Association Between Outdoor Activity and Insufficient Sleep in Chinese School-Aged Children

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Data Collection **B**
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Data Interpretation **D**
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This work was funded by Ministry of Health (public welfare special fund, 2012, No. 201202010), National Natural Science foundation, P.R. China (No. 81872639) and Guangdong Medical Science Foundation, P.R. China (No. A2018136)

Background: The aim of this study was to explore the relationship between outdoor activity (OA) and insufficient sleep duration (ISD) among Chinese children and to assess the potential age- and gender-specific effects.

Material/Methods: A national sample of 62 517 children aged 6–17 years were recruited from 7 provinces of China in the autumn of 2013. Children and their caregivers reported daily sleep duration (<7 h, 7–9 h and ≥9 h), daily OA time (<1 h, 1–2 h, and ≥2 h), and other behavior and demographic information by standardized questionnaire. ISD was defined as <9 h/day. Logistic regression analysis was used to evaluate the relationship between ISD and OA.

Results: In total, 46 639 children (50.9% boys) completed this survey. The prevalence of ISD was 74.9% (73.7% in boys and 76.1% in girls). Stratified by age, compared with <1 h OA, the odds ratios for ISD were 0.67 (95% confidence interval: 0.62–0.72, aged 6–13 years) and 0.69 (0.49–0.98, 14–17 years) in the ≥2 h OA group; 0.91 (0.85–0.97, 6–13 years) and 0.73 (0.54–0.97, 14–17 years) in the 1–2 h OA group. Further stratified by gender, we found similar trends for both boys and girls in each age group, although some results became non-significant.

Conclusions: Adequate OA time per day is associated with decreased risks for ISD among children aged 6–17 years, but age and gender can modify the association.

MeSH Keywords: Child • Motor Activity • Sleep

Abbreviations: **BMI** – body mass index; **CI** – confidence interval; **NSF** – National Sleep Foundation; **OA** – outdoor activity; **OR** – odds ratio; **ISD** – insufficient sleep duration; **PA** – physical activity; **VPA** – vigorous physical activity; **MPA** – moderate physical activity

Full-text PDF: https://www.medscimonit.com/abstract/index/idArt/921617

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Background

Sleep is an important factor that influences cognitive, behavioral, and functional development of children [1]. According to the recommendation of the National Sleep Foundation (NSF), school-aged children need over 9 hours of sleep per night to maintain health and normal daily performance [2]. However, along with the rapid development of modern society, the sleep duration of children has been decreasing globally in recent decades [3]. For instance, nearly 16% of American urban children failed to meet the NSF criteria [4] in the early 2000s, and the prevalence of insufficient sleep increased to 45% [5] by 2006. Many researchers reported similar results in different countries and areas [6,7], showing that insufficient sleep of school-aged children has become a public health problem.

Evidence suggests that insufficient sleep duration (ISD) is associated with many behavior-related factors, especially activity level [8]. Outdoor activity (OA) is a specific form of physical activity (PA) that not only provides exercise but also allows children exposure to fresh air and sunshine, an environment that promotes health with low cost [9]. Limited research had been performed on the association between OA and sleep, with inconclusive results [10–13]. According to a study focused on adult women [11], those who spent more time on OA had better sleep than those who had less time outdoors. On the contrary, Sijtsma et al. [12] found no association between outdoor play and sleep duration among children age 2–5 years, and Lin et al. [10] also found this result in children 10–13 years old. In a study of children in 8 European countries [13], time spent playing outside was associated with sleep in univariate analyses, but this association did not persist in multivariate analyses. Sampling heterogeneity may compromise the power of studies [10–13]; therefore, multi-center studies with larger sample sizes are necessary.

Our study investigated: (i) distribution of OA among different age groups of Chinese school-aged children and adolescents, (ii) the prevalence of insufficient sleep in Chinese school-aged children, and (iii) the association between OA time and insufficient sleep among different age and gender groups. We hypothesized that insufficient OA time is associated with insufficient sleep in Chinese children age 6–17 years.

Material and Methods

Participant enrollment

Seven provinces (Beijing, Tianjin, Liaoning, Ningxia, Shanghai, Hunan, and Guangdong) which represent the northern, northeastern, northwestern, eastern, central, and southern areas of China, were chosen as research centers [14]. In each center, multi-level stratified cluster random sampling was conducted, then we recruited children and collected baseline information from September to November 2013. Finally, approximately 12–16 primary and secondary schools (except for special education schools for children with severe physical or mental disability) with at least a total of 10 000 students aged 6–17 years were enrolled in each center. With school permission, all parents of participants signed the informed consent. Overall, there were 62 517 children who participated in this study.

Questionnaire survey

A Structured questionnaire was used to collect data, including demographic factors (age, gender, education level of mother and father, urban/rural area), lifestyle (daily hours of vigorous and moderate physical activities, walking, and sedentary, daily OA time, and sleep duration) and dietary pattern (daily servings of fruit, vegetables, sugary beverages, and meat). The questionnaire was designed based on the multi-factors model, which was proved to be acceptable for participants in the early stages of the project [14].

Details of the questionnaire distribution and quality control can be found in a previous publication [15]. Questionnaire items are described briefly as follows:

OA

OA was obtained by the question, "How many hours each day do you spend on outdoor activity? including but not restricted ball sports, swimming, hide and seek and so on (except for just sitting or lying down outside)." Outdoor activity was categorized as <1 h, 1–2 h (excluding for 2 h) and ≥2 h.

Sleep duration

Sleep duration determined by asking, "How many hours each day do you spend on sleep? just calculate the duration between fall asleep time and awake time (the period between bedtime and falling asleep time should be omitted)." The response options included <7 h, 7–9 h (excluding for 9 h), and ≥9 h.

Definition of ISD

Based on NSF recommendations, ISD is defined as "less than 9 h per day" for school-aged children. Because this was a national study, it was difficult create subgroups; it is more appropriate to regard 9 h of sleep (median of 8–10 h) for children 14–17 years old as the cut-off point.

Daily PA, sedentary behavior, dietary pattern, and anthropometric measurement

The details of questionnaire information about PA, sedentary behavior, and dietary pattern and details of anthropometric measurement have been reported elsewhere [15].

Statistical analysis

Data analyses were performed with SPSS 24.0. We performed descriptive analyses for all the data, in which continuous variables were expressed as mean values and standard deviation, and categorical variables were expressed as percentage. We conducted *t* tests and one-way analysis of variance to evaluate the sex differences and OA differences of continuous variables, respectively; Student-Newman-Keuls test was conducted for post hoc analyses between different outdoor time groups. Chi-square tests were performed to evaluated the differences in categorical variables. Logistic regression models were run to evaluate the association between OA and ISD, with the <1 h OA group as reference, which was adjusted for age, gender, urban/rural area, father's education, mother's education, body mass index (BMI), dietary pattern, PA, and sedentary behavior. Robustness testing indicated that the results did not differ across areas and schools. Regression results are presented using odds ratios (ORs) and corresponding 95% confidence intervals (CIs). *P* values <0.05 were interpreted as statistically significant.

Results

Characteristics of participants

The study flow chart is shown in Figure 1. The sample comprised 62 517 children, with 46 639 children (missing data: 25.40%) aged 6–17 years (mean 10.82 years, 50.9% boys) included in final analysis. There were 15 878 children excluded from the analysis due to lack of sleep and OA information. Compared with those included in analysis, children with missing information had no differences in age, height, level of VPA and MPA, and servings of fruits vegetables consumed. The baseline characteristics of the participants are described in Table 1 and Supplementary Table 1. The overall prevalence of ISD was 74.9% (73.7% in boys, 76.1% in girls, p<0.001) and 37.5% of the participants reported daily OA time less than 1 h. More girls had <1 h OA time than boys (Table 1). Children tended to have increased OA time as they age from 6 to 10 years, but this trend reversed when they prepared to enter puberty (Figure 2). Similar patterns occur in both boys and girls.
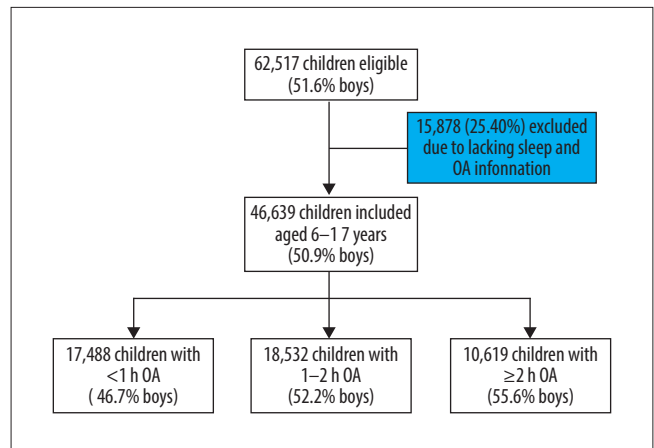

Figure 1. The flow chart of the study.

Participants characteristic among OA time groups

In total, the prevalence of ISD was highest in children with <1 h OA time (78.3%, Table 2), and lowest in children with ≥2 h OA time (70.0%, Table 2), and the trend remained when stratified by age and gender (all p<0.001, Table 2).

Compared with children who had <1 h OA time, participants who had ≥2 h OA time were younger and had less daily sedentary time (p<0.001, Table 2), but had higher daily VPA, MPA, and walking time (all p<0.001, Table 2). In sedentary behavior, children with ≥2 h OA time had a longer daily time watching TV and playing computer games (both p<0.001, Table 2), and shorter daily time doing homework (p<0.001, Table 2) compared with children with <1 h OA time. In dietary pattern, compared to children with <1 h OA time, those with ≥2 h OA time had more intake of food (fruit, vegetable, sugary beverage, and meat) (all p<0.001, Table 2). Participants who had OA time ≥2 h also were more likely to have both parents with low educational level and were more likely came from a rural area, when compared with the <1 h OA group (all p<0.001, Table 2). A similar trend was found when we compared the 1-2 h OA group with the <1 h OA group, although the intake of sugary beverages and the distribution difference of caregiver's educational level became non-significant.

Association between OA time and ISD

The ORs for ISD are presented in Table 3. Compared with the <1 h OA time group, both the 1-2 h OA group and ≥2 h OA group were significantly associated with ISD (ORs: 0.85 and 0.60, 95% CI: 0.80–0.89 and 0.56–0.63, respectively, Table 3) after adjustment for age and gender, similar association (ORs: 0.87 and 0.64, 95% CI: 0.82–0.93 and 0.59-0.69, respectively, Table 3) were found in multivariate analysis.

Table 1. Sample characteristics by gender.

	ALL	Boy	Girl	P
Sample size	46639	23743 (50.9%)	22896 (49.1%)	
Age	10.82±3.31	10.69±3.27	10.95±3.35	<0.001
Outdoor activity (%)				
<1 h	37.5	34.4	40.7	<0.001
1–2 h	39.7	40.8	38.7	
≥2 h	22.8	24.9	20.6	
Insufficient sleep duration (%)	74.9	73.7	76.1	<0.001
6–13 years	68.2	67.6	68.8	0.022
14–17 years	96.4	95.1	97.5	<0.001
Sedentary	5.68±3.69	5.51±3.66	5.85±3.72	<0.001
6–13 years	5.25±3.49	5.18±3.49	5.32±3.49	<0.001
14–17 years	7.07±3.97	6.69±4.00	7.41±3.92	<0.001
Doing homework	1.92±1.21	1.87±1.19	1.97±1.23	<0.001
6–13 years	1.73±1.11	1.72±1.11	1.74±1.11	0.127
14–17 years	2.52±1.32	2.39±1.32	2.64±1.31	<0.001
Watching TV	0.91±1.02	0.95±1.04	0.87±1.00	0.01
6–13 years	0.95±0.96	0.99±1.00	0.90±0.91	<0.001
14–17 years	0.78±1.19	0.76±1.12	0.80±1.24	0.130
Playing computer game	0.68±1.09	0.79±1.22	0.58±0.93	<0.001
6–13 years	0.61±0.98	0.70±1.09	0.51±0.83	<0.001
14–17 years	0.93±1.37	1.10±1.56	0.78±1.16	<0.001
Urban/rural area (%)				
Urban	62.1	61.8	62.4	0.181
Rural	37.9	38.2	37.6	
BMI (kg/m²)	18.60±3.79	18.90±3.98	18.28±3.57	<0.001
6–13 years	17.88±3.55	18.30±3.75	17.44±3.25	<0.001
14–17 years	20.87±3.66	21.03±4.01	20.73±3.31	<0.001
Physical activity (PA, hour/day)				
VPA	0.46±0.72	0.53±0.76	0.39±0.67	<0.001
6–13 years	0.46±0.67	0.51±0.71	0.41±0.61	<0.001
14–17 years	0.45±0.86	0.59±0.90	0.33±0.80	<0.001
MPA	0.46±0.71	0.50±0.75	0.42±0.66	<0.001
6–13 years	0.47±0.69	0.49±0.72	0.44±0.65	<0.001
14–17 years	0.43±0.77	0.52±0.84	0.36±0.70	<0.001
Walking	0.76±1.08	0.79±1.14	0.72±1.01	<0.001
6–13 years	0.73±1.05	0.76±1.11	0.70±0.98	<0.001
14–17 years	0.84±1.15	0.92±1.23	0.77±1.07	<0.001

BMI – body mass index; PA – physical activity; VPA – vigorous physical activity; MPA – moderate physical activity. P value presented as the difference between boys and girls.
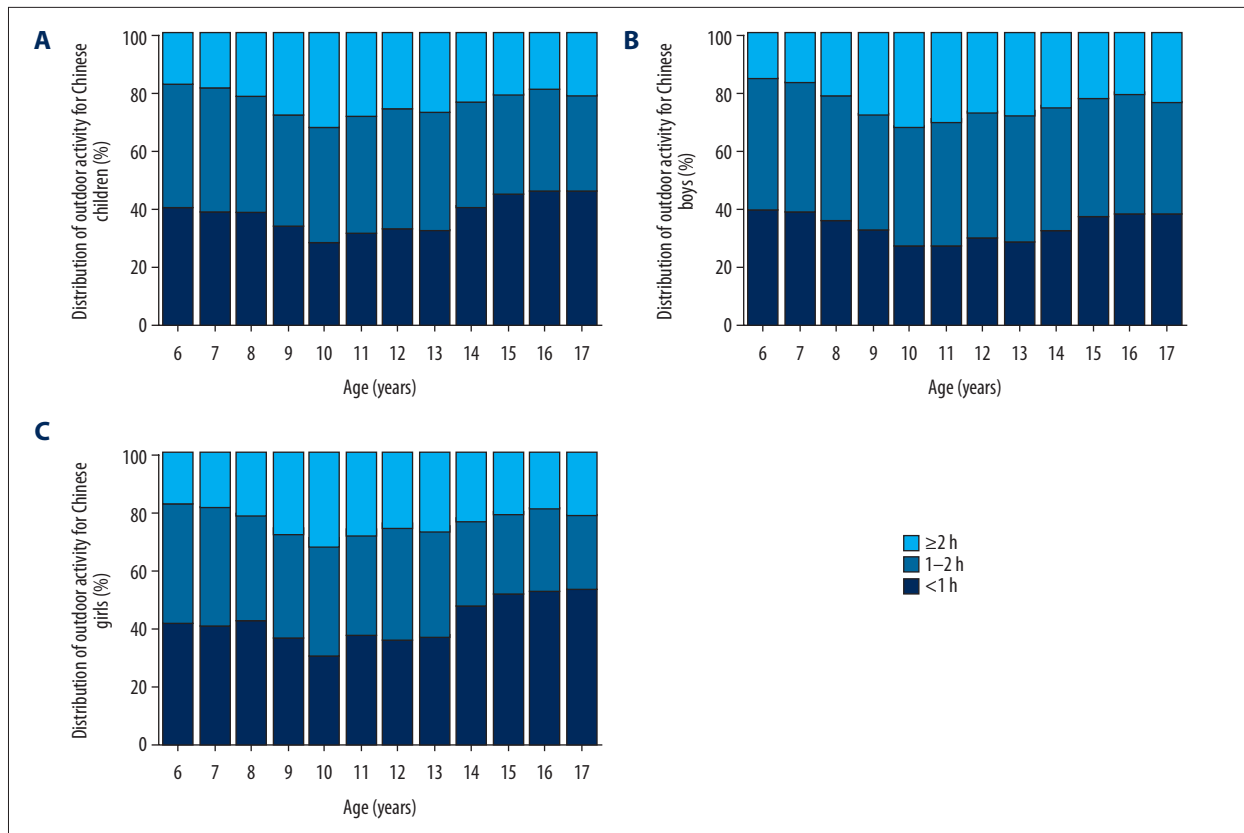
Figure 2. Distribution of daily outdoor activity time among children aged 6-17 years in China. (**A**) Data from all of the subjects; (**B**) data from boys; (**C**) data from girls.

Stratified by age and relative to the OA <1 h group, OA ≥2 h was inversely associated with ISD in both age groups (multivariate-adjusted, ORs: 0.67 and 0.69; 95% CI: 0.62–0.72 and 0.49–0.98, 6–13 years old and 14–17 years old, respectively, Table 3), as well as the 1–2 h OA group (multivariate-adjusted, ORs: 0.91 and 0.73, 95% CI: 0.85–0.97 and 0.54–0.97, respectively, Table 3).

Further stratified by gender, for boys with ≥2 h OA, a lower ISD risk relative to <1 h OA was found in the 6–13 years group and 14–17 years group (ORs: 0.70 and 0.62; 95% CI: 0.62–0.77 and 0.39–0.99, respectively, Table 3), and their female counterparts showed a similar trend (ORs: 0.64 and 0.87; 95% CI: 0.57–0.71 and 0.49–1.54, aged 6–13 and aged 14–17 groups, respectively, Table 3), although in the 14-17 years group, the relationship became non-significant. Relative to <1 h OA, although the p value was >0.05, boys 6–13 years and 14–17 years that had 1–2 h OA showed an inverse trend with ISD risk (ORs: 0.94 and 0.79; 95% CI: 0.86-1.03 and 0.52–1.20, respectively, Table 3). For girls, OA with 1–2 h was inversely associated with ISD in each age group (ORs: 0.87 and 0.61; 95% CI: 0.80–0.96 and 0.40-0.93, respectively, Table 3).

Discussion

Sleep is essential for physical and mental health of children [16], but ISD has become a serious epidemic. Although age [7], BMI [17], and lifestyle [18] are known to play important roles, the mechanism underlying these effects is unclear due to the complexity of sleep behavior. By performing a multi-center national survey of Chinese children, we determined that 37.5% of Chinese children had less than 1 h of OA time per day. Moreover, OA time increased as school-aged children aged to 10 years, then decreased during the period 11–17 years (Figure 2). Most importantly, more than 2 h of OA is associated with decreased risk of ISD in boys aged 6–17 years and girls aged 6–13 years, but 1–2 h OA is associated with decreased risk of ISD only in girls aged 6–17 years.

In our study, the rate of ISD was 74.9% (Table 1), which is consistent with previous research [19] in China. Considering the academic burden Chinese children generally face, it is easier to understand the relatively high level of ISD [20]. A previous study showed the rate of ISD is higher in girls than in boys [21], which was confirmed by our research (Table 1), and this may be explained by research showing that girls need less sleep than boys [21]. The discrepancy between school-aged

Table 2. Sample characteristics by outdoor activity.

	<1 h	1–2 h	≥2 h	P
N	17488 (37.5%)	18532 (39.7%)	10619 (22.8%)	
Age	10.82±3.31	10.69±3.27	10.95±3.35	<0.001
Insufficient sleep duration (%)	78.3	74.5	70.0	<0.001
6–13 years	70.6	68.8	63.6	<0.001
Boys	69.5	68.5	63.6	<0.001**
Girls	71.5	69.0	63.6	<0.001
14–17 years	97.6	95.8	94.6	<0.001#
Boys	96.7	95.1	92.7	<0.001
Girls	98.2	96.5	97.0	<0.001*,#
Sedentary	5.98±3.87	5.61±3.57	5.31±3.56	<0.001
Doing homework	2.01±1.25	1.85±1.16	1.87±1.23	<0.001#
Watching TV	0.81±0.99	0.90±0.96	1.09±1.14	<0.001
Playing computer game	0.59±1.07	0.66±1.01	0.87±1.25	<0.001
Urban/rural area (%)				
Urban	64.6	61.8	58.6	<0.001
Rural	35.4	38.2	41.4	
Father's education (%)				
Low	68.2	69.4	75.0	<0.001**
High	31.8	30.6	25.0	
Mather's education (%)				
Low	71.0	71.6	77.6	<0.001**
High	29.0	28.4	22.4	
BMI	18.62±3.79	18.52±3.77	18.69±3.83	0.001*
Physical activity (PA, hour/day)				
VPA	0.27±0.47	0.46±0.58	0.77±1.09	<0.001
MVA	0.30±0.50	0.47±0.61	0.71±1.02	<0.001
Walking	0.58±0.86	0.76±1.00	1.06±1.41	<0.001
Dietary pattern (servings/day)				
Fruit	1.15±0.99	1.30±1.04	1.48±1.23	<0.001
Vegetable	1.67±1.35	1.82±1.38	1.99±1.53	<0.001
Sugar beverage	0.37±0.69	0.38±0.71	0.45±0.80	<0.001**
Meat	1.10±1.11	1.14±1.11	1.23±1.29	<0.001

BMI – body mass index; PA – physical activity; VPA – vigorous physical activity; MPA – moderate physical activity. * No significant difference between group <1 h and group >2 h; ** no significant difference between group <1 h and group 1–2 h; # no significant difference between group 1–2 h and group >2 h.

Table 3. Odds ratio (OR) and 95% confidence interval (CI) for insufficient sleep duration according to outdoor activity time among children aged 6–17 years.

	<1 h	1–2 h		≥2 h	
Age- and gender-adjusted	1	0.85	(0.80, 0.89)#	0.60	(0.56, 0.63)#
Multivariate-adjusted*	1	0.87	(0.82, 0.93)#	0.64	(0.59, 0.69)#
Age					
6–13 years*	1	0.91	(0.85, 0.97)#	0.67	(0.62, 0.72)#
14–17 years*	1	0.73	(0.54, 0.97)#	0.69	(0.49, 0.98)#
Age/gender groups					
6–13 years					
Boys**	1	0.94	(0.86, 1.03)	0.70	(0.62, 0.77)#
Girls**	1	0.87	(0.80, 0.96)#	0.64	(0.57, 0.71)#
14–17years					
Boys**	1	0.79	(0.52, 1.20)	0.62	(0.39, 0.99)#
Girls**	1	0.61	(0.40, 0.93)#	0.87	(0.49, 1.54)

* Adjusted for age, gender, urban/rural area, father's education, mother's education, BMI, dietary pattern, physical activity and inactivity; ** adjusted for age, urban/rural area, father's education, mother's education, BMI, dietary pattern, physical activity and inactivity; # $p < 0.05$.

and adolescent age groups (Table 1), puberty onset [22], and academic burden increased by age [23] may account for this.

We found that the average daily PA time for Chinese children generally met the WHO requirement (moderate to vigorous PA, Table 1) [24]. To the best of our knowledge, there is no recommendation for OA. Our literature review showed that a 1-h increase in daily OA would benefit children (e.g., reduced risk of myopia [25] and increased PA [26]). However, in our study, 37.5% of children had less than 1 h of OA (Table 1). It is not surprising that children in urban area of China have decreased opportunity to play outdoors [27] due to the crowed environment in cities and lack of open spaces for play [28]. Considering that the 7 centers we chose were mainly urban areas (Table 2), it is easy to understand the relatively high proportion of children who have <1 h OA time. Interestingly, having less than 1 h OA becomes more common when children age from 11 to 17 years old (Figure 2), whereas the opposite trend is found in children age 6–10 years. Children spend more time outdoors before puberty onset [29,30], and the decreased activity after age 11 years may be related to the increasing academic burden that limits time for OA [29]. We found that boys had more OA than girls (Table 1), which is also in accordance with previous research [30]. The activity preference is gender-dependent, as girls tend to prefer quiet and less active play, while boys tend prefer outdoor vigorous activity [30], thus explaining the gender differences in our results.

In the multivariate analyses, we found that increased OA time was associated with decreased risk of ISD, after univariate and multivariate adjustment (Table 3). Compared with PA, OA increases exposure to sunlight and fresh air [31], which is believed to benefit night sleep [32,33]. Although the mechanism is unknown, it is accepted that OA is associated with sleep [11,34]. For humans, a normal circadian rhythm strongly depends on cues from sunlight and the subsequent restricted melatonin release [35,36], which can prevent children from falling to sleep in the daytime. Lack of sunlight at night causes melatonin levels to surge (the dim light onset effect) [36], which promotes sleep onset, which could be one reason that OA time is associated with longer sleep duration. In addition, exposure to fresh air could be another beneficial effect of outdoor play. Compared with indoor activity, playing outside provides children a well-ventilated environment. It is reported that sufficient oxygen may protect against sleep problems [37]; thus, we speculate that OA helps children maintain long sleep duration by providing fresh air and normal circadian rhythm.

Many studies [30] have reported that boys are more active than girls (Table 1). Furthermore, it widely accepted that boys need more sleep than girls [21]. This may indicate that males need to spend more time on OA to reach the same effect as females to achieve decreased risk of ISD, which might account for the slightly different results in boys and girls. Compared to <1 h OA time, children who spend more than 2 h on OA showed significantly decreased risk of ISD, except for teenage girls, in which the relationship became non-significant,

although the trend was still present (Table 3). In a previous review [38], decreased outdoor time was found to be related to increased use of electronic media. In further analysis, we also found that, compared to those with 1–2 h OA, teenage girls who had ≥2 h OA spent more time watching TV (0.85±1.24 *vs.* 0.96±1.21, 1–2 h and ≥2 h, respectively, p<0.05) and playing computer games (0.82±1.09 *vs.* 0.96±1.26, 1–2 h and ≥2 h, respectively, p<0.05). Use of electronic media is believed to be negatively associated with sleep duration among children and adolescents [39]. Based on the above evidence, we speculate that the association between OA and ISD among girls in the 14–17 years group may be affected by the consumption of TV and computer games to became non-significant.

We used <9 h as the criteria of insufficient sleep due to the NSF's recommendation and our study's relatively wide age span. Although one study defined inadequate sleep duration as <10 h (for ages 6–11) and <9 h (for 12–17 years old), but based on our previous research [15], our criteria is more appropriate for Chinese children. Thus, it could be that the different criteria we used could be why our results disagree with several previous studies [10,12,13]. On the other hand, the age composition and ethnic cultural background of study samples, which have been thought to be relevant to sleep [6,13], could also be another cause of conflicting results.

To the best of our knowledge, this is the first study exploring the association of self-reported OA and sleep time among Chinese children aged 6–17 years, using a representative national multi-center dataset. In addition, both PA and OA were assessed, as PA adjusted, the results can elucidate the single effect of OA for sleep duration. We found that age and gender are specific factors when considering the relationship between OA and ISD, and the inner mechanism still needs further research to confirm.

This study has several limitations. Firstly, causal inferences about the relationship between outdoor time and sleep duration cannot be elucidated due to the cross-sectional design. Secondly, the use of self-reported sleep duration and outdoor playing time may have recall bias, and the questionnaire we used has not been tested for reliability and validity. The items

of sleep and OA we collected were presented as categorical values, which may involve some loss of information. The use of longitudinal designs, objective tools, and continuous variables to assess sleep duration and outdoor time in further researches would improve our understanding of the relationship between sleep and OA. As previously reported, attending school and studying are the main psychological stressors among Chinese children [40], which could be a contributor to inadequate sleep duration. However, in a national survey with a large sample size, it is difficult to collect all information related to the outcomes of interest, and in future we will try to explore more psychological stressors. Furthermore, our study only focused on the duration of sleep and outdoor time during the whole week, which fails to differentiate between weekday and weekend, and sleep quality and OA type could be relevant to consider in future studies.

Conclusions

In summary, this study provides initial evidence that sufficient time spent outdoors is associated with decreased risk of insufficient sleep in children 6–17 years old in China. The association is age- and gender-dependent, which suggest the definition of sufficient OA time should consider the factors of age and gender. Based on our findings, further research is warranted to determine the age and gender effects on the association between OA and ISD, and to investigate whether the intervention of promoting time spent outdoors is a useful way to prevent insufficient sleep in children.

Acknowledgements

Conflict of interest

None.

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Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
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Supplementary Data

Supplementary Table 1. Sample characteristics by gender.

	ALL	Boy	Girl	P
Sample size	46639	23743 (50.9%)	22896 (49.1%)	
Height (cm)	145.86±17.09	146.88±18.48	144.79±15.45	<0.001
6–13 years	139.90±14.66	140.20±14.92	139.62±14.37	<0.001
14–17 years	164.81±8.20	170.52±6.78	159.73±5.60	<0.001
Weight (kg)	41.07±15.64	42.48±17.06	39.62±13.87	<0.001
6–13 years	36.11±13.07	37.13±13.87	34.99±12.05	<0.001
14–17 years	56.94±12.24	61.38±13.46	52.98±9.42	<0.001
Waist circumference (cm)	64.89±10.83	66.00±11.61	63.74±9.84	<0.001
6–13 years	62.56±10.23	63.75±10.93	61.26±9.24	<0.001
14–17 years	72.32±9.24	73.94±10.37	70.89±7.82	<0.001
Hip circumference (cm)	77.15±12.09	77.03±12.20	77.27±11.97	0.032
6–13 years	73.33±10.68	73.45±10.68	73.20±10.67	0.03
14–17 years	89.35±7.31	89.69±8.13	89.04±6.49	<0.001
Father's education (%)				
Low	70.2	70.8	69.7	0.015
High	29.8	29.2	30.3	
Mother's education (%)				
Low	72.7	73.1	72.3	0.088
High	27.3	26.9	27.7	
Dietary pattern (servings/day)				
Fruit	1.28±1.07	1.27±1.11	1.30±1.03	0.002
6–13 years	1.34±1.09	1.33±1.13	1.35±1.05	0.065
14–17 years	1.11±0.99	1.06±1.01	1.16±0.97	<0.001
Vegetable	1.80±1.41	1.81±1.44	1.79±1.38	0.078
6–13 years	1.81±1.41	1.81±1.44	1.82±1.37	0.791
14–17 years	1.76±1.42	1.81±1.45	1.71±1.39	<0.001
Sugar beverage	0.39±0.72	0.47±0.83	0.31±0.58	<0.001
6–13 years	0.33±0.63	0.38±0.72	0.27±0.52	<0.001
14–17 years	0.60±0.92	0.80±1.07	0.43±0.72	<0.001
Meat	1.14±1.16	1.27±1.27	1.02±1.02	<0.001
6–13 years	1.13±1.14	1.23±1.24	1.01±1.00	<0.001
14–17 years	1.20±1.22	1.39±1.35	1.02±1.06	<0.001

P value presented as the difference between boys and girls.

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