

## Preplanned Studies

## Sleep Status Among Children and Adolescents Aged 6–17 Years — China, 2016–2017

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### Summary

#### What is already known about this topic?

There has been little to no description of sleep status among children and adolescents nationwide in recent years.

#### What is added by this report?

This report assesses the sleep duration and sleep patterns of children and adolescents in China. Approximately half of the adolescents did not get the recommended amount of sleep on school days, and more than half overslept on weekends.

#### What are the implications for public health practice?

The importance of children and adolescents meeting recommended sleep durations needs greater emphasis, especially among older age groups and those in urban areas.

One of the most important age ranges for children to develop good sleeping habits, behaviors, and lifestyles is 6–17 years of age. During these years, sleep has significantly impacted many aspects of learning, daily life, and health status (1). Studies from 2010–2012 showed that the proportion of children and adolescents in China who do not get the recommended sufficient sleep was 69.8% (2). With only a few subsequent studies reporting on the sleep status of children and adolescents nationwide, knowledge of this field has been limited in recent years (2–5). This study used data from the China Nutrition and Health Surveillance of Children and Lactating Mothers in 2016–2017 to assess the average sleep duration, sleep patterns, and distribution of total sleep duration per 24 hours and naptime among children and adolescents aged 6–17 years in China. It is the latest data inferred from the surveillance program. The results show that approximately half of adolescents aged 13–17 years do not get the recommended amount of sleep on school days, and more than half oversleep on weekends. Targeted interventions are needed to

make parents and children, especially older age groups and those in urban areas, aware of the importance of getting sufficient sleep and developing good sleeping habits.

The data in this study came from the China Nutrition and Health Surveillance of Children and Lactating Mothers in 2016–2017, which uses a multi-stage stratified cluster randomized sampling method. The method classifies all county-level administrative units in the mainland of China into four categories: big cities, medium and small cities, ordinary rural areas, and rural areas with lower economic development. These four areas were classified according to their economic and social development (6). First, a total of 275 county-level units were selected as surveillance points from the four categories. Second, two townships/subdistricts were selected from each surveillance point, with one primary school and one junior high school selected from each township/subdistrict. In addition, one high school was selected from each surveillance point, and one class was selected from each grade, with 28 students from each class being surveyed. The sample size was calculated using the 2013 overweight rate of 4.5% for children and adolescents aged 7–17 years as the calculation marker for determining sample size and taking into account a non-response rate of 10%. After data cleaning, a total of 74,246 valid samples of children aged 6–17 years were obtained. A total of 67,657 participants were included in this analysis, while 6,589 participants were excluded as a result of missing basic information variables or extreme values. The study was approved by the Ethical Committee of the Chinese Center for Disease Control and Prevention. All participants provided written informed consent signed by their parents.

The China Nutrition and Health Surveillance of Children and Lactating Mothers included questionnaires, medical examinations, dietary surveys, and laboratory tests. A self-designed questionnaire, with consultation and validation from experts, was

used to collect basic information from respondents during face-to-face interviews with trained and qualified interviewers. The questionnaire collected information including demographic characteristics (i.e., gender, age, region, etc.) and sleep behaviors. Regions were divided based on physical geography and expert research, including North China (Beijing Municipality, Tianjin Municipality, Hebei Province, Shanxi Province, Inner Mongolia Autonomous Region), Northeast China (Heilongjiang Province, Jilin Province, Liaoning Province), East China (Shanghai Municipality, Jiangsu Province, Zhejiang Province, Shandong Province, Anhui Province, Jiangxi Province, Fujian Province, Taiwan, China), Central China (Hubei Province, Hunan Province, Henan Province), South China (Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province, Hong Kong Special Administrative Region, Macao Special Administrative Region), Southwest China [Sichuan Province, Chongqing Municipality, Guizhou Province, Yunnan Province, Xizang (Tibet) Autonomous Region], and Northwest China (Shaanxi Province, Gansu Province, Xinjiang Uygur Autonomous Region, Qinghai Province, Ningxia Hui Autonomous Region). Left-behind children are defined as those with at least one parent currently working and living away from home for six or more months by the time of the survey, resulting in the child living alone without parental supervision. The wake-up time and bedtime were obtained by asking parents, “what time does your child usually get up in the morning and go to bed at night?” Naptime durations were obtained by asking parents, “how long does your child usually sleep during the day?” Sleep duration was calculated from the wake-up time and bedtime, while total sleep duration per 24 hours was calculated by the addition of sleep duration and naptime. According to a consensus statement by the American Academy of Sleep Medicine (7), the recommended amount of sleep is 9–12 hours for children aged 6–12 years and 8–10 hours for adolescents aged 13–18 years per 24 hours regularly. Insufficient sleep was defined as <9 hours for children and <8 hours for adolescents.

All statistical analyses were performed using the software SAS (version 9.4, SAS Institute Inc., Cary, USA), and  $P < 0.05$  was statistically significant. The data were adjusted for complex sample weights to ensure that the findings were nationally representative of children and adolescents; each observation was

weighted by two components, namely sample weights, and ex-post weights, which were based on urban-rural, age- and sex-specific population data from the Sixth Population Census 2010 published by the National Bureau of Statistics. Means were calculated using the survey means process. *t*-tests and ANOVA were conducted to test for group differences in means, and Rao-Scott chi-squared tests were conducted for prevalence.

A total of 67,657 Chinese children and adolescents aged 6–17 years were included in the data analysis, including 33,652 males and 34,005 females. Table 1 describes the baseline characteristics of the participants and the total sleep duration per 24 hours for children and adolescents with different characteristics. Their average total sleep duration per 24 hours was 9.10 [standard deviation (SD): 1.30] hours on school days and 10.31 (SD: 1.42) hours on weekends. The total sleep duration per 24 hours decreased with age and was shortest in the Northeast and longest in the Southwest. Boys slept longer than girls on school days (9.15 hours versus 9.04 hours,  $P < 0.0001$ ), but the opposite occurred on weekends (10.23 hours versus 10.40 hours,  $P < 0.0001$ ). Children and adolescents in rural areas slept longer than those in urban areas, especially on school days (9.29 hours versus 8.87 hours,  $P < 0.0001$ ). The sleep duration composition of children and adolescents aged 6–12 years and 13–17 years is shown in Figure 1. The proportion of children aged 6–12 years meeting the recommended amount of sleep was 84.8% on school days and 80.7% on weekends. Among adolescents aged 13–17 years, the proportions were 54.7% and 37.0% on school days and weekends, respectively.

Overall, children and adolescents aged 6–17 years had an average wake-up time of 6:22 and 7:57, an average bedtime of 21:43 and 22:08, and an average nighttime sleep duration of 8.64 and 9.81 hours on school days and weekends, respectively. With increasing age, the wake-up time on school days is earlier from 6:06 to 6:40, bedtime is later from 20:56 to 22:56, and sleep duration at night is shorter from 9.73 to 7.16 hours. On weekends, the wake-up time is around 8:00, and bedtime is generally about half an hour later than on school days. Urban children slept later and less than rural children (Table 2). Figure 2 shows the distribution of naptime among Chinese children aged 6–17 years, classifying naptime into three categories:  $\geq 1$  hour, <1 hour, and no nap. The proportion of children taking naps increased with age, especially on school days.

TABLE 1. Total sleep duration per 24-hour for children and adolescents with different characteristics — China, 2016–2017.

Characteristics	Total (%)	School-days sleeptime, [hours (SD)]	P value	Weekends sleeptime, [hours (SD)]	P value
Total	67,657 (100)	9.10±1.30		10.31±1.42	
Age group (years)			<0.0001		<0.0001
6–	17,720 (26.19)	10.02±0.80		10.63±1.09	
9–	20,601 (30.45)	9.77±0.95		10.50±1.24	
12–	16,515 (24.41)	8.95±1.10		10.29±1.44	
15–17	12,821 (18.95)	7.89±0.98		9.90±1.67	
Sex			<0.0001		<0.0001
Male	33,652 (49.74)	9.15±1.27		10.23±1.42	
Female	34,005 (50.26)	9.04±1.33		10.40±1.43	
Area			<0.0001		<0.0001
Urban	31,896 (47.14)	8.87±1.26		10.25±1.46	
Rural	35,761 (52.86)	9.29±1.30		10.35±1.39	
Region*			<0.0001		<0.0001
North China	10,114 (14.95)	8.89±1.25		10.12±1.38	
Northeast China	5,367 (7.93)	8.77±1.29		10.04±1.50	
East China	17,203 (25.43)	9.07±1.27		10.28±1.42	
Central China	9,063 (13.40)	9.28±1.34		10.36±1.35	
South China	7,041 (10.41)	8.93±1.23		10.13±1.50	
Southwest China	10,883 (16.09)	9.36±1.30		10.51±1.40	
Northwest China	7,986 (11.80)	8.94±1.32		10.46±1.41	
Primary caregiver			<0.0001		<0.0001
Father/mother	53,744 (79.44)	9.02±1.30		10.29±1.44	
Grandparents	12,416 (18.35)	9.44±1.23		10.39±1.33	
Others	1,497 (2.21)	8.92±1.23		10.27±1.61	
Living in the school			<0.0001		<0.0001
Yes	18,532 (27.39)	8.61±1.35		10.08±1.59	
No	49,125 (72.61)	9.31±1.21		10.41±1.33	
Left-behind children			<0.0001		<0.0001
Yes	13,547 (20.02)	9.32±1.27		10.39±1.39	
No	54,110 (79.98)	9.03±1.30		10.28±1.43	

Abbreviation: SD=standard deviation.

\* Regions were divided based on physical geography and expert research, including North China (Beijing Municipality, Tianjin Municipality, Hebei Province, Shanxi Province, Inner Mongolia Autonomous Region), Northeast China (Heilongjiang Province, Jilin Province, Liaoning Province), East China (Shanghai Municipality, Jiangsu Province, Zhejiang Province, Shandong Province, Anhui Province, Jiangxi Province, Fujian Province, Taiwan, China), Central China (Hubei Province, Hunan Province, Henan Province), South China (Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province, Hong Kong Special Administrative Region, Macao Special Administrative Region), Southwest China [Sichuan Province, Chongqing Municipality, Guizhou Province, Yunnan Province, Xizang (Tibet) Autonomous Region], and Northwest China (Shaanxi Province, Gansu Province, Xinjiang Uygur Autonomous Region, Qinghai Province, Ningxia Hui Autonomous Region).

## DISCUSSION

This study showed the total sleep duration per 24 hours and sleep patterns for children and adolescents aged 6–17 in China during 2016–2017. The proportion of insufficient sleep was 13.3% on school days and 4.6% on weekends for children aged 6–12

years, and 36.9% and 6.0% for adolescents aged 13–17 years. The proportion of insufficient sleep in the United States of America is 37.4% for children aged 6–12 years and 31.2% for adolescents aged 13–17 years (8). Comparatively, the situation of short sleep durations on school days is slightly more serious for Chinese adolescents aged 13–17 years. Older and

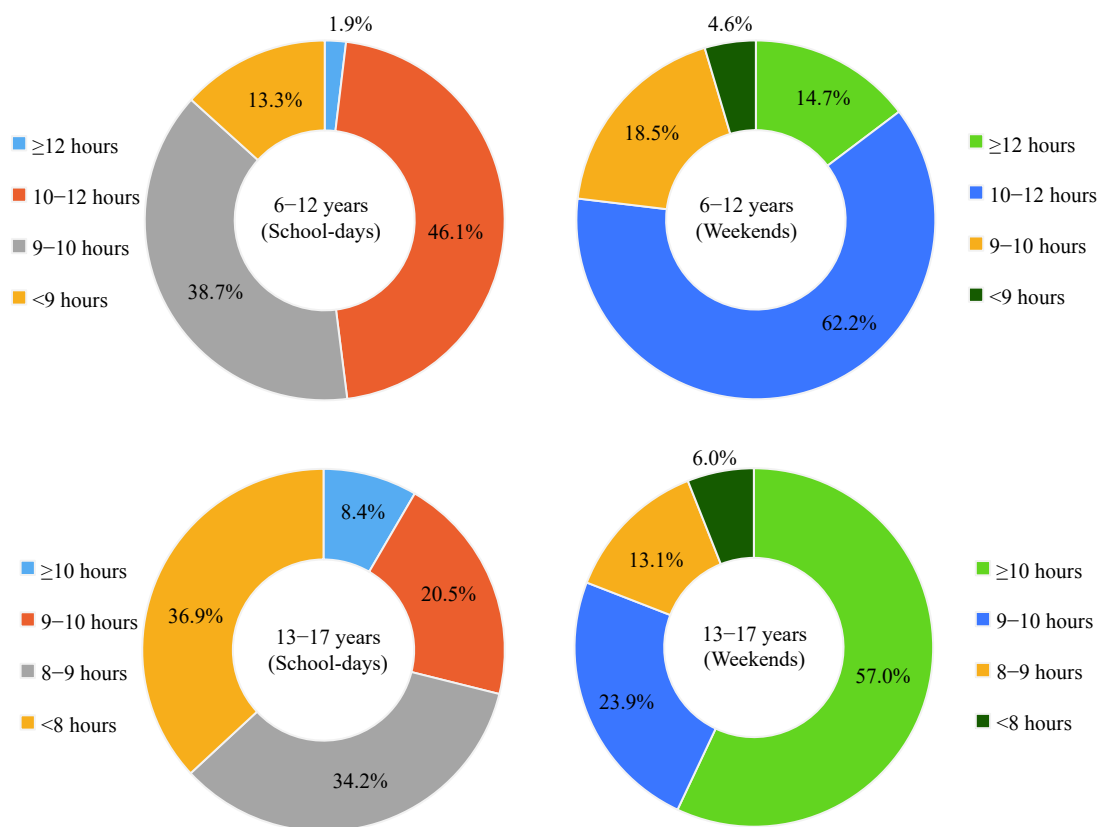


FIGURE 1. Sleep duration composition of children and adolescents aged 6–17 years — China, 2016–2017.

TABLE 2. Sleep patterns of children and adolescents aged 6–17 years — China, 2016–2017.

Sleep patterns	Total	Age group (years)				P-value	Area		P value
		6–	9–	12–	15–17		Urban	Rural	
School-days									
Wake-up time	6:22±0:32	6:40±0:26	6:31±0:28	6:14±0:31	6:06±0:29	<0.0001	6:23±0:32	6:21±0:32	<0.0001
Bedtime	21:43±1:09	20:56±0:41	21:03±0:46	21:43±0:54	22:56±0:48	<0.0001	22:00±1:06	21:29±1:09	<0.0001
Sleep duration at night (h)	8.64±1.34	9.73±0.69	9.46±0.81	8.52±1.00	7.16±0.84	<0.0001	8.39±1.27	8.86±1.36	<0.0001
Weekends									
Wake-up time	7:57±1:04	7:52±0:52	7:53±0:57	8:00±1:06	8:03±1:15	<0.0001	8:01±1:05	7:53±1:03	<0.0001
Bedtime	22:08±1:06	21:33±0:49	21:43±0:54	22:11±1:01	22:57±1:01	<0.0001	22:22±1:03	21:56±1:06	<0.0001
Sleep duration at night (h)	9.81±1.25	10.32±0.82	10.17±1.05	9.81±1.18	9.10±1.34	<0.0001	9.65±1.21	9.95±1.27	<0.0001

urban participants were particularly at risk of short sleep durations and tended to sleep late. As their age increased, Chinese adolescents aged 13–17 years got up earlier and took a higher proportion of napping on school days. This may be the result of senior students in cities having heavier academic loads, especially on school days, and needing longer naps to catch up on sleep. Children who are left behind have a longer sleep duration, likely because they are largely located in rural areas. Children whose primary caregivers are not parents or grandparents and children who live in

school have even shorter sleep durations. Public health practitioners, educators, and clinicians should advise primary caregivers about the importance of meeting recommended sleep durations in children and adolescents and support parents in developing good sleep habits for their children.

An analysis conducted in eight Chinese provinces in 2010 showed that the average sleep duration for children aged 6–12 years was 9.11 hours and 9.80 hours on school days and weekends, respectively. The proportion of sleeping <9 hours and 9–10 hours was

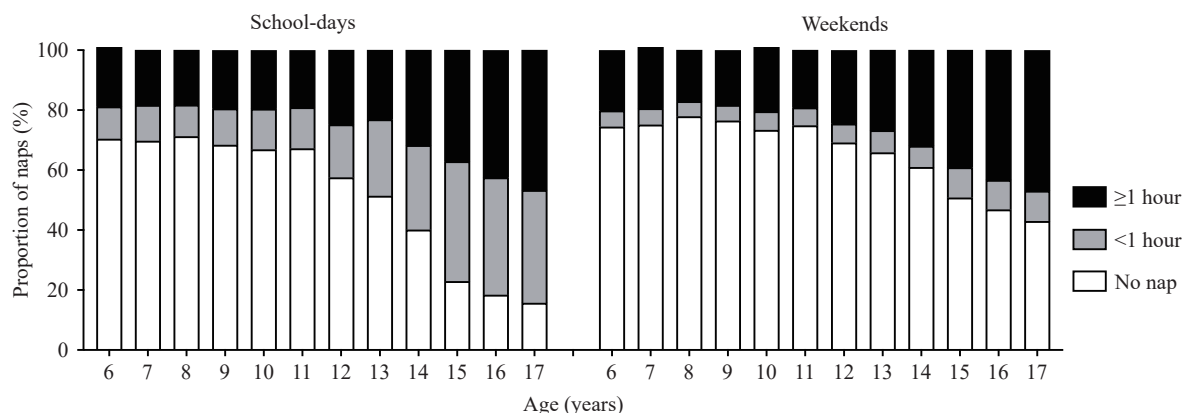


FIGURE 2. Distribution of naptime among children aged 6–17 years — China, 2016–2017.

32.8% and 39.7% on school days, and 13.6% and 27.3% on weekends (3). This study showed that this population has a longer average sleep duration, with 13.3% and 38.7% sleeping <9 hours and 9–10 hours on school days and 4.6% and 18.5% on weekends. Another study in 2010 showed that 68.7% of students aged 13–15 years and 91.1% of students aged 16–18 years slept <8 hours, which was comparable to 74.1% and 93.8% reported in a 2014 study (4–5). Although the two results showed an upward trend in the proportion of adolescents in China with short sleep duration, the proportion of adolescents aged 13–17 years in this study who slept <8 hours was 36.9% on school days and 6.0% on weekends. Previous estimates of the proportion were significantly higher, which may be explained by different methods used to obtain sleep duration data between studies. The data in this study was calculated from parent-reported wake-up times, bedtimes, and added nap times. The results of previous studies were derived from parents' or students' self-reported sleep durations, which may contribute to an underestimation of total sleep duration. Additionally, the ages of the study populations in the 10- and 14-year studies were not the same as the ages in this study.

Comparing these results shows that sleep status among children and adolescents in China improved in 2016–2017 compared to previous years. Short sleep duration was improved on weekends. Oversleeping was more serious than school days, with 57% of adolescents aged 13–17 years sleeping more than the recommended amount of sleep (i.e., 10 hours). It is important to note that weekend oversleeping does not alleviate the usual lack of sleep and may lead to several negative consequences. A nationally representative cross-sectional study in the United States of America showed that both later weeknight bedtimes and weekend oversleeping were associated with increased

odds of mental disorders and even suicidality (9). A large sample study in the Republic of Korea also found that long weekend oversleeping among adolescents independently predicted higher suicidality (10). Therefore, this phenomenon should not be encouraged.

The findings in this study are subject to several limitations. First, responses might be affected by recall bias, interpretation of items, or social desirability. Second, the study results were derived from a cross-sectional survey, which is not specific to the sleep of children. Therefore, the results were not adequate and comprehensive. Most current studies in the field of child sleep in China are based on cross-sectional surveys, with few longitudinal studies designed. The lack of uniform questionnaires or scales between different studies as well as the often incomplete agreement in defining relevant concepts, leads to a lack of comparability between studies. Methods for sleep duration surveillance among children need to be improved, and it is hoped that more detailed and reliable survey data will be available in the future to analyze child sleep status.

Insufficient sleep is a serious risk factor for poor physical and mental health in children and adolescents (1). Primary caregivers can help children get an ideal amount of sleep by supporting good sleep habits. If possible, children should choose a parent or grandparent as their primary caregiver and try not to stay in school accommodations. Clinicians and educators can guide parents about the importance of sleep at all ages as well as discuss sleep routines and sleep problems with parents, children, and adolescents. Teachers should teach students about sleep health and support them in developing good sleep habits as part of their educational work. Students themselves should also be conscious of the need to develop a regular

routine. Public health practitioners should call on society, schools, and families to cultivate good home and living environments, reduce student academic loads, and encourage active exercise habits. Doing so will help improve the sleep status of children and adolescents.

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## REFERENCES

1. Paruthi S, Brooks LJ, D'Ambrosio C, Hall WA, Kotagal S, Lloyd RM, et al. Consensus statement of the American academy of sleep medicine on the recommended amount of sleep for healthy children: methodology and discussion. *J Clin Sleep Med* 2016;12(11):1549 – 61. <http://dx.doi.org/10.5664/jcsm.6288>.
2. Song C, Gong WY, Ding CC, Zhang Y, Yuan F, Liu AL. Sleep duration among Chinese children and adolescents aged 6–17 years old. *Chin J Sch Health* 2017;38(9):1288 – 90. <http://dx.doi.org/10.16835/j.cnki.1000-9817.2017.09.003>. (In Chinese).
3. Shi WH, Zhai Y, Li WR, Shen C, Shi XM. Difference on sleeping between school-days and weekends in elementary school children, data from 8 provinces in China. *Chin J Epidemiol* 2015;36(6):552 – 5. <http://dx.doi.org/10.3760/cma.j.issn.0254-6450.2015.06.003>. (In Chinese).
4. Song Y, Zhang B, Hu PJ, Ma J. Current situation of sleeping duration in Chinese Han students in 2010. *Chin J Prev Med* 2014;48(7):596 – 601. <http://dx.doi.org/10.3760/cma.j.issn.0253-9624.2014.07.013>. (In Chinese).
5. Luo DM, Xu RB, Hu PJ, Dong B, Zhang B, Song Y, et al. Analysis on the current situation of insufficient sleep and its association with physical exercise among Chinese Han students aged 9-18 years, in 2014. *Chin J Epidemiol* 2018;39(10):1298 – 302. <http://dx.doi.org/10.3760/cma.j.issn.0254-6450.2018.10.002>. (In Chinese).
6. Song C, Gong WY, Ding CC, Yuan F, Zhang Y, Feng GY, et al. Physical activity and sedentary behavior among Chinese children aged 6–17 years: a cross-sectional analysis of 2010–2012 China National Nutrition and health survey. *BMC Public Health* 2019;19(1):936. <http://dx.doi.org/10.1186/s12889-019-7259-2>.
7. Paruthi S, Brooks LJ, D'Ambrosio C, Hall WA, Kotagal S, Lloyd RM, et al. Recommended amount of sleep for pediatric populations: a consensus statement of the American academy of sleep medicine. *J Clin Sleep Med* 2016;12(6):785 – 6. <http://dx.doi.org/10.5664/jcsm.5866>.
8. Wheaton AG, Claussen AH. Short sleep duration among infants, children, and adolescents aged 4 months-17 years-United States, 2016-2018. *MMWR Morb Mortal Wkly Rep* 2021;70(38):1315 – 21. <http://dx.doi.org/10.15585/mmwr.mm7038a1>.
9. Zhang JH, Paksarian D, Lamers F, Hickie IB, He JP, Merikangas KR. Sleep patterns and mental health correlates in US adolescents. *J Pediatr* 2017;182:137 – 43. <http://dx.doi.org/10.1016/j.jpeds.2016.11.007>.
10. Lee YJ, Cho SJ, Cho IH, Kim SJ. Insufficient sleep and suicidality in adolescents. *Sleep* 2012;35(4):455 – 60. <http://dx.doi.org/10.5665/sleep.1722>.