Original article

Poor toddler-age sleep schedules predict school-age behavioral disorders in a longitudinal survey

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Abstract

Objective: Behavioral problems are often associated with poor sleep habits in children. We investigated whether undesirable toddler-age sleep schedules may be related to school-age behavioral problems.

Methods: We analyzed the data of a nationwide longitudinal survey with available results from 2001 to 2011. The participants were 41,890 children. The predictors were waking time and bedtime at 2 years of age, and the outcomes were assessed by determining the presence or absence of three attention problems and four aggressiveness problems at 8 years of age. In logistic regression models with adjustments for confounding factors, we estimated odds ratios (ORs) and confidence intervals (CIs) for the association between toddler sleep schedules and behavior during primary-school age years.

Results: The outcomes of attention problems and aggressiveness problems were observed in 1.7% and 1.2% of children, respectively, at 8 years of age. The OR of an irregular or late morning waking time at 2 years of age with the outcome of aggressiveness problems was 1.52 (95% CI, 1.04–2.22) in comparison to an early waking time. The OR of an irregular or late bedtime with attention problems was 1.62 (95% CI, 1.12–2.36), and the OR of an irregular or late bedtime with aggressiveness problems was 1.81 (95% CI, 1.19–2.77) in comparison to an early bedtime.

Conclusion: Poor toddler-age sleep schedules were found to predict behavioral problems during primary-school age years. Thus, good and regular sleep habits appear to be important for young children's healthy development.
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Keywords: Sleep habits; Behavioral disorders; Children; ADHD; Survey

1. Introduction

Behavioral disorders are important developmental problems with considerable educational and social impacts. Among them, estimates of the prevalence of attention-deficit/hyperactivity disorder (ADHD) range from 5.9% to 7.1% in children and adolescents [1]. Behavioral disturbances are often accompanied by a

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variety of comorbidities and undesirable habits. In particular, poor sleep habits and sleep problems are commonly observed in association with behavioral problems in preschool-age and school-age children [2–7]. Sleep problems, such as nightmares, sleepwalking, and trouble sleeping, at 4 years of age were reported to predict behavioral/emotional problems in mid-adolescence in a study involving 490 children [8]. It was also found that such sleep problems at 4–19 years of age were related to attention problems, aggressive behaviors, and anxiety/depression later in life [9]. Severe sleep problems including bedtime struggles and long sleep latencies in infancy have been suggested to be associated with subsequent development of ADHD [10]. In a large twin study, sleep problems including frequent/early waking, nightmares, and resistance to sleep at age 3 and 4 years predicted anxiety, conduct problems, and hyperactivity at 7 years of age [11].

Since 2001, the Japanese Ministry of Health, Labour, and Welfare (JMHLW) has been collecting information regarding family circumstances, child rearing, and children's health and developmental status from all over Japan as part of the Longitudinal Survey of Babies in the 21st Century [12]. This nationwide longitudinal survey involves a large number of participants and allows for investigations of the relationship between habits and living patterns at a young age and problems at school age. Sleep is the primary activity of the brain during early development, and a good night's sleep is suggested to be important for every aspect of a child's functioning [13].

Actually, in a nationally representative longitudinal study of infants in the United Kingdom (UK), 7-year-old children with non-regular bedtimes were found to have more behavioral difficulties than children who had regular bedtimes [14]. Therefore, we utilized data from the JMHLW survey to investigate if school-age children with behavioral problems may have had undesirable sleep habits regarding waking times and bedtimes even when they were toddlers.

Because the sleep schedule is part of the lifestyle of the family, sleep schedules may be intentionally corrected. If it were possible to predict the potential occurrence of behavioral disorders in school age and later to some extent based on toddler-age sleep habits, it might be possible to take some measures to alleviate behavioral disorders before the occurrence of such behavioral disorders.

2. Methods

This study was approved by the institutional review board of Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences (approval no. 486). The first questionnaire was sent by the JMHLW to all families in Japan who had had an infant between January 10 and 17 or July 10 and 17, 2001. The first questionnaire was sent when the infants were 6 months old. A total of 53,575 questionnaires were sent, and 47,015 were returned (response rate: 88%). Follow-up questionnaires were sent every year. Currently, results from the first to tenth surveys (i.e., 2001–2011) have been collected, and we obtained electronic data from the JMHLW for these surveys. Individual personal information was excluded from the obtained data. Vital statistics from birth records were also linked to the data from these surveys, such as gestational weeks, singleton birth or multiple birth, and gender. Returned surveys from the third year included data regarding sleep schedules at 2 years of age.

Returned surveys from the eighth year included data on behavioral problems at 8 years of age. Although the surveys were performed independently of the Child Behavior Checklist (CBCL)/4–18 Japanese Edition designed for children aged 4–18 years [15], there were seven questions that were largely common to the CBCL. Among these questions, three were related to attention problems and included: (1) interrupting people, (2) inability for the child to wait his/her turn during play, and (3) failure to pay attention to the surrounding area when crossing a street (Table 1). The remaining four questions concerned delinquent/aggressive behaviors and included: (1) lying, (2) destroying toys and/or books, (3) hurting other people, and (4) causing disturbances in public (Table 2). The survey included no more clear questions regarding school-age behavioral problems.

As indicated in Fig. 1, we restricted the participants in the current analysis to 41,890 singleton children born with a weight ≥ 2500 g at ≥ 37 gestational weeks. The eligible children were defined as participants with complete relevant information supplied in the questionnaires. The baseline factors included the gender of each participant (dichotomous), educational attainment of the child's parents (categorical data from the second survey), and the person who acted as the primary caregiver (dichotomous data from the third survey; childcare worker; mother or other family member).

Regarding the subjects' usual sleep schedules at 2 years of age, the following choices were possible for morning waking times on the surveys: before 7:00 am; 7:00–8:00 am; 8:00–9:00 am; and irregular or late (i.e., after 9:00 am). Bedtime choices were: before 9:00 pm; 9:00–10:00 pm; 10:00–11:00 pm; and irregular or late (i.e., after 11:00 pm) (Table 3). Irregular waking times or bedtimes were covered by the term "irregular" in the survey. The survey included no questions regarding toddler-age sleep problems, such as nightmares and sleepwalking.

An outcome of attention problems was defined as the existence of all three attention problems, and an outcome of aggressiveness was defined as the existence of