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The Effects of a Forest Kindergarten Program on the Sleep Habits of Preschool Children

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Background and Objective It has been reported that preschool children attending a forest kindergarten had a more balanced development in the physical, emotional, and cognitive areas. We evaluated the effects of the forest kindergarten program on the sleep habits of preschool children.

Methods Thirty-seven children (n = 18 in the forest kindergarten, n = 19 in a regular kindergarten) participated in this study. Parents of the children completed a Children's Sleep Habits Questionnaire (CSHQ) at the initial assessment, and the CSHQ was repeated after 8 months of attending the kindergarten program.

Results There were no significant differences between groups in terms of the CSHQ total and subscale measures at the initial assessment. After 8 months enrollment in a kindergarten program, the CSHQ total score ($p < 0.01$), the subscale scores of sleep disordered breathing ($p = 0.04$), and daytime sleepiness ($p < 0.01$) were significantly lower in children attending the forest kindergarten compared with those at the regular kindergarten. Within the forest kindergarten group, the total CSHQ score ($p = 0.02$) and the daytime sleepiness subscale score ($p = 0.02$) significantly decreased after 8 months in the program.

Conclusions Preschool children who are educated in forest kindergarten programs had less problematic sleep habits and daytime sleepiness compared with children in the regular kindergarten program. Forest kindergarten programs may positively influence daytime sleepiness in children.

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Key Words Forest kindergarten, Preschool child, Sleep, Daytime sleepiness.

INTRODUCTION

In modern society, children typically spend most of their time indoors. In large crowded cities, children are usually permitted to play in their house or are sent to a structured program facility because of the lack of safe playgrounds and parental worries about safety.[1,2] This has reduced the opportunity for children to experience outdoor activities and reduced the amount of time spent staying in touch with nature. Moreover, children become unwilling to choose free outdoor play, which usually occurs in natural settings. In addition, children can easily access TV, video games, or personal computers as a result of the influence of increasing modern technology and media exposure.[2] Playing indoors with various mobile electronic devices has also been considered a new problem in children due to the effects on cognitive and emotional development, physical health, and obesity.[3-8]

In recent years, interest in the positive effects on children of spending time outdoors or in a natural environment setting has grown. Allowing children to play in a natural environment is currently considered to be important and related to better physical health and cognitive development. A "forest kindergarten" was developed in Europe[9] as a new type of facility that encourages a child's experiences of the outdoors. This is a special type of nursery located in forested areas where children spend their time whilst outdoors.[10,11] Many studies have demonstrated

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the positive effects of a forest kindergarten on the physical and psychological health of children. This environment allows children to develop their creativity, imagination, motor fitness, concentration, self-discipline, independence, and cognitive function. In addition, children learn how to work, share, collaborate, and resolve conflicts with others in a natural setting.[12-15] However, there are few studies of the effects of forest kindergartens on sleep problems in children. Recently, Songpa-gu, one of the largest local governments in Seoul, Korea, created a forest kindergarten. We investigated the effects of this facility on sleep problems in children.

METHODS

Participants

A total of 37 children who were 3−6 years old were recruited in this study. The children live in same local district area of Seoul (Songpa-gu). The exclusion criteria were 1) current use of any psychotropic agent or sleeping pills, 2) the presence of a major psychiatric disorder such as major depressive disorder and anxiety disorder, or any behavioral problem, and 3) the presence of any sleep disorder, including primary insomnia, circadian rhythm sleep disorder, restless legs syndrome (RLS), periodic limb movements during sleep (PLMS), or obstructive sleep apnea syndrome (OSAS). Developmental and psychiatric histories were examined for all participants by a child psychiatrist. The presence of a sleep disorder such as primary insomnia, RLS, or OSAS was assessed based on parental reports and on reports from the patients in accordance with the diagnostic criteria of the International Classification of Sleep Disorders 2nd edition.[16]

Eighteen children in our study cohort were allocated to the forest kindergarten program, and 19 children were allocated to a regular kindergarten program, commencing in June 2010. Children were not randomly assigned, and parents of children decided to let their children enter forest kindergarten or regular kindergarten. The forest kindergarten program was sponsored by Songpa-gu, a local government in Seoul, Korea. We received written informed consent from the parents of all of the children who took part in the study. Sleeping habits of the children were assessed using the Children's Sleep Habits Questionnaire (CSHQ).[17] After 8 months, the CSHQ was repeated for all of the children at the end of this study. The study protocol was approved by the Institutional Review Board of the Asan Medical Center.

Forest Kindergarten and Regular Kindergarten Programs

The forest kindergarten in Songpa-gu originated from a single regular kindergarten, which was sponsored by Songpa-gu. The local government decided to divide the regular kindergarten into a forest kindergarten and a regular kindergarten. Students attend forest kindergarten five days (Monday to Friday) per week, year-round, regardless of weather conditions. Forest kindergarten is different from general kindergarten in that children are outdoors more than 80% of the day all year round. The children in forest kindergarten spent their time in the forest all day long. They usually play, walk, run, and observe various things in the forest. In addition, forest kindergarten is child-centered, and children actively select their activity. Children are entitled to take part in physical activities, to learn through play and to have an opportunity to explore using multiple senses and judge and manage risk.

The Children's Sleep Habits Questionnaire[17]

The CSHQ is a sleep questionnaire for children aged 4 to 12 years. It was originally developed to screen for the most common sleep problems and focuses on 1) bedtime resistance, 2) sleep onset delay, 3) sleep duration, 4) sleep anxiety, 5) night wakings, 6) parasomnia, 7) sleep-disordered breathing, and 8) daytime sleepiness. In addition, the total sleep time of the child should be reported as part of the test. Parents are asked to report their child's sleeping behaviors during the last week of the observation timeframe. There are 33 items on the CSHQ, and each is rated 3 point scale such as "usually (5−7 times a week)", "sometimes (2−4 times a week)", and "rarely (0−1 time a week)".

Statistical Analysis

The Mann-Whitney U test and chi-square analyses were used to compare clinical characteristics between the children in the forest kindergarten and the regular kindergarten program. Within group changes were assessed using a Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$ for two-tailed tests. We used the Statistical Package for the Social Sciences (SPSS) version 12.0K (SPSS Inc., Chicago, IL, USA) to conduct these analyses.

RESULTS

Eighteen children (males, n = 11) participated in the forest kindergarten program and 19 children (males, n = 11) participated in the regular kindergarten program. The mean age of the children in the forest kindergarten program was 4.2 ± 1.1 years old, and was 4.0 ± 1.1 years old in the regular kindergarten program. There was no statistically significant difference in age ($p = 0.53$), gender ($p = 0.96$), or total sleep time ($p = 0.72$) between these two groups. There was no significant difference in the economic status, because all the families of the children are in middle-class (data not shown).

During 8 months of the program, 3 children (males, n = 2) in the forest kindergarten and 1 child (male) in the regular kindergarten dropped out of the study due to family relocation (3 children) and withdrawal of consent (1 child).

The total score and subscale scores of CSHQ from the initial assessment are shown in Table 1. There was no significant difference between the total and subscale scores in the CSHQ between the two groups. After 8 months, the CSHQ total score (forest kindergarten: 47.7 ± 5.7, regular kindergarten: 55.8 ± 6.5, $p < 0.01$) and subscale scores such as sleep disordered breathing ($p = 0.04$), and daytime sleepiness ($p < 0.01$), were significantly lower in children from the forest kindergarten program compared with the regular kindergarten program (Fig. 1). There was no significant difference in bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnia, and total sleep time between the two groups at the end of this study.

Within-group changes are presented in Table 2. When the scores from the final evaluation were compared with those from the initial assessment, the total CSHQ score and subscale score for daytime sleepiness significantly decreased ($p < 0.05$) (Table 2) within the forest kindergarten program group. However, there were no significant changes in the total score and any of the subscale scores from the CSHQ test in the regular kindergarten program group.

Table 1. Scores of the CSHQ at the initial assessment

	Forest kindergarten (n = 18)	Regular kindergarten (n = 19)	p*
Total score of CSHQ	51.6 ± 8.2	55.6 ± 6.6	0.11
Bedtime resistance	11.8 ± 2.6	12.7 ± 2.5	0.36
Sleep onset delay	1.3 ± 0.6	1.2 ± 0.5	0.70
Sleep duration	3.7 ± 1.1	4.1 ± 1.4	0.41
Sleep anxiety	7.1 ± 2.0	7.4 ± 1.8	0.72
Night wakings	3.6 ± 0.8	3.6 ± 0.8	0.99
Parasomnia	9.2 ± 2.0	10.0 ± 1.8	0.30
Sleep disordered breathing	3.3 ± 0.6	3.4 ± 0.8	0.59
Daytime sleepiness	11.6 ± 2.5	13.3 ± 2.9	0.08
Total sleep time (h)	10.5 ± 1.1	10.7 ± 1.1	0.62

*Mann-Whitney U test was done.
CSHQ: Children's Sleep Habits Questionnaire.

DISCUSSION

In our current study, there were significant differences found between the total and subscale CSHQ scores, such as daytime sleepiness or sleep disordered breathing, between the two groups after 8 months in the program. The total CSHQ score was significantly lower in children from the forest kindergarten compared with those from the regular kindergarten, indicating that children in the forest kindergarten program may experience less sleep disturbance. In particular, children in the forest kindergarten program experienced less daytime somnolence and less obstructive sleep apnea. It is well known that daytime sleepiness can be affected by the sleep-wake cycle, which is controlled by homeostatic determinants and circadian timing.[18] Generally, two peaks of sleepiness have been characterized (2–6 a.m. and 2–4 p.m.). Sleep disturbance during the night (homeostatic determinants) and light exposure during daytime (circadian timing) can affect daytime sleepiness. Throughout the day, the children in the forest kindergarten program usually did various activities in the forest. Outdoor activities are very helpful in exposing children to light during the daytime, which can help to set the biological clock. This is especially important because children can easily develop a delayed sleep phase. Light exposure is helpful in reducing daytime sleepiness and enhancing brain response.[19-21] In addition, sleepiness in children can be masked by sensory inputs, exercise, or their emotional state.[22,23] Children tend not to pay attention for a long time if their curriculum is boring. The programs in the forest kindergarten demand vigorous activity, motivation, and energy and are there-

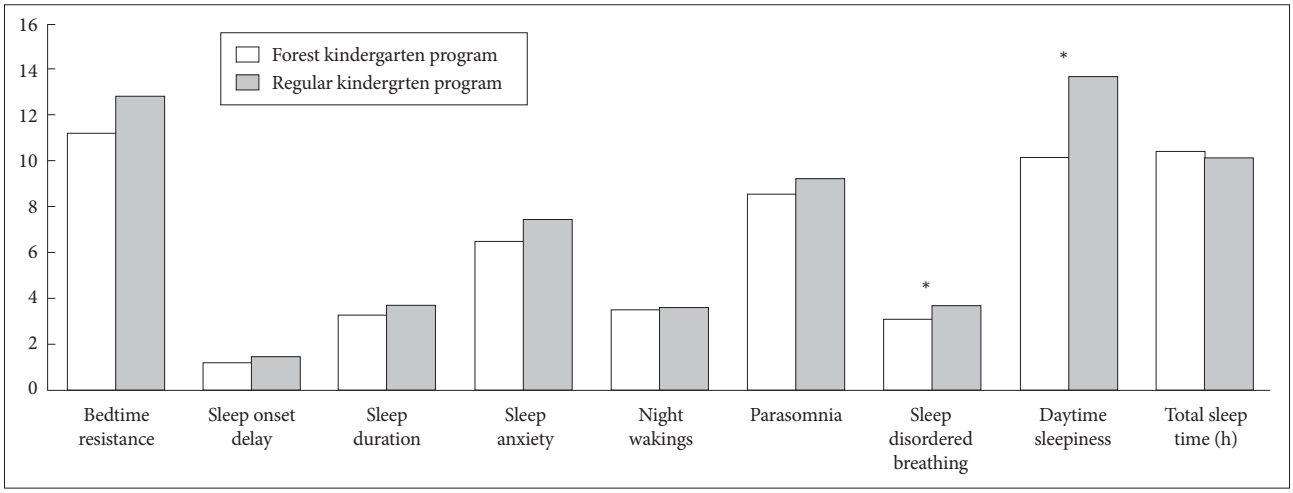

Fig. 1. Differences in the CSHQ scores between children in the forest kindergarten and the regular kindergarten program at the end of the study. *p < 0.05. CSHQ: Children's Sleep Habits Questionnaire.

Table 2. Changes in the scores of the CSHQ from the initial to the final assessment

	Forest kindergarten (final n = 15)		p*	Regular kindergarten (final n = 18)		p*
	Initial	Final		Initial	Final	
Total score of CSHQ	51.6 ± 8.2	47.7 ± 5.7	0.02	55.6 ± 6.6	55.8 ± 6.5	0.92
Bedtime resistance	11.8 ± 2.6	11.3 ± 2.4	0.34	12.7 ± 2.5	12.8 ± 2.2	0.98
Sleep onset delay	1.3 ± 0.6	1.2 ± 0.4	0.08	1.2 ± 0.5	1.4 ± 0.7	0.36
Sleep duration	3.7 ± 1.1	3.3 ± 0.6	0.13	4.1 ± 1.4	3.7 ± 1.3	0.37
Sleep anxiety	7.1 ± 2.0	6.5 ± 2.0	0.28	7.4 ± 1.8	7.5 ± 1.5	0.84
Night wakings	3.6 ± 0.8	3.5 ± 0.4	0.71	3.6 ± 0.8	3.6 ± 1.0	0.99
Parasomnia	9.2 ± 2.0	8.6 ± 1.5	0.11	10.0 ± 1.8	9.3 ± 1.9	0.12
Sleep disordered breathing	3.3 ± 0.6	3.1 ± 0.5	0.16	3.4 ± 0.8	3.7 ± 1.0	0.10
Daytime sleepiness	11.6 ± 2.5	9.8 ± 1.0	0.02	13.3 ± 2.9	13.7 ± 3.5	0.52
Total sleep time (h)	10.5 ± 1.1	10.5 ± 1.0	0.68	10.7 ± 1.1	10.4 ± 0.9	0.21

*Wilcoxon signed-rank test was applied.
CSHQ: Children's Sleep Habits Questionnaire.

fore likely to be more stimulating. At the forest kindergarten, it has been reported that children can develop higher concentration levels and perform better.[15] A higher attention span can also reduce the daytime sleepiness of children.

At the end of this study, the subscale sleep disordered breathing score was also significantly lowered in children from the forest kindergarten program compared with those in the regular kindergarten program, although the score did not significantly decrease within the forest kindergarten program group. The prevalence of OSAS has been reported to be 1−4% in children.[24] Sleep disturbance and daytime sleepiness are core symptoms of patients with OSAS. In children in particular, OSAS induces adverse consequences in terms of cognitive function, behavioral problems, cardiac function, and growth.[25,26] Obesity is one of major risk factors of OSAS.[27] Playing in natural environments can encourage physical activity and decrease the risk of childhood obesity. In addition, chronic stress may exacerbate several psychologic condition and metabolic abnormalities including obesity via activation of the stress system,[28] and spending more time in the forest may decrease stress in children.[29,30] Consequently, we can hypothesize that the forest kindergarten program has a potential to reduce obstructive sleep apnea in children and decreased daytime sleepiness in our study may be related to decreases in OSAS. This hypothesis should be tested in our further study.

After 8 months of exposure to the two different settings, there was significant difference in the overall CSHQ score between two groups. This suggests that sleep habits may have improved in aggregate more after forest kindergarten than regular kindergarten. It was noteworthy however that there were no significant differences in other subscales such as bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnia, and total sleep time between the two kindergarten groups in our study. The regular kindergarten facility also provides various activities and daytime work, which can be energy consuming and can enhance deep sleep in children. Our results may also be explained by the fact that we did not compare the sleep characteristics of children in the forest kindergarten with those who stay indoors and regularly use electronic devices, which have been considered to have a negative impact on sleep in children and adolescents.[31]

Our study has several limitations to note. First, nocturnal polysomnography was not performed to evaluate the sleep status in the children. Usually OSAS and PLMS are assessed based on polysomnographic findings, and we could not completely exclude the existence of these conditions. Second, children were not randomly assigned in this study. It means that parents' attitude toward the educational programs which is nature-oriented, can affect the allocation of the children into each program. Contrary to Europe nations, forest kindergarten is not popular in Korea. We had parents of children decide to let their children enter forest kindergarten or regular kindergarten, because "educational program" is very important issue to the parents of children. Third, we could not show the information about anthropometric status of the children such as body mass index (BMI). We will get more information about that in our further study. Fourth, the small sample size of this study and the fact that we could not assign the children into each kindergarten program randomly are other problems. Our analysis may therefore have lacked the power to detect significant group differences. It was also difficult to enroll subjects who entered the forest kindergarten because this is still very experimental in Korea and not well known to the public. Last, we cannot confirm whether the "forest" itself may influence children's sleep. Outdoor time or light also may affect, but we cannot clarify it using our study design.

In conclusion, preschool children who are educated in the forest kindergarten program may have fewer dysfunctional sleep habits and less daytime sleepiness compared with children who participated in a regular kindergarten program. Despite the

limitations of our current study, we have observed that the forest kindergarten program has some positive influence on children's sleep habits.

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Conflicts of Interest

The authors have no financial conflicts of interest.

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