

Elena Netsi [a, *], Ina S. Santos [b], Alan Stein [a, c], Fernando C. Barros [d], Aluísio J.D. Barros [b], Alicia Matijasevich [b, e]

[a] Department of Psychiatry, University of Oxford, Oxford, UK
[b] Postgraduate Program in Epidemiology, Federal University of Pelotas, Pelotas, Brazil
[c] MRC/Wits Rural Public Health and Health Transitions, Research Unit (Agincourt), School of Public Health, University of the Witwatersrand, Johannesburg, South Africa
[d] Post-Graduate Program in Health and Behavior, Catholic University of Pelotas, Pelotas, RS, Brazil
[e] Department of Preventive Medicine, School of Medicine, University of Sao Paulo, São Paulo, Brazil

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ABSTRACT

Objective: Sleep is an important marker of healthy development and has been associated with emotional, behavioral, and cognitive development. There is limited longitudinal data on children's sleep with only a few reports from low- and middle-income countries (LMICs). We investigate sleep parameters and associated sociodemographic characteristics in a population-based longitudinal study in Pelotas, Brazil.
Methods: Data from the Pelotas 2004 Birth Cohort were used ($N = 3842$). Infant sleep was collected through maternal report at 3, 12, 24, and 48 months: sleep duration, bed and wake time, nighttime awakenings, co-sleeping and sleep disturbances (24 and 48 months).
Results: Compared to children in high-income countries (HICs), children in Brazil showed a substantial shift in rhythms with later bed and wake times by approximately 2 hours. These remain stable throughout the first 4 years of life. This population also shows high levels of co-sleeping which remain stable throughout (49.0–52.2%). Later bedtime was associated with higher maternal education and family income. Higher rates of co-sleeping were seen in families with lower income and maternal education and for children who were breastfed. All other sleep parameters were broadly similar to data previously reported from HICs.
Conclusion: The shift in biological rhythms in this representative community sample of children in Brazil challenges our understanding of optimal sleep routine and recommendations.

1. Introduction

Sleep is an important indicator of healthy development and one of the earliest markers of bio-behavioral organization. Sleep in young children, specifically sleep problems, has been associated both with current and future symptoms of emotional and behavioral problems, as well as cognitive development [1–3]. Higher levels of motor activity during sleep and more fragmented sleep (measured using actigraphy) have also been negatively associated with cognitive and language scores as early as 10 months of age using the Bayley Scales of Infant Development [4] as well as attention at 3–4 years of age [5]. Longitudinally, sleep problems have been associated with anxiety [6], aggression, social and attention problems. Better sleep consolidation and sleep duration are associated with higher language achievement [7], cognition function (executive function, school performance, and multiple domain cognitive functioning), better future performance on executive function tasks [8], fewer current internalizing, and externalizing symptoms [9].

Epidemiological studies have primarily reported data on sleep duration and awakenings in children but fewer studies have reported population level estimates for other sleep parameters. The

* Corresponding author. Department of Psychiatry, Warneford Lane, Headington, Oxford OX3 7JX, UK.
E-mail address: elena.netsi@psych.ox.ac.uk (E. Netsi).

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limited longitudinal data available have almost exclusively stemmed from high-income countries (HICs) mostly Europe and the USA [13–16]. Consequently, sleep recommendations have largely been proposed in HICs, but are still lacking a large empirical base [17]. In identifying normative patterns of sleep in children and in proposing sleep recommendations which may relate to sleep duration or hygiene, data from low- and middle-income country (LMIC) cohorts have an important part to play due to the specific cultural and socioeconomic factors that influence sleep and parental perceptions of sleep.

Sleep patterns result from the interaction of environmental and biological aspects that govern the sleep–wake rhythm. Identifying environmental factors associated with sleep parameters is important for two reasons: first, they can help identify individuals who may be at increased risk of disturbed sleep and second, they can be useful in assessing the likely effectiveness of interventions in specific groups or settings. Comparing sociodemographic factors associated with sleep parameters in different cohorts affords greater confidence in the strength of these associations but also potentially in identifying any causal link. Notably, the opportunity to compare these associations across different cohorts, especially of those from HICs vs LMICs where there may be different confounding structures gives further insight with regard to the generalizability of sleep norms and reference values across countries [18].

1.1. Aim

The aim of this paper is to present data from a large prospective ongoing birth cohort in Brazil of children born in 2004, to report population-based sleep parameters from infancy to four years of life and identify associated sociodemographic factors. We examine a range of sleep parameters to allow for comparability to previously published research (eg sleep duration and bed/wake times), to present normative patterns on parameters known to be predictive of later child development (eg sleep duration, awakenings, sleep disturbances) and to present normative data on culture-specific factors (co-sleeping) which are less common in HICs.

2. Materials and methods

2.1. Participants

This study used data from the Pelotas 2004 Birth Cohort. The study included all live births which took place from 1 January 2004 to 31 December 2004 in the city of Pelotas, Brazil. Births were identified through daily visits to the city's five maternity hospitals. Mothers were interviewed soon after delivery providing detailed information on demographic, socioeconomic, and behavioral characteristics. The study complies with ethical standards and principles of the Declaration of Helsinki and was approved by the Medical Ethics Committee of the Federal University of Pelotas. All women provided written informed consent at each follow-up. The study recruited 4231 participants at birth (<1% refusals). Data from four follow-ups are used for this analysis at 3, 12, 24, and 48 months. Sleep measures at the three-month follow-up were only collected for a randomly selected sub-sample of the cohort ($N = 903$). These mothers did not differ from the larger sample in any demographic characteristics. Overall, the follow-up rates ranged from 96% at age three months to 90% at age 48 months. Information was collected at home using paper questionnaires and included socioeconomic and demographic characteristics, feeding practices and child growth, maternal health, and child development. Interviewers read out loud the questions to the mother or caregiver. A detailed description of the sample can be found in Santos et al. [19].

2.2. Measures

2.2.1. Sleep variables

Maternal reports of infant sleep were collected at 3, 12, 24, and 48 months. Seven variables of sleep behavior are described. Parents were asked to report on children's sleep in the past two weeks. Parents were asked for the bed and wake time (hh.min, “In the last two weeks, what time did the child go to bed?” and “What time did the child wake up?”). These were used to calculate nighttime sleep duration. Parents were also asked “In the last two weeks, more or less how many times did the child sleep during the day?” and “How long, more or less did the child sleep each time”. These two variables were used to calculate daytime sleep duration. Sleep duration over the 24-h period (total sleep duration) was calculated by adding the nighttime and daytime sleep duration variables. Parents were asked whether “in the last two weeks the child woke up in the night?”, “How many nights in the last two weeks?”, and “How often per night?” (nighttime awakenings). Parents were also asked to report whether the child sleeps in the same bed with someone else (co-sleeping). Sleep disturbances were calculated for 24 and 48 months and were intended to indicate behaviors which may increase the risk of future sleep problems. We used the following variables as indicators of potential sleep disturbances (sum of yes/no answers): the child has nightmares/night terrors, the child has restless sleep, child experiences difficulty going to sleep, child wakes up at night, and child woke up early (bottom 10% of early wakers) (potential total score of 5). This scale was derived from variables which are good indicators of potential sleep problems and is modeled on a sleep problems scale used in the ALSPAC cohort study [20]. When parents were asked about potential sleep problems there was no specified time period.

2.2.2. Clinical and demographic variables

The following variables were included in this analysis:

Maternal Factors: maternal skin color (white, black, other), age at delivery (≤19 years, 20–34 years, and ≥35 years), prenatal smoking (no/yes), prenatal alcohol (no/yes), maternal education (0–4 years, 5–8 years, ≥9 years), family income (categorized in quintiles), and parity (1, 2, 3, or more).
Child Factors: sex (male/female), gestational age at birth (≤28 weeks, 28–32 weeks, 32–36 weeks, and ≥37 weeks), birth weight in grams (<2500 g, ≥2500 g), and neonatal complications (APGAR scores at 5 min <7).
Environmental/Other Factors: type of delivery (vaginal, cesarean, collected at birth), does the child sleep alone (no/yes, collected at each time point), breastfeeding (no/yes, collected at 3, 12, and 24 months), time spent watching TV (total in the day), and time spent watching TV at nighttime (collected at 24 and 48 months of age). The top 15% of values were categorized as watching more TV. For TV at nighttime this was 90 or more minutes at 24 months and 120 or more minutes at 48 months. For total time watching TV in the day this was 210 or more minutes at 24 months and 350 or more minutes at 48 months. We also included data on whether there were other children living in the home (siblings or other) who were younger or older than the study child (entered in the model as yes/no for children under the age of the study child and yes/no for children older than the study child) at 24 and 48 months of age.

2.3. Statistical analysis

First, we examined the descriptives for each sleep variable. We modeled change in sleep across time using growth curve models (STATA command xtmixed). Associations between sleep variables