Sleep Duration and School Readiness of Chinese Preschool Children

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Objectives To examine the average sleep duration in Chinese preschoolers and to investigate the association between sleep duration and school readiness.

Study design This is a cross-sectional study that included 553 Chinese children (mean age = 5.46 years) from 20 preschools in 2 districts of Hong Kong. Average daily sleep duration in the last week was reported by parents and school readiness as measured by the teacher-rated Chinese Early Development Instrument (CEDI).

Results Most Chinese preschoolers had 9-10 hours of sleep per day. Only 11% of preschoolers had the recommended 11-12 hours of sleep per day. This group was associated with more "very ready" CEDI domains. Sleep deprivation (≤7 hours per day) was associated with a lower CEDI total score, lower scores in the emotional maturity and language/cognitive domain, and prosocial behaviors subdomain but a greater score in the hyperactivity/inattention subdomain. Children with a lower family socioeconomic index, lower maternal education level, infrequent parent-child interactions, and who used electronic devices for more than 3 hours per day had shortened sleep durations.

Conclusions Optimal sleep duration was associated with better school readiness in preschool children, whereas sleep deprivation was associated with lower school readiness, more hyperactivity and inattention, and less prosocial behavior. *(J Pediatr 2016;169:266-71)*.

Sleep is the primary activity of a child's brain during early development. In the first few years of a child's life, more than one-half of the day is spent sleeping.[1] Sleep plays vital roles in brain growth,[2] restoration, and metabolic homeostasis,[3] which have significant life-long effects on development and health. However, parents of preschool children often focus on their child's daytime activities and overlook the importance of sleep in their development.

It is widely recognized that sleep disruption could negatively affect cognitive performance and emotional adjustment,[4,5] and the lack of sleep impairs brain function and adversely affects learning, cognition, and reaction time.[6,7] Sleep deprivation in early childhood increases the risk of physical health problems such as obesity,[8,9] as well as developing neurodevelopmental problems, such as intensifying symptoms of autism or behavioral problems,[10] leading to poor attention in later life.[11] A study showed that young children ages 4-7 years were at risk of poorer physical and mental health if they were "persistent short sleepers."[12]

There is a positive association of sleep duration with social skills, peer acceptance, and emotional adjustment in preschool children. The present study aimed to investigate the relationship among sleep duration, sleep deprivation, and school readiness in preschool children. We hypothesized that sleep duration had a positive association with the holistic and domain-specific school readiness and sleep deprivation had a negative association. In addition, we also explored any potential factors that might influence sleep duration.

Methods

This was a cross-sectional study conducted in 2011-2012. A list of preschools selected at random by a computerized program was generated from all Chinese-speaking preschools in 2 districts of Hong Kong, Hong Kong Island (HKI) and Yuen Long (YL). HKI is a typical affluent district of Hong Kong, whereas YL is representative of one of the more disadvantaged districts. In 2012, HKI had a median monthly family income of US $4240 compared with US $2680 in YL.[13]

With the approval of the school principals, 1 class from the final year (Year 3) was randomly chosen from each preschool. In total, 575 Year 3 children from 20 preschools were invited to participate in this study. Informed written consent was obtained from 567 parents, giving a response rate of 98.6%. Participants from this study also were recruited in another study on the socioeconomic gradients of school readiness in Chinese

CEDI	Chinese Early Development Instrument
HKI	Hong Kong Island
NIH	National Institutes of Health
SES	Socioeconomic status
YL	Yuen Long

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preschool children.[14] The study was approved by the ethical committee of the Institutional Review Board of the University of Hong Kong.

School Readiness and the Chinese Early Development Instrument

School readiness is an indicator of whether a child possesses the cognitive, social, and emotional skills necessary for success in school. School readiness was measured with the Chinese Early Development Instrument (CEDI). The CEDI was derived from the Early Development Instrument, a comprehensive, teacher-rated scale that was originally developed in Canada by Janus and Offord in 2007.[15] The Chinese version of Early Development Instrument has been validated previously and has been proven to be a reliable tool with good psychometric properties for assessing the school readiness and holistic development of Chinese children.[16]

Using the CEDI, the teacher most familiar with each child was asked to assess his or her school readiness. The 69 qualified teachers were given training in the use of the instrument. A teacher's guide for the CEDI was developed to help teachers understand, interpret, and code each item within a local Chinese context. The CEDI rating scale contains 103 items that assess the 5 developmental domains of physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication skills and general knowledge.

The score for each of the 5 domains ranged from 0 to 10, and the CEDI total score ranged from 0 to 50. A greater score indicated a better performance in the measured developmental domain. A child would be regarded as "very ready" for school if his or her domain scores were within the top 25% of the local population, as suggested in the instrument handbook.[17] These children are expected to benefit the most from school.

Family Questionnaire

Parents were asked to complete a family questionnaire, which was a pretested questionnaire developed in-house that covered the child's sleep duration, family demographics and socioeconomic status (SES), parent-child interaction, and the child's ownership and use of electronic devices. Items in the family questionnaire have been piloted in 167 parent-child pairs and showed good face and content validity.

Sleep Duration

Sleep duration was assessed with a parent-report item on the average number of hours the child slept per day in the past week, including both nighttime sleep and daytime naps. The single-item assessment was used because this is a feasible and reasonably accurate means to measure the children's sleep duration in a larger-scale epidemiologic study. Previous studies have found the parent-report sleep duration to be valid and reliable.[18] Average sleep duration was categorized into 4 groups ($\leq$8, >8 to <11, 11-12, and $\geq$13 hours) in regression analysis. Sleep duration was analyzed as a categorical variable rather than continuous variable so that comparisons could be made against the recommended sleep duration of 11-12 hours according to National Institutes of Health (NIH) guidelines.[19] In analyzing the effect of sleep deprivation on child development, we further categorized the category of $\leq$8 sleep hours as $\leq$7 hours and >7 to 8 hours.

Family SES

We generated the family SES index as a summary of the family socioeconomic indicators: maternal and paternal education, maternal and paternal occupation, family assets, and adjusted family monthly household income. These measurements were aggregated into a single SES index by the use of principal component analysis, which has been validated previously as a method to describe SES differentiation within a population.[20] The SES index had significant correlation with all the SES variables ($r = 0.59$-0.82, $P < .001$) and accounted for 58.4% of the total variation, larger than previous reports.[20]

Frequency of Parent-Child Interaction

Frequency of parent-child interaction was measured through a scale previously used in Chinese preschoolers.[14] This is a 6-point Likert scale assessing the frequency of any 1 of the 7 parent-child activities per week in the past month (0 = almost none, 5 = almost every day). The parent-child interaction items were categorized into 3 domains: reading (such as parental reading), recreational activities (such as sports, playing games, and art), and learning activities (such as learning the alphabet). These items were averaged within the domains and the 3 domain scores were used in the analysis. The scale was shown to have strong positive association with child development.[14]

Use of Electronic Devices

Common electronic devices were categorized into 3 types: television (including television-related devices), electronic games (game consoles, smartphone), and computers (both desktop and laptop). Information was collected on the ownership of electronic devices and the number of hours per day the child spent using them in the past week. These items have been used in another study examining the relationship between electronic devices and school readiness.

Statistical Analyses

The association between the CEDI scores and sleep duration was examined by the use of multiple linear regressions. Family SES was adjusted in the models to avoid confounding variables. The relationship between sleep duration and the likelihood of "very ready" was studied with the use of binomial logistic regressions after we adjusted for the family SES index. To delineate the potential effects of sleep deprivation (average sleep duration $\leq$7 hours), a linear model was fitted to estimate the average CEDI total score for each sleep duration category after we adjusted for SES. Any difference in the CEDI total score between the sleep-deprived group and the reference group (11-12 hours) was determined by the Wald test. The associations of sleep duration also were