

A comparison of sleep habits and electronic media usage among Japanese children: a cross-sectional study

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Abstract

Background Children are increasingly exposed to electronic media, which can potentially influence sleep habits. Few studies have investigated how children's life patterns affect their sleep habits and electronic media usage. This study aimed to elucidate differences in sleep habits and electronic media usage among 18-month and 42-month old children attending nursery schools or kindergartens or staying at home.

Methods We included 183 18-month-old children (boys, n = 93; girls, n = 90) and 215 42-month-old children (boys, n = 104; girls, n = 111) who underwent health check-ups. Data concerning sleep habits and electronic media usage time were obtained by caregivers and compared using the chi-square test, Mann-Whitney U-test, and Bonferroni-Dunn post hoc analysis.

Results At 18 months old, children attending nursery school had significantly earlier wake times on weekdays and shorter sleep duration on weekends than children staying at home, although there were no significant differences in electronic media usage. There were no significant differences in sleep duration among 42-month-old children attending nursery schools, kindergartens, or staying at home; however, children attending kindergarten demonstrated a higher use of portable and home video games.

Conclusion Different life patterns affected electronic media usage in preschool children, especially those attending kindergarten. Particular attention should be paid to the higher usage of electronic media devices by kindergarten-attending children, although they slept for the same amount of time as other preschool children. Future studies are required to assess the content of electronic games and the ways in which preschool children use their time.

Background

Sleep is vital for physical and psychological well-being, especially for infants and children [1]. Sleep-wake regulation and sleep states evolve rapidly during the first year of life and continue to mature through childhood. The circadian rhythm begins to emerge at approximately 10–12 weeks of age, after which infant sleep becomes dominant at night [2]. Children aged 1–4 years continue to take daytime naps to achieve their sleep requirements; however, on reaching 5 years of age, daytime napping ceases and, concurrently, overnight sleep duration gradually declines throughout childhood [3]. However, sleep-wake patterns vary widely and are driven by a complex interplay between biological processes and environmental, behavioral, and social factors.

Over the last decade, there has been a sharp increase in the availability and use of electronic media devices, such as smartphones, tablet devices, portable games, home video games, and computers, which have all had a strong influence on children's lives. It has been reported that American children and adolescents aged 8–18 years spend an average of 7 hours a day on entertainment media, including television, computers, and handheld and other electronic devices [4]. This has led to less time being spent on homework, sleep, and play [5]. Media usage can also affect the lifestyles of parents and caregivers.

Additionally, evening exposure to bright light from a television or computer screen may suppress melatonin and consequently delay the circadian rhythm [6]. Vijaisakkhana et al. reported that screen exposure in the evening affected night-time sleep duration in infants at 12 months of age [7].

There is a consensus among health authorities that excessive screen exposure time has an adverse effect on childhood development. American Academy of Pediatrics guidelines recommend that children aged < 2 years should not spend time on electronic media, and children aged \geq 2 years should be restricted to usage of < 2 hours per day [8, 9]. Conversely, some parents consider that media content is educational, with one study reporting that 290 of 1000 parents interviewed allowed their children aged < 2 years to watch television because it was “good for their brain” [10]. The remaining parents admitted to not limiting their children’s screen time to avoid conflict or social isolation, or to provide entertainment or distraction [11]. Exposure to screens tends to start from very early infancy despite certain negative side-effects of electronic media use [12, 13, 14].

The degree of screen exposure is also related to preschool children’s daily life pattern, whether attending nursery schools, kindergartens, or staying at home. Conversely, children’s life patterns may affect their daily activities, including electronic media usage. In Japan, the life patterns of young children vary according to the parents’ lifestyle and the family structure. Generally, children whose parents go out to work throughout the day attend nursery schools between the ages of 0–5 years old. Kindergartens welcome children between the ages of 3–5 years old. Some parents prefer their children to stay at home rather than attend nursery schools or kindergartens. Thus, 0- to 3-year-old children either attend nursery school or remain at home, and 3- to 5-year-old children attend nursery school or kindergarten, although some stay at home. Despite the variety of life patterns among children, it appears that no studies have investigated the association between life patterns, sleep habits, and media usage in children. We hypothesized that life patterns of children aged 0–3 years and 3–5 years have different effects on children’s sleep habits and media usage.

This study aimed to show the characteristics of sleep habits and electronic media usage in children aged 18 and 42 months and to investigate sleep habits and electronic media usage in these two age groups, especially focusing on differences in their lifestyles, including attendance at kindergarten or nursery school or staying at home.

Methods

Participants

This study was conducted in Toon city, Ehime Prefecture, Japan, which had a population of 34,600 and 234 births in 2015. We included all children who attended a health check-up at age 18 months or 42 months between September 2016 and October 2017 in our study. Therefore, the participants were children aged 18 months who were born between February 2014 and September 2016 (18M group) or children aged 42 months who were born between November 2012 and May 2014 (42M group). Their parents/caregivers were provided with a written explanation regarding the study and its purpose and were

asked to complete questionnaires concerning their child's sleep habits, sleep-related problems, electronic media usage, and electronic media use time in advance of the check-up. The complete response rates were 72.1% and 76.8% for the 18-month-old and 42-month-old children, respectively. The study was approved by the Institutional Review Board of our institute, and consent to participation was assumed with submission of the completed questionnaires.

Measures

The questionnaire included basic information, such as a child's age, sex, height, weight, medical history, number of siblings and order of birth, and whether the child attended nursery school or kindergarten. Children's sleep habits, involving bedtime, wake time, sleep duration at night-time and during daytime naps on weekdays and weekends, days per week with naps, and nap duration were assessed using the Child and Adolescent Sleep Checklist, which has been developed and validated for clinical and research purposes [15, 16, 17].

The percentages of electronic media users who utilized a television, a laptop/computer, a tablet device, a music player, a smartphone, a mobile phone, a portable game, and/or a home video game, even if only very occasionally during the past month, were assessed. The average use time of each electronic media device per day was also measured.

Sample size calculation

The sample size was calculated based on a multiple logistic regression model using G* power 3.1.9.2 software [18]. A small size effect of 0.4, a significance level of $\alpha = 0.05$, and a statistical power of $1 - \beta = 0.95$ were considered. The necessary sample size is fulfilled in this study.

Statistical analysis

The 18M group was subdivided into those attending and not attending nursery school ("nursery school" and "home" groups, respectively). The 42M group was subdivided into those attending kindergarten or nursery school or staying at home ("kindergarten," "nursery school," and "home" groups, respectively). Data are expressed as mean and standard deviation. These measures were used for further comparison among the subgroups. Basic sleep, electronic media usage, and electronic media use time were compared between the groups using the chi-square test, and continuous variables were compared using the Mann-Whitney *U*-test. Analysis of variance and Bonferroni–Dunn post hoc analysis were used to compare sleep habits and electronic media use time. The chi-square test was used to compare the usage

of media devices. IBM SPSS Statistics version 22.0 (IBM Corporation) was used for statistical analysis, and the level of significance was set at $p < 0.05$.

Results

Demographic and clinical characteristics

Table 1 shows a comparison between the 18M and 42M groups in terms of participant characteristics, sleep habits, and electronic media usage. The 18M group comprised 183 children; 93 (50.8%) were boys, and 84 (45.9%) were firstborn children. The 42M group comprised 215 children; 104 (48.4%) were boys and 91 (42.3%) were firstborn children.

[Table 1 placed here]

A comparison of sleep habits and media usage between 18-month-old children in the nursery school and home groups

A comparison between the two subgroups of the 18M group: nursery school group ($n = 79$) and home group ($n = 104$) is presented in Table 2.

[Table 2 placed here]

There were no significant differences in sleep duration on weekdays or bedtime both on weekdays and weekends between the two groups; however, the wake time on weekdays was significantly earlier in the nursery school group ($p < 0.001$), and the difference in wake time between weekdays and weekends was also significantly greater in this group ($p < 0.001$). The nursery school group took longer naps than the home group ($p < 0.05$); however, there was no significant difference in the number of days in which naps were taken. There were no significant differences between the groups in the percentages of electronic media device usage and the average electronic media use time per day, except for portable game use time (nursery school group, 0 min; home group, 1.1 min; $p = 0.048$).

Sleep habits and media usage in 42-month-old children among kindergarten, nursery school, and home subgroups.

Table 3 shows a comparison of sleep habits and electronic media usage among the three subgroups of the 42M group: kindergarten group ($n = 66$), nursery school group ($n = 114$), and home group ($n = 35$).

[Table 3 placed here]

There were no significant differences in sleep duration between the three groups. Bedtime on weekdays was significantly earlier for the kindergarten group than for the other groups, and bedtime at weekends was significantly earlier for the kindergarten group than for the nursery school group. On weekdays, wake time was significantly later in the home group than the other groups; on weekends, wake time was

significantly later in the home group than in the kindergarten group. The number of days with naps per week was greater in the nursery school group, followed by the home group and the kindergarten group ($F [2, 196] = 62.93, p < 0.001$). The nap duration was significantly longer in the nursery school group than in the other groups. There were significant differences in electronic media usage, including use of portable games ($\chi^2 [2] = 11.49, p < 0.05$) and home video games ($\chi^2 [2] = 6.85, p < 0.05$). Of the home group, 3.1% used portable games and 3.1% used home video games compared with 18.8% in the kindergarten group. Of the nursery school group, 4.6% used portable games and 8.3% used home video games. The kindergarten group had the longest portable game use time among the three groups, and the use of home video games was significantly longer in the kindergarten group than in the nursery school group.

Discussion

This study compared sleep habits and electronic media usage in community-dwelling children aged 18 months and 42 months, grouped according to their life patterns. Empirical research is lacking concerning the effects of exposure to electronic media devices and the influence of life patterns on electronic media usage for infants and toddlers. To our knowledge, this is the first study to compare sleep habits and media usage in relation to whether children attended kindergarten, nursery school, or stayed at home. Usage of the terms “kindergarten” and “nursery school” varies between countries. Kindergarten and nursery school are types of preschools that enroll children aged ≤ 5 years. In Japan, kindergartens are for children aged 3–5 years, and are considered to be more of an educational preparation for school, and are supervised by the Ministry of Education, Culture, Sports, Science, and Technology. In contrast, nursery schools are essentially for children aged 0–5 years whose caregivers work during the day, and these nurseries are under the jurisdiction of the Ministry of Health, Labour, and Welfare.

This study, conducted during health check-ups, identified that sleep habits of children both 18- and 42-month-old differed according to specific life patterns. Among the 18-month-old children, those who stayed at home had a longer sleep duration on weekends and woke up later than those attending nursery school. The 42-month-old children attending nursery school went to bed later and woke up earlier than those attending kindergarten or staying at home and had the longest daytime naps among the three groups.

In terms of naps, there were no significant differences in the number of days with naps and in the nap duration between 18-month-old children attending nursery school and those staying at home. In contrast, significantly different patterns were observed in the 42-month-old children attending nursery school who were found to nap on a greater number of days per week (5.6 days/week) and for a longer duration (94.8 min) than those in the other two groups. Fukuda et al. (2002) reported the sleeping patterns of Japanese kindergarten and nursery school children aged between 3 and 6 years and found that nursery school children went to bed later at night and their night-time sleep was shorter than that of children attending kindergarten. Moreover, the afternoon nap appeared to cause delayed sleep onset but was not a result of sleep deficiency, as shown through a comparison of the sleep duration on the previous night and the sleep onset time between the days with and without an afternoon nap [19]. In our study, nap

conditions significantly differed among the children in the 42M group attending kindergarten, attending nursery school, and staying at home. Nursery school children with obligatory naps had later bedtimes among the 42-month-olds. It may be worth considering whether children attending nursery schools should have such long nap times.

Our research showed that television, smartphones, and tablet devices were the most popular electronic media devices used by both 18- and 42-month-old children, of whom 77% in the 18M group and 84.5% in the 42M group watched television regardless of their life pattern. A smartphone was used by 22% of 18-month-old children and 46% of 42-month-old children. A tablet device was used by 10% of 18-month-old children and 19% of 42-month-old children. The use of mobile devices, including smartphones and tablet devices, by young children has increased dramatically since the Kaiser Foundation began research into the use of technology for parents of 0- to 8-year-olds [20]. In 2011, 52% of children aged 0–8 years were able to access mobile devices; however, by 2013 this had increased to 75% [21]. Recent trends indicate that smart devices are becoming increasingly popular among children. A touch-based multi-modal interface smart device provides an easy-to-use platform for young children, especially when compared with using an electronic mouse, which requires fine motor and keyboard techniques [22].

There were no significant differences in electronic media usage between 18-month-old children attending and not attending nursery school, except for portable game use time. However, a greater number of the 42-month-old children attending kindergarten used portable games and home video games compared with those attending nursery schools or those staying at home. Children attending kindergarten arrive at kindergarten later and leave for home earlier than nursery school children. Consequently, kindergarten children would have more free time at home than those attending nursery schools. Moreover, it is possible that 42-month-old children attending kindergarten have more time available to be influenced and/or taught how to work electronic media devices by their elder siblings or by neighborhood children. However, it is unclear why more of the children remaining at home did not use electronic games. Our results indicated that more attention should be paid to children attending kindergartens, especially in relation to acquiring appropriate screen time habits as habits developed in childhood could have a significant effect throughout their lifetime.

Many studies have shown that excessive screen time for young children is associated with language delay, attention problems, obesity, aggressive behavior, and sleep problems [13, 23, 24, 25]. Moreover, screen time habits formed in early childhood have been shown to predict negative psychological and health outcomes later in life [26, 27, 28]. One recent longitudinal study demonstrated that parental monitoring of children's media influenced their sleep, school performance, and prosocial and aggressive behaviors, and that limiting the amount of media use and its content was a powerful protective factor for children between the third and fifth grades [29]. Our results indicating the use of screen media games in early childhood may imply a need for early intervention.

One strength of this study was that attention was paid to the children's lifestyles rather than those of their caregivers. Moreover, sleep habits and media usage were compared in relation to whether children

attended kindergarten, nursery school, or stayed at home. This study had some limitations that should be considered for an appropriate interpretation of the results. First, the children's sleep habits were evaluated using questionnaires answered by the parents or caregivers, rather than through using objective sleep measurements such as actigraphy. Second, data concerning parents' socioeconomic status and behaviors were unavailable; therefore, this information could not be related to the children's sleep patterns. Third, because of the relatively small sample size, the present study could not conduct comprehensive analyses concerning associations between children's sleep habits, media usage, and life patterns.

Conclusions

Sleep habits and electronic media usage were found to differ according to the age and life patterns of preschool children. More children attending kindergarten used portable games and home video games than those attending nursery school or those who stayed at home. Therefore, when advising families on appropriate electronic media use for their children, consideration of children's individual life patterns is essential. Future studies are needed to determine how best to use electronic media and to identify more specifically the content of electronic games played by preschool children.

Declarations

Ethical approval and Consent to participate

This study was approved by the Institutional Review Board of our institute (IRB No.1607009). Consent to participate was assumed with submission of completed questionnaires.

Consent for publication

Our submission is not currently under review elsewhere and all authors have read and approved the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors contribution

Fumie Horiuchi and Yasunori Oka designed the study. Fumie Horiuchi, Yasunori Oka, and Kentaro Kawabe collected and analyzed the data. Kentaro Kawabe performed the statistical analysis. Fumie Horiuchi, Kentaro Kawabe and Yasunori Oka wrote the manuscript. Shu-ichi Ueno gave technical support and conceptual advice. All authors read and approved the final manuscript.

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Tables

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