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Lifestyle Behaviors from Early Childhood to Junior High School in Rural Japan: A Cross-sectional Study

Haolu Shu

shuhaolu@aoni.waseda.jp

Waseda University

Linjing Jiang

Nagoya University

Norikazu Hirose

Waseda University

Maehashi Akira

Waseda University

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Abstract

Background

Understanding combinations of lifestyle behaviors, including screen time, outdoor activity, and sleep, is essential for promoting children's health. However, evidence spanning multiple developmental stages within the same community remains limited, particularly in rural areas of Japan.

Methods

This cross-sectional study examined school stage and sex differences in lifestyle behaviors among children living in a rural region of southern Japan. Participants included 1,192 children from early childhood through junior high school (49.8% girls, 50.2% boys). Information on sleep timing, sleep duration, outdoor activity time, and screen time was collected using parent- and self-reported questionnaires. Differences by grade and sex were analyzed using two-way analysis of variance and chi-square tests.

Results

Across all school stage, average sleep duration fell below age-specific recommendations, with progressively later bedtimes and shorter sleep duration evident from early childhood onward. Screen time increased steadily across school stages, suggesting the early establishment and consolidation of screen-related behaviors. Outdoor time was below recommended levels among girls and children in lower elementary grades (Grades 1–3), and sex differences became increasingly apparent during the elementary grades (Grades 4–6). Collectively, these findings indicate that insufficient sleep, inadequate physical activity, and escalating screen exposure may originate early in life and intensify throughout childhood, underscoring the need for early preventive interventions.

Conclusions:

Unhealthy lifestyle behaviors related to sleep, physical activity, and screen use were observed across multiple developmental stages within a single rural community. These findings underscore the importance of a life-course approach and highlight the need for early, developmentally appropriate public health strategies to support healthier daily routines among children in rural regions.

Background

Children's lifestyle behaviors including physical activity, screen time, sleep, and dietary routines play a fundamental role in shaping their physical and mental health [1, 2]. These behaviors imbalances have been associated with increased risks of obesity, reduced physical fitness, impaired cognitive

development, and poorer overall well-being [3, 4]. In particular, excessive screen time and insufficient sleep have been identified as global public health concerns among children[5, 6]. In recent years, these lifestyle-related health challenges have been increasingly framed within a life-course public health perspective, emphasizing the importance of early behavioral patterns for later health trajectories[7].

National surveys have reported persistent declines in physical activity levels, increased sedentary behavior among school-aged children[8, 9]. In Japan, lifestyle-related health issues have become increasingly evident, especially among children living in rural areas[10]. Despite educational efforts, current health education in Japan has not been fully effective in addressing these challenges, particularly in rural regions where access to community resources and structured activity opportunities tends to be limited[11]. In rural settings, children's daily lifestyle behaviors are often shaped not only by individual or familial factors but also by structural conditions, such as population decline, school consolidation, limited recreational infrastructure, and reduced opportunities for organized physical activity. These contextual constraints may influence how lifestyle behaviors are formed, maintained, and altered across childhood.

Although previous research has examined specific lifestyle behaviors within certain age groups—such as preschoolers, elementary school students, or adolescents—studies rarely cover the full developmental spectrum [12, 13]. To date, very few studies have examined lifestyle behaviors continuously from early childhood through elementary school within a single community, even though habits established in early childhood often persist into adolescence and beyond [14]. From a public health standpoint, examining lifestyle behaviors across consecutive developmental stages within the same social and environmental context is critical. Such an approach allows for the identification of developmental windows during which unhealthy behavior patterns emerge or intensify, thereby informing the timing and targeting of preventive interventions. Understanding how lifestyle behaviors vary across school grades within the same rural community is therefore essential for designing effective, developmentally appropriate interventions.

Given these gaps, this study aimed to examine grade-level differences in lifestyle behaviors—such as sleep duration, outdoor playtime, and screen time—among children living in a rural area of southern Japan from early childhood through junior high school. By focusing on a single rural community and spanning multiple developmental stages, this study seeks to clarify when unhealthy lifestyle patterns first become evident and how they evolve across childhood. The findings of this study are expected to contribute to improved life-course-oriented health education policies and community-based support strategies for children in rural Japan.

Method

Participants

This cross-sectional study analyzed part of the data collected from a convenient sampling of kindergartens, nursing schools, elementary schools, Junior high schools in rural prefecture of Japan. Children's lifestyle-related behaviors were assessed using questionnaire administered between September and October 2021. Among 1081 preschools in Kochi Prefecture in Japan (area: 7,103km², population: 669,516,population of children aged 0–14years: 75,171) [15]. Per the Declaration of Helsinki, informed consent was obtained from the parents and teachers of children aged 1–15 years from the selected schools in Kochi, Japan. Data from 1192 children (50.2% boys, 49.8% girls) who provided signed consent forms were collected and analyzed. The participation recall rate was 74.6%. The study received prior approval from the Waseda University Ethics Committee, Faculty of Sports Science (2021-HN012).

Measurements

Bed Time

Bedtime was assessed using the question, "What time does the child usually go to sleep on weekdays?" [16]. Parents provided this information for younger children, whereas elementary and junior high school students reported their own usual weekday bedtime.

Waking Time

Waking time was assessed using the items "What time does the child usually wake up in the morning on weekdays?"[16]. Parents provided this information for younger children, whereas elementary and junior high school students reported their own usual weekday Waling time.

Sleep Duration

The sleep duration was calculated by evaluating the reported bedtime and wake-up time[16].

Outdoor Playtime

Outdoor playtime of preschoolers was assessed using the following item: "How much outdoor activity does your child indulge in on average after spending the day at the preschool on weekdays?"[16]. The parents were asked to freely enter the outdoor playtime on weekdays in the last week. For elementary and junior high school students reported their own usual weekday outdoor playtime.

Screen Time

Screen time of preschoolers was assessed by asking parents how much time their children spent watching TV and using smartphones, tablets, and computers in the past week, using the following questions: (1) How many media devices, including TVs, smartphones, tablets, and computers, are available at home? (2) How much time does your child spend watching TV or videos in a day? and (3) For how long, on average, does your child use electronic devices, such as smartphones, tablets, and computers, in a day?[16]. For elementary and junior high school students asked same question by their own.

Demographic Variables

Anthropometric measurements were performed by school nurses. Height and body mass were measured to the nearest 0.1 cm and 0.1 kg, respectively, without shoes and with participants wearing light clothing. Participants' gender and age were reported by parents or guardians for preschool children and self-reported by the participants for elementary and junior high school students. Morning fatigue and breakfast intake were assessed using a structured questionnaire validated in children living in Kochi Prefecture [17]. Breakfast intake was assessed by asking parents (for preschool children) or the children themselves (for elementary and junior high school students) whether the child usually consumed any food in the morning before leaving home on weekdays. Responses were categorized as "every day," "sometimes," or "never."

Statistical Analyses

A two-way analysis of variance (ANOVA) was performed to examine the effects of sex and school stage on lifestyle variables, including outdoor time, screen time, sleep duration, bedtime, and wake-up time. School stage was categorized into five groups: Preschool (1–2 years), Preschool (3–5 years), Elementary school lower (Grades 1–3), Elementary school upper (Grades 4–6), and Junior high school (Grades 7–9) [18]. When significant main effects or interactions were detected, Bonferroni-adjusted post hoc comparisons were conducted. Chi-square tests were used to compare proportions for categorical variables, including gender, age, morning fatigue, and breakfast intake status. All statistical analyses were conducted using IBM SPSS 25.0 [19], and the level of significance was set to $p < 0.05$.

Results

Participants' Characteristics

The characteristics of the children by sex are presented in Table 1. This study included 598 boys and 594 girls. The percentage of boys and girls was not significantly different in any school stage. Further, no significant difference was found in the percentage of body composition and Morning fatigue types, breakfast take types.

[Table 1 here]

Bedtime

Figure 1A shows bedtime by school stage among preschoolers, elementary school children, and junior high school students. In both sexes, bedtime was progressively delayed with advancing school stage ($p < 0.01$). Among junior high school students, girls had significantly later bedtimes than boys ($p < 0.01$).

Waketime

Figure 1B shows wake times by school stage among preschoolers, elementary school children, and junior high school students. No significant sex differences were observed. However, significant differences were found across school stages: preschool children (3–5 years) woke later than elementary school students (Grades 1–3) in both boys and girls ($p < 0.01$).

Sleep duration

Figure 1C shows sleep duration by school stage. Significant sex differences were observed only among junior high school students. Sleep duration differed significantly across school stages. In both sexes, children aged 1–2 years had longer sleep duration than those aged 3–5 years ($p < 0.01$). Preschool children aged 3–5 years had longer sleep duration than elementary school students in Grades 1–3, and students in Grades 1–3 had longer sleep duration than those in Grades 4–6 ($p < 0.01$). Among junior high school students, girls had significantly shorter sleep duration than boys ($p < 0.001$).

[Figure 1 here]

Outdoor Playtime

Figure 2A shows outdoor time by school stage. Significant sex differences were observed among elementary school students in Grades 4–6 ($p < 0.05$). Significant differences across school stages were also identified. Preschool girls aged 1–2 years spent less time outdoors than those aged 3–5 years ($p < 0.05$). Among boys, elementary school students in Grades 4–6 had shorter outdoor time than junior high school students ($p < 0.05$).

Figure 2B presents screen time by school stage. No significant sex differences were observed. However, significant differences were found across school stages. In both sexes, elementary school students in Grades 1–3 had significantly shorter screen time than those in Grades 4–6 ($p < 0.01$). Among girls, students in Grades 4–6 had significantly shorter screen time than junior high school students ($p < 0.01$).

[Figure 2 here]

Discussion

Regarding the standards for the amount of sleep required for children, the American Academy of Sleep Medicine recommends that children 1 to 2 years of age should sleep 11–14 hours of sleep, children aged 3 to 5 years should sleep 10–14 hours of sleep, children aged 6 to12 years require at least 9 hours

of sleep, while adolescents aged 13 to18 years require at least 8 hours of sleep [18]. In the present study, sleep duration from preschool through junior high school was consistently shorter than these recommended standards, indicating a tendency toward late bedtimes and short sleep duration. As a grade-related characteristic, bedtimes became significantly later as school grade increased ($p < 0.01$), and sleep duration became significantly shorter ($p < 0.05$). This pattern suggests that insufficient sleep may not be a temporary phenomenon but rather a behavioral pattern that emerges early and becomes increasingly established across childhood. This trend mirrors recent reports on children's sleep conditions and raises public health concerns that delayed bedtimes and short sleep duration may become habitual starting in early childhood. From a life-course perspective, such early-emerging sleep behaviors may have cumulative implications for later health and well-being.

Regarding physical activity time, the 2010 WHO guidelines recommend that children aged 5–17 years engage in at least 60 minutes of moderate- to vigorous-intensity physical activity daily, or perform vigorous-intensity activity on at least three days per week to promote muscle and bone development [20]. In the present study, average daily outdoor activity time fell below this recommendation among girls and among boys in Grades 1–3, suggesting that insufficient physical activity may emerge early rather than appearing abruptly at later developmental stages. Notably, sex differences became evident during elementary school, with girls in Grades 4–6 demonstrating significantly shorter outdoor time than boys. Although boys in this age group met the recommended activity duration, girls did not, indicating a widening gender gap in physical activity during the school years.

Reduced outdoor activity has been consistently associated with an increased risk of myopia in children, with evidence suggesting that greater time spent outdoors exerts a protective effect against myopia onset[21, 22]. In addition, insufficient physical activity is linked to adverse weight outcomes and reduced cardiorespiratory fitness [23]. Sleep insufficiency further compounds these risks, as inadequate sleep duration has been associated with obesity, poorer mental health, and impaired academic performance in school-aged children [24]. The co-occurrence of reduced outdoor time and inadequate sleep observed in the present study may reflect behavioral clustering, a phenomenon increasingly recognized in pediatric public health research [25].

Rather than reflecting individual motivation alone, these patterns may be shaped by developmental, social, and environmental factors that influence opportunities for outdoor play. Unless opportunities for physical activity are intentionally provided and exercise habits are fostered from an early age, it may be challenging for girls, in particular, to achieve sufficient levels of daily physical activity. From a public health standpoint, identifying such developmental periods of divergence is important, as they may represent critical windows for timely preventive intervention.

The present findings revealed a clear school-stage–related increase in screen time. Notably, screen time began to rise significantly from Grade 4 in primary school and continued to increase throughout junior high school. This developmental trajectory warrants particular attention, as accumulating evidence suggests that prolonged screen exposure is not merely a form of sedentary behavior, but is closely

intertwined with broader lifestyle patterns, including reduced physical activity, insufficient sleep, and unhealthy dietary behaviors. The observed increase in screen time from Grade 4 onward may partially coincide with structural changes in the school curriculum, including a modest increase in instructional hours[26]. However, developmental transitions and increasing autonomy in media use are also likely contributing factors. Previous studies have reported that longer screen time is associated with increased nighttime snacking and evening-type tendencies [27]. Even moderate screen exposure has been linked to sleep onset difficulties[28, 29]. In this context, the relatively shorter screen time observed in preschool and early elementary school children may represent a protective window, during which healthy screen-use habits can be established before screen exposure markedly increases with age.

In Kochi Prefecture, the number of children enrolled in public elementary, junior high, and high schools has continued to decline due to population decrease, the progression of low birth rates, and increased out-migration. The total number of students decreased from 73,954 in 2008 to 60,867 as of May 2017[15]. Along with this decline in student numbers, school consolidation and closures have progressed across the prefecture, with the number of public elementary and junior high schools decreasing by 73 over the 10-year period from 2008 to 2017. Within this demographic and educational context, children's daily routines and opportunities for healthy behaviors may be increasingly shaped by structural and environmental constraints. Given this demographic and educational structure, coordinated efforts among the community, families, schools, and local government are essential to promote healthy child development throughout the prefecture.

Limitations

Several limitations of this study should be acknowledged. First, the cross-sectional design precludes causal inference regarding the relationships between age, lifestyle behaviors, and their developmental trajectories. Although school stage differences provide important insights into when unhealthy patterns may emerge, longitudinal studies are needed to confirm the persistence and causal pathways of these behaviors across childhood and adolescence. Second, lifestyle behaviors such as sleep duration, outdoor activity time, and screen time were assessed using parent- or self-reported measures, which may be subject to recall bias or social desirability bias. However, these measures are commonly used in large-scale epidemiological studies and remain practical tools for assessing children's daily routines across a wide age range. Third, the study was conducted in a single rural prefecture in Japan, which may limit the generalizability of the findings to urban areas or other regions with different demographic and environmental characteristics. Nevertheless, focusing on a single community allowed for the examination of school stage patterns within a shared social and environmental context, which represents a key strength of the study. Finally, although outdoor activity time was used as a proxy for physical activity, it does not fully capture activity intensity or context; future studies incorporating objective measures of physical activity may provide a more comprehensive understanding of children's movement behaviors.

Conclusions

Taken together, these findings highlight that sleep, physical activity, and screen-related behaviors appear to develop sequentially across childhood within a shared rural environment. By examining school stage patterns across multiple developmental stages, the present study underscores the value of a life-course approach for identifying when unhealthy lifestyle behaviors first emerge and how they evolve over time. Such evidence may help inform the timing and focus of public health strategies aimed at promoting healthier daily routines among children living in rural regions.

Declarations

Ethics approval and consent to participate

This study has been approved by the Ethics Committee of the Waseda University Institutional Review Board (Approval Number: 2021-H043). All participants or their guardians read a comprehensive explanation of the research process prior to participation and signed informed consent forms. The research process was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable. This manuscript does not contain data from any individual person that would require consent for publication.

Availability of data and materials

The datasets of the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no competing interests.

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Authors' contributions

Conceptualization and supervision: H.S., N.H., A.M and J.L. Methodology, data collection, and analysis: H.S and A.H. Writing draft: H.S, N.H., A.M. Draft Revision: H.S., N.H., A.M., J.L. All authors have read and approved the manuscript.

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Tables

Table 1 The characteristics of the studied population

Variables	*Boys*	Girls	p-values
Number (N (%))	598 (50.2%)	594(49.8%)	
School stage (N (%))			
Preschool			
1-2 years	44(7.4%)	46(7.7%)	
3-5 years	107(17.9)	102(17.2%)	0.58
Elementary school			
Lower: Grades 1–3	150 (25.1%)	153 (25.8%)	
Upper :Grades 4–6	161 (26.9%)	146 (24.6%)	
High school			
Grades 7–9	136 (22.7%)	147 (24.7%)	
Body composition			
Height(cm: mean, SD)	131.0(23.1)	129.0(22.8)	0.24
Weight(kg:mean, SD)	31.1(14.4)	31.2(14.5)	0.09
Body mass index (BMI) (kg/m2:mean,SD)	17.5(3.0)	17.7(3.4)	0.18
Morning fatigue (N (%))			
yes	555(46.6%)	563 (47.2%)	0.16
No	43 (3.6%)	31 (2.6%)	
breakfast take(N (%))			
Everyday	566(47.5%)	565(47.4%)	0.07
Sometimes	15(1.3%)	22(1.8%)	
Never	17(1.4%)	7(0.6%)	

Figures

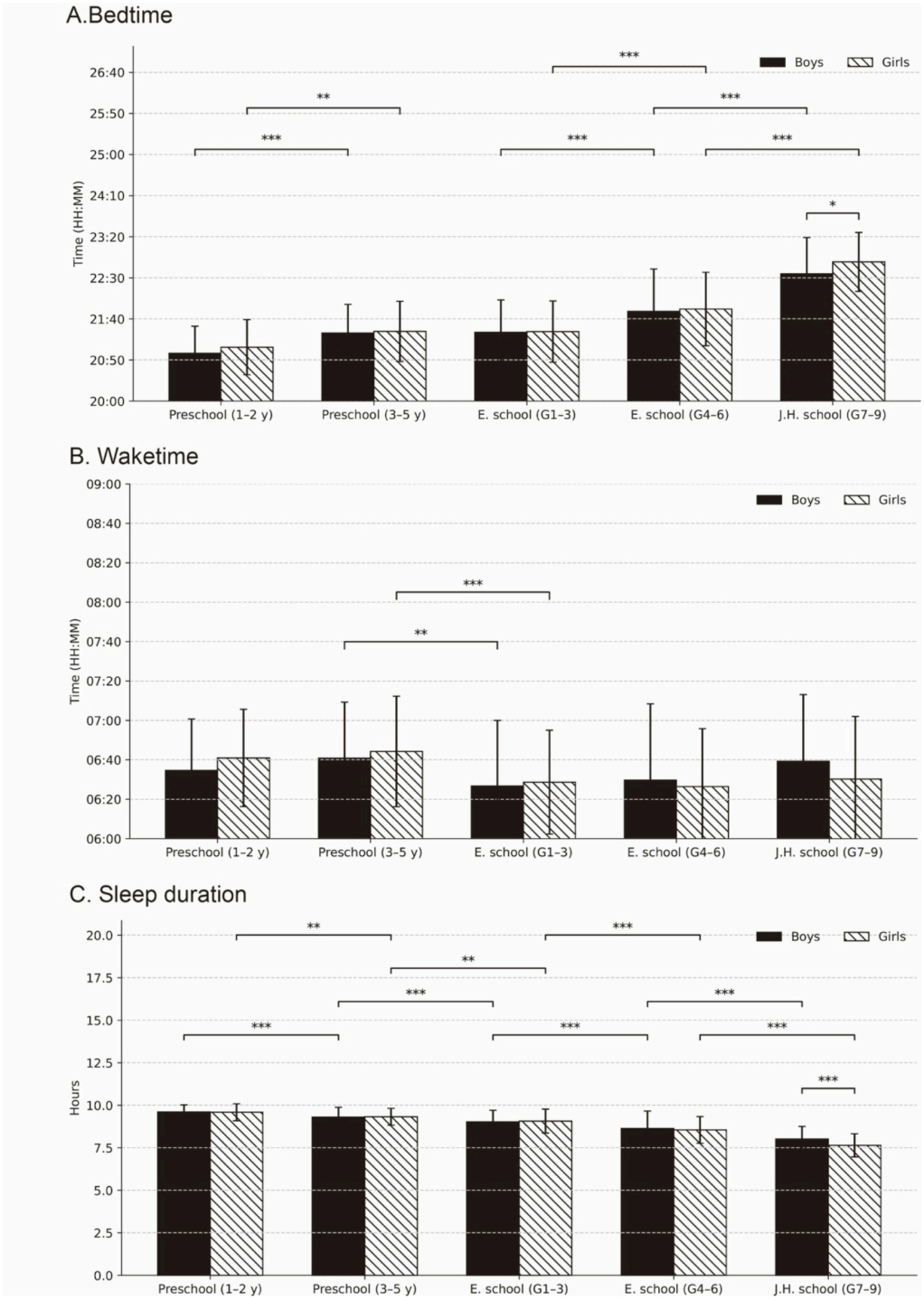


Figure 1

Sleep behaviors across school stage in rural Japan.

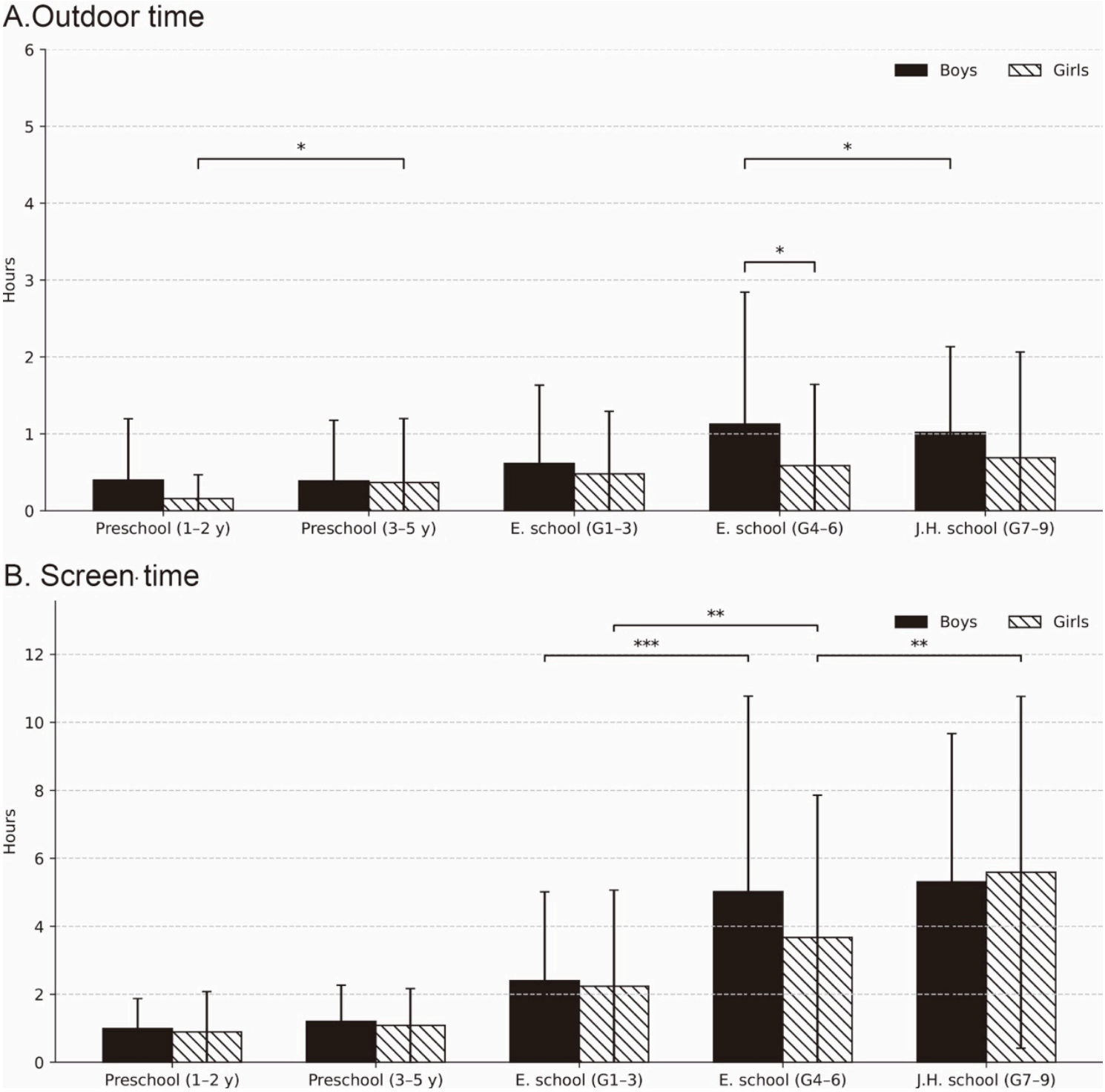


Figure 2

Outdoor time and Screen time across school stage in rural Japan.

Screen time: Television and video , smartphones, tablets, games, the internet viewing time was investigated