Roles of Parental Sleep/Wake Patterns, Socioeconomic Status, and Daytime Activities in the Sleep/Wake Patterns of Children

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Objectives To determine sleep/wake patterns of primary school children and their correlates.
Study design A total of 4470 sets of mother-father-child community-based trios were recruited in this study. We constructed 3 integrated models with structural equation modeling to predict sleep/wake patterns of children (bedtime, wakeup time, and time in bed [TIB]).
Results Our best-fitting models explained 40% to 71% variances of various sleep/wake patterns of the children, which were influenced by a web of interactive factors including school start time, parental sleep/wake patterns, sociodemographics, and daytime activities. The strongest predictor of various sleep/wake patterns was school start time. Higher socioeconomic status would shorten TIB of both children and parents, but through different pathways (by advancing wakeup time and delaying bedtime in children but by delaying bedtime in parents). Media use and homework shortened TIB of children, while leisure extracurricular activities and later school start time lengthened it. The age and sex effects on sleep/wake patterns, at least in part, were mediated by daytime activities. Daytime activities of children also influenced their parental sleep/wake patterns, especially their maternal one. A consistent pattern of stronger mother-child than father-child associations were found in various sleep/wake patterns.
Conclusions There was a complex and interactive relationship among school schedule, parental sleep/wake patterns, socioeconomic status, and daytime activities in determining the sleep/wake patterns of children. These findings have important clinical implications for the management of childhood sleep/wake habits and problems. *(J Pediatr 2010;156:606-12)*.

Sleep/wake patterns have been found to be influenced by both environmental and genetic factors, with variation across different populations and cultures.[1-4] Almost all studies found that sleep/wake patterns of children changed progressively with advancing age with shortened time in bed (TIB), delayed bedtime, and wakeup time.[1,5-10] In addition, their sleep/wake patterns were influenced by daytime activities,[11-13] socioeconomic status (SES),[2,9,11] and parental monitoring.[14] Parents exert strong genetic and psychosocial influences on behaviors, sleep/wake habits, and problems of their offspring.[15] Two studies from north China and Taiwan suggested that there were low but significant correlations in sleep/wake patterns between adolescents and their parents.[16,17] However, both studies were limited by the relatively low response rates of the parents and moderate sample sizes. In particular, both studies did not control for other co-variates such as SES and daytime activities, which were closely related to sleep/wake patterns.[2,9,11]

Inadequate sleep is a common global problem in both children and adolescents,[18,19] with a constellation of pervasive consequences, including impaired cognitive functioning,[20] emotional problems,[21] obesity,[22-24] and elevated blood pressure.[25] Thus, understanding the determinants of the sleep/wake patterns of children may shed light on prevention and management aspects. Although multiple etiological factors were implied, the integrative and interactive relationships of these factors remain unclear. Hence, we conducted this large community-based study with mother-father-child trios to explore the sleep/wake patterns of children and their predicting factors in terms of parental sleep/wake patterns, SES, demographics, and daytime activities by using structural equation modeling (SEM).

Methods

This study was part of an ongoing epidemiologic investigation of sleep problems and sleep/wake patterns in Hong Kong Chinese children since 2003. The detailed description of the study design and

CFI	Comparative fit index
RMSEA	Root mean square error of approximation
SEM	Structural equation modeling
SES	Socioeconomic status
SRW	Standardized regression weight
TIB	Time in bed

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data collection has been reported.[24,26,27] In brief, parents of school children from 13 randomly chosen primary schools in 2 districts were asked to complete a pack of questionnaires on the sleep patterns and problems of their children and themselves. A total of 9172 questionnaires were returned; 6447 children (response rate: 70.3%) returned their questionnaires, and 5695 questionnaires were returned with at least 1 of the parent's data. Because this study aimed to explore the independent and synergistic influences of parental sleep/wake patterns on their children's sleep/wake patterns, only data from children with completed questionnaires from both parents were analyzed. Of those children who were excluded from this study, 67.9% of their parents were married/cohabiting, and the rest (32.1%) were single parents. The final sample included 4470 sets of mother-father-offspring trios (2231 boys), which represented 69.3% of children who returned the questionnaires. There were 3 types of school schedules at the time of study: 1235 children (27.6%) attended morning school (mean school start time, 07:35 ± 0:09), 1531 children (34.3%) attended afternoon school (mean school start time, 12:54 ± 0:15), and 1704 children (38.1%) attended whole-day school (mean school start time, 08:08 ± 0:17). No differences in age and sex distribution were found in the different types of schools (**Table I**; available at www.jpeds.com).

Measurements

Sleep questionnaire for children. The questionnaire for children consisted of 54 items on demography, sleep environment, family information, sleep/wake habits and problems.[26,27] The psychometric properties of the questionnaire suggested good validity and internal consistency (Cronbach's alpha coefficient, 0.868).[26,27] Because sleep duration in children typically changed during the weekend, long holidays, and seasons,[21,24] all sleep/wake patterns were reported on the basis of the past 12 months. We believed that this approach gave a more even and informative record of the sleep/wake patterns of children. The sleep/wake patterns during different periods (weekdays, weekends, and long holidays) were asked for children, and the sleep/wake patterns of parents were reported on weekdays and weekends. Questions about bedtime and wakeup time were asked as follows: (1) "When do(es) you (your child) go to bed usually during weekday and weekend (holiday)?" and (2) "When do(es) you (your child) get up during weekday and weekend (holiday)?" TIB was defined as the period between bedtime and wakeup time. Sleep environments including co-sleeping (bed sharing), sharing room, and numbers of siblings were also recorded.

SES assessments included parental educational levels (<12 years [accounted for 90.6% of mothers and 85.3% of fathers] or >12 years) and family income (<HK$10 000/month [28.2%], HK$10,001-15,000/month [23.0%], or >HK$15 000/month [48.8%]; HK$7.8 = US$1).

The questionnaire also asked about the average daily duration spent on usual daytime activities of the children: time in school, homework, television watching, talking on the telephone, reading, sports, electronic games, computer/internet use, and other extracurricular activities (such as piano playing).

Sleep questionnaire for parents. The brief sleep questionnaire for parents consisted of 25 items, including demography, smoking, chronic use of medicine, sleep/wake patterns, and sleep problems.[26] The sleep/wake patterns of parents during weekdays and weekends were evaluated. The questionnaire demonstrated satisfactory validity and internal consistency (Cronbach's alpha coefficient, 0.846).[26]

Statistical Analysis

Descriptive statistics were presented as percentages for discrete variables and as means (± SD) for continuous variables. Sleep/wake patterns among children, fathers, and mothers were normally distributed. The comparison of sleep/wake patterns among children, fathers, and mothers were performed with the paired *t* test. Differences in sleep/wake patterns in different types of schools were analyzed by using 1-way analysis of variance with the post-hoc Tukey method.

As various factors were closely correlated with each other, we used SEM rather than linear regression to analyze the relationships among children's sleep/wake patterns, school schedule, daytime activities, SES, demographic, and parental sleep/wake patterns with latent variables. Different sleep/wake patterns were calculated as mean data across a year (for example, mean bedtime = [{bedtime during weekday x 5} + {bedtime during weekend x 2}/7 x30 x 10 + {mean bedtime during holidays} x30 x 2]/360). There are normally 2 months of summer holidays for primary school students in Hong Kong for children,[24] and sleep/wake patterns across a year for parents equaled (bedtime during weekday x 5) + (bedtime during weekend x 2)/7.

The model with a smaller X^2 value and more degree-of-freedom was considered as the best-fit model (**Appendix**; available at www.jpeds.com). Two indices were used to reflect the success of the model in balancing explanatory power and parsimony: the comparative fit index (CFI) and the root mean square error of approximation (RMSEA).[28] CFI indicates how much variance is explained when going from a null model in which no variables are allowed to correlate with each other to the estimated model.[29] RMSEA indicates how much variance is not accounted for when comparing a saturated model with the estimated model per degree of freedom.[29] Models with a CFI between 0.80 and 0.90 fit moderately well, and a CFI >0.90 indicates a well-fitting model.[29,30] RMSEA values <0.05 are considered to be representative of good-fitting models, and values between 0.05 and 0.08 are considered to be moderately fit.[30]

For the determination of the paths in SEM, a P value <.05 was considered to be statistically significant. In view of multiple comparisons of sleep/wake patterns differences in children and parents, an adjusted value of P <.017 (Bonferroni adjustment) was used in a paired-sample *t* test (**Table II**). SPSS software version 16.0 for Windows (SPSS, Chicago, Illinois) was used for the *t* test and correlation analysis. Amos software version 16.0 (SPSS) was used for SEM.