

## Relationship between Sleep Habits and Daytime Sleepiness, Inattention, and Aggressive Behavior among Taiwanese Kindergarten Children

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### Abstract

**Objectives:** Sleep is a physiological process essential to life. The aim of this study is to investigate the association between demographic factors, sleep habits, and behavior in Taiwanese preschool children.

**Methods:** This is a cross-sectional study conducted between February 2012 to April 2012. Children aged 3 to 6 years (mean age=4.59 years; 50.83% girls) were recruited from certified public or private preschools in Taiwan. Using stratified random sampling, we distributed 1,750 copies of a self-designed questionnaire and collected 1,204 effective samples. Primary caregivers completed the questionnaire by providing information about the sleep habits and behavior of their children.

**Results:** The preschool children's behavior, ranked from high to low frequency, were inattention (close to the "sometimes to usually" category), daytime sleepiness (close to the "sometimes" category), and aggressive behavior (close to the "never" category). Preschool children who were 6 years old ( $F=15.98$ ,  $p<0.001$ ) and girl ( $t=-3.87$ ,  $p<0.01$ ) had longer attention spans than 3 or 4 year olds and boy, respectively. There were no significant differences between ages and sex for daytime sleepiness and aggressive behavior. Multiple regression analysis revealed that the preschool children with less daytime sleepiness, longer attention spans, and less aggressive behavior were those who had slept more than 10.01 hours at night, went to bed before 9:00 p.m, watched television less than one hour per day on weekdays, and caregiver's education  $\geq$  college.

**Conclusion:** Favorable sleep habits are crucial for preventing daytime sleepiness, inattention, and aggressive behavior in preschool children.

**Keywords:** Sleep habits; Daytime sleepiness; Inattention; Aggressive behavior

### Introduction

Sleep plays a critical role in child neurobehavioral development [1-3]. Poor sleep habits, such as delayed bedtimes and insufficient sleep durations, are risk factors for subsequent daytime sleepiness, reduced attention, and aggressive behavior in childhood [1,4-6]. In a Canadian experimental study, healthy students were randomly assigned to a long sleep duration group or a short sleep duration group. After one week, the long sleep duration group outperformed the short sleep duration group in both subjective and objective measures of emotion, memory, and attention [3]. Several cross-sectional and longitudinal studies have indicated different causes for delayed bedtimes and reduced sleep durations, such as increased television viewing among children [7-9]. Poor sleep habits (e.g., watched television before bed or irregular bedtime) are associated with increased sleep problems, aggressive or attention problems among preschool children [1,10]. A longitudinal study of kindergarten students in Hong Kong found that children who used electronics for more than three hours per day did not get adequate sleep at night [11]. The association of bedroom TV varied by race/ethnicity (White, Black, Latino, Asian and Other); bedroom TV was associated with 31 minutes per day shorter sleep among racial/ethnic minority children, but not among white, non-Hispanic children [12]. These studies, which vary in method and field,

all confirm that among children, watching television before bed clearly affects their sleep and the correlation between sleep and behavior is significant. However, as Cespedes et al. found, ethnic differences exist in the habit of watching television before bed [12]. Because of cultural and lifestyle differences between Taiwan and the geographical regions in the aforementioned studies, the present study is both important and necessary.

A recent study found that sleep problems among Taiwanese kindergarten children include going to bed late, difficulty initiating sleep, and short sleep durations. The average night time sleep duration on weekdays for 3 to 6 year old children in Taiwan was 9 hours and 26 minutes, with only 16.69% of the children in bed by 9 p.m. [13]. Sleep habits related to daytime sleepiness, attention, and aggressive behavior in healthy, nonclinical Taiwanese kindergarten children have been ignored and inadequately understood. A study that examined the relationship between sleep duration and school readiness among Hong Kong kindergarten children found that children who have low socioeconomic status, whose mothers have a low level of education, who have a poor relationship with their parents, and who use electronics exceeding three hours per day do not get enough sleep at night. In addition, these sleep-deprived children scored substantially higher on the attention-deficit/hyperactivity disorder test [11]. A study of preschool children in Shanghai found that among demographic factors including parent age, parents' level of education, and family income, only the age of the father was correlated to aggressive

behaviors in children. Children with older fathers showed substantially fewer aggressive behaviors [6]. Low father education and hostile/coercive parenting style were significantly linked to aggression in Shanghai kindergartens preschool children [14]. These studies demonstrate that no conclusive relationship has been established between demographic factors and aggressive behaviors in children. Because kindergarten children's age range is quite wide, there are substantial differences in behavior across this developmental period. Summarizing the above, the correlation between the demographic factors of Taiwanese children and their caretakers and the children's sleep habits and behaviors is an issue that merits attention and research.

## Materials and Methods

### Subjects, sampling inclusion and exclusion criteria

This is a cross-sectional study design conducted between February 2012 to April 2012 (12 weeks duration) using a stratified random sampling method for recruiting participants. In this study, sampling was inclusion criteria if children were healthy and well-developing 3-6 years old, and whose were recruited from certified public or private kindergartens in Taiwan. Sampling was excluded if children were related to individuals with special need.

### First stage sampling: kindergarten

We consulted the website of the Ministry of Education's Department of Statistics [15] to obtain the ratio of kindergarten students located in each of the 19 counties and cities in Taiwan. First, the required sample size from each stratum, which comprised one county or city, was determined. Second, all members of the population (i.e., all licensed kindergartens in a county or city) were numbered from 1 to N. Third, a random number generator on a computer was used to randomly select n number of kindergartens (i.e., the desired sample size) from N members of the population. Fourth, we then telephoned each of the selected kindergartens to seek their assistance with distributing and collecting the questionnaires.

### Second stage sampling: children

Upon kindergarten consent, we then asked the principal or a teacher to convenience select a class of approximately 15-20 students that met our age requirements for participation in the study. After receiving further consent from the primary caregiver of each child, we mailed a questionnaire to be filled in anonymously, a self-addressed stamped envelope, and an inexpensive gift that acted as an incentive to complete the questionnaire.

### Response rate and valid questionnaires

Using stratified random sampling, we distributed 1,750 questionnaires and received 1,376 responses and attempted responses. The questionnaire was completed for a total of 1,204 (for a valid rate of 70.6%) preschool children.

### Sleep habits of preschool children

Primary caregivers reported the weekday sleep habits of preschool children; specifically, children's bedtimes, the time they awoke, and the time they spent each day watching television. From this, the night time sleep duration per weekday was calculated as follows: (24-children's

bedtime)+children are waking time. For example, if a child's bedtime is 10:00 p.m. and they wake up at 7:30 a.m., then the total night time sleep duration is 9.5 hours [(24-22)+7.5].

### Daytime sleepiness, inattention, and aggressive behavior measures

The Epworth Sleepiness Scale [11], Child Behavior Checklist/2-3, and Child Behavior Checklist/4-18 [12,13] have not been standardized for use with preschool children within the age groups of this study. Therefore a behavior scale was constructed for this study. Prior to constructing the scale, international and domestic literature, studies, and assessment scales [2,16-22] were consulted to establish potential dimensions of the self-constructed scale. Items were then designed and formulated to target the characteristics of each dimension. Content validity was established through a review by five experts and using a test questionnaire. Experts reviewed the scale and provided suggestions in the following four areas: (1) the function and relevance of each item; (2) the relevance of each item to its dimension; (3) the name of each dimension; and (4) adding behavioral symptoms commonly found in kindergarten teaching sites. To ensure that reviewers could accurately discern behavioral problems in the children, only long-term, primary caregivers for the children were chosen for the study. A stepwise item selection procedure was performed on the basis of item quality, taking into account the results of the internal consistency analysis as a measure of reliability [23]. The significance level was alpha ( $\alpha$ )=.05. A threshold of  $>.3$  for corrected item-total correlation was considered sufficient. Items were eliminated if their elimination caused an increase in the Cronbach's  $\alpha$  value. The theoretical basis of the scale was tested by applying a principal component analysis with orthogonal rotation (VARIMAX). The Kaiser-Meyer-Olkin (KMO) criterion was used to assess the requirements for a factor analysis [23]. Items not clearly loading on any factor were excluded.

### Reliability and validity of the behavior scale

The Cronbach's  $\alpha$  of the 24-item behavior scale was recalculated and revealed a value of .855. The Cronbach's  $\alpha$  was calculated for the three subscales and revealed values of .823 for daytime sleepiness, .801 for inattention, and .792 for aggressiveness.

For the factor analysis, all requirements were fulfilled. The KMO criterion was fair (0.918). The Bartlett test was significant ( $\chi^2=12017.39$ ;  $p<0.001$ ). Three factors were extracted according to the KMO criterion. On the VARIMAX rotation method, all items showed clear loadings (0.50) on one of the three factors. The principal component analysis with VARIMAX was performed for the remaining 24 items (8 items for daytime sleepiness, 8 items for inattention, and 8 items for aggressiveness), resulting in a three-factor solution: Factor 1 (daytime sleepiness, Items 1-8, eigenvalue=6.77), Factor 2 (inattention, Items 9-16, eigenvalue=5.08), Factor 3 (aggressiveness, Items 17-24, eigenvalue=3.92).

### Itemized questions for behavior

The finalized scale included 24 items that were categorized into three subscales: (I) Daytime Sleepiness subscale included 8 items, (II) Inattention subscale included 8 items and (III) Aggressiveness subscale included 8 items.

The daytime sleepiness subscale includes eight items, for example: Do you find your children falling asleep "eating breakfast," "sitting in a

car,” and during “morning class,”? Do your children “need multiple wake-up reminders in the morning?” Are they “tired when waking up?” Has a teacher or other supervisor commented that the child appears sleepy during the day?

The inattention subscale involves eight items, for example: Do you find your children “losing necessary items (pencils, or books) for tasks or activities,” “talking too much,” “are easily distracted by extraneous stimuli,” “get into trouble at home,” “get into trouble at kindergarten,” find it “hard to sit still,” and “leave their work and tasks unfinished?”

The aggressiveness subscale includes eight items such as the following: Do you find your children easily exhibiting “punching or hitting behavior,” “easily setting up a booby trap,” “manipulating a child to hurt another child,” and “easily insulting or derogating another person?”

### Scoring of behavior

The children’s primary caregivers answered each question by selecting one of four frequency choices: 1=never (0 weekdays), 2=sometimes (1–2 weekdays), 3=usually (3–4 weekdays), and 4=always (all 5 weekdays). A higher score indicated a higher likelihood of daytime sleepiness, inattention, or aggressiveness.

### Statistical analysis

All data were coded, entered, and analyzed using the Statistical Package for Social Sciences (SPSS, Chicago, Illinois, USA), Version 19.0. The descriptive results were expressed as frequencies (N), mean (M), and standard deviation (SD). Continuous variables were analyzed using an independent t test or a one-way analysis of variance. The Scheffe test (homogeneity of variance) or the Games-Howell test (heterogeneity of variance) was performed as a post hoc test. Stepwise regression included regression models for which the choice of predictive variables was conducted using an automatic procedure. All results were considered statistically significant when  $p < 0.05$ .

## Results

### Sample demographic characteristics

In this study, questionnaires were completed for 1,204 preschool children. Girls slightly outnumbered boys in the study, with 612 girls (50.83%) and 592 boys (49.17%), ranging in age from 3 to 6 years (mean age of  $4.59 \pm 1.53$  years). Of these, 38.70% (N=466), 19.68% (N=237), 32.64% (N=393), and 8.97% (N=108) resided in Northern, Central, Southern, and Eastern Taiwan, respectively. Primary caregiver age was categorized as <30 years (N=167), 31–35 years (N=489), 36–40 years (N=343), and >41 years (N=205). Most of the children came from primary caregiver age of 31–35 years (40.61%). Primary caregivers’ level of education was categorized as ≤high school (N=463), college (N=361), and ≥university (N=380). Most of the children came from primary caregiver education of high school (38.46%). Family monthly income was categorized as <NT\$40,000 (N=376), NT \$40,001–60,000 (N=320), NT\$60,001–80,000 (N=222), and >NT \$80,001 (N=286). Most of the children came from families with a family monthly income of <NT\$40,000 (31.23%), followed by those with a family monthly income of NT\$40,001–60,000 (26.58%); these two categories combined accounted for nearly 60% of all participants (Table 1).

Demographic Variable	Group	Number (N)	%
Children age	① 3 years	120	9.97
	② 4 years	337	27.99
	③ 5 years	664	55.15
	④ 6 years	83	86.9
Children sex	① Girl	612	50.83
	② Boy	592	49.17
Residence area	① Northern	466	38.7
	② Central	237	19.68
	③ Southern	393	32.64
	④ Eastern	108	8.97
Caregiver age	① ≤30 years	167	13.87
	② 31-35 years	489	40.61
	③ 36-40 years	343	28.49
	④ ≥ 41 years	205	17.03
Caregiver education	① ≤High school	463	38.46
	② College	361	29.98
	③ ≥University	380	31.56
Family monthly income	① ≤NTD 40,001	376	31.23
	② 40,001-60,000	320	26.58
	③ 60,001-80,000	222	18.44
	④ ≥NTD 80,001	286	23.75

**Table 1:** Demographic variable in Taiwanese kindergarten children (N=1,204).

### Daytime sleepiness, inattention, and aggressive behavior

Among the three subscales, the mean frequencies for aggressiveness (M=1.35; SD=.58), daytime sleepiness (M=1.92; SD=.53), and inattention (M=2.41; SD=.49) were close to the “never,” “sometimes,” and “sometimes to usually” categories, respectively.

### Association between demographic factors and behavior

As shown in Table 2, 6-year-old and girl preschool children had longer attention spans than 3 or 4 year olds did ( $p < 0.001$ ), and boy ( $p < 0.01$ ), respectively. There were no significant differences between ages and sex for daytime sleepiness and aggressive behavior.

The results in Table 2 indicates that caregiver’s age and monthly family income were not correlated to daytime sleepiness, inattention, and aggressive behaviors in preschool children. Preschool children with college or ≥university caregiver exhibited significant fewer daytime sleepiness ( $p < 0.001$ ), inattention ( $p < 0.001$ ), and aggressive behavior ( $p < 0.001$ ) than did preschool children whose caregiver’s education was ≤high school.

### Association between sleep habits (bedtime, night time sleep duration, television-viewing time) and behavior

As shown in Table 2, preschool children with a bedtime before 9 p.m. or between 9:01–10:00 p.m. exhibited significantly less daytime sleepiness, inattention, and aggressive behavior ( $p < 0.001$ ,  $p < 0.001$ , and  $p < 0.05$ , respectively) than did preschool children whose bedtime was after 10:01 p.m.

Demographic Variable	Group	N	Daytime sleepiness	Inattention	Aggressive
Children age	① 3 years	120	F=2.68	F=15.98***	F=1.98
	② 4 years	337		①>④g	
	③ 5 years	664		②>④g	
	④ 6 years	83			
Children sex	① Girl	612	t=1.56	t=-3.87**	t=-2.03
	② Boy	592		②>①	
Caregiver age	① ≤ 30 years	167	F=2.17	F=2.34	F=2.49
	② 31-35 years	489			
	③ 36-40 years	343			
	④ ≥ 41 years	205			
Caregiver education	① ≤ High school	463	F=7.68***	F=11.18***	F=18.01***
	② College	361	①>②s	①>②s	①>②s
	③ ≥ University	380	①>③s	①>③s	①>③s
Family monthly income	① ≤ NTD 40,001	376	F=1.98	F=2.15	F=2.09
	② 40,001-60,000	320			
	③ 60,001-80,000	222			
	④ ≥ NTD 80,001	286			
Bedtime (p.m.)	① 9:00 before	201	F=19.68***	F=44.98***	F=4.27*
	② 9:01-10:00	690	③>①s	③>①g	③>①g
	③ after 10:01	313	③>②s	③>②g	
Sleep duration per night	① ≤ 8.5 hr	172	F=9.16***	F=11.20***	F=6.87***
	② 8.51-9 hr	285	①>⑤g	①>⑤s	①>⑤s
	③ 9.01-9.5 hr	338	②>⑤g	②>⑤s	②>⑤s
	④ 9.51-10 hr	271	③>⑤g	③>⑤s	③>⑤s
	⑤ ≥ 10.1 hr	138			
TV watching time	① 0 hr	45	F=7.26***	F=8.06***	F=6.64***
	② 0.1-1 hr	412	④>①s	④>①s	④>①s
	③ 1.1-2 hr	399	④>②s	④>②s	④>②s
	④ 2.1-3 hr	202	⑤>①s	⑤>①s	⑤>①s
	⑤ ≥ 3.1 hr	146	⑤>②s	⑤>②s	⑤>②s

Note: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ ; s-Scheffe; g-Games-Howell; A higher score indicated a higher likelihood of daytime sleepiness, inattention, or aggressive behavior.

Abbreviations: N=number

**Table 2:** Associations demographic variables, sleep habit (bedtime, sleep duration, TV watching time) and behavior in Taiwanese kindergarten children (N=1,204).

Preschool children who slept more than 10.01 hours per night exhibited less daytime sleepiness, inattention, and aggressive behavior ( $p < 0.001$ ) than did those who slept less than 9.5 hours (Table 2).

Preschool children with little (0.1–1 hours) or no television viewing exhibited significantly less ( $p < 0.001$ ) daytime sleepiness, inattention, and aggressive behavior than did those who watched television for more than 2.1 hours (Table 2).

### Relationship between demographic variable and sleep habits and behavior: A multiple regression analysis

Collinearity diagnostics for all independent variables was conducted before making stepwise multiple regression analysis. The results did not show collinearity problems; all independent variables of variance inflation factors were less than 10, with tolerance values greater than 0.1.

Aspects	Variables	R	R <sup>2</sup>	ΔR	F	β
Daytime sleepiness	Sleep duration ≥ 10.01hr <sup>a</sup>	0.663	0.382	0.382	513.64***	-0.465
	watch TV time 0.1–1 hr <sup>b</sup>	0.679	0.404	0.022	305.82***	-0.221
	bedtime before 9:00 p.m. <sup>c</sup>	0.703	0.416	0.012	213.09***	-0.117
	≥ university education <sup>d</sup>	0.718	0.425	0.009	98.34***	-0.091
	college education <sup>d</sup>	0.725	0.432	0.007	77.02***	-0.087
Inattention	Sleep duration ≥ 10.01hr <sup>a</sup>	0.528	0.273	0.273	275.58***	-0.418
	Sleep duration 9.51-10hra	0.579	0.332	0.059	171.30***	-0.209
	bedtime before 9:00 p.m. <sup>c</sup>	0.597	0.346	0.014	129.21***	-0.124
	watch TV time 0.1–1 hr <sup>b</sup>	0.611	0.357	0.011	98.45***	-0.115
	≥ university education <sup>d</sup>	0.623	0.367	0.01	87.05***	-0.112
	college education <sup>d</sup>	0.635	0.376	0.009	82.11***	-0.111
	6 years old children <sup>e</sup>	0.649	0.384	0.008	78.96***	-0.009
Aggressive	Sleep duration ≥ 10.01hr <sup>a</sup>	0.323	0.124	0.124	104.52***	-0.181
	watch TV time 0.1–1 hr <sup>b</sup>	0.354	0.152	0.028	71.43***	-0.107



	≥ university education <sup>d</sup>	0.368	0.177	0.025	68.38***	-0.105
	college education <sup>d</sup>	0.381	0.198	0.021	64.22***	-0.009
	Bed time before 9:00 p.m. <sup>c</sup>	0.401	0.218	0.02	58.29***	-0.083

Notes: \*p<0.5, \*\*p<0.01, \*\*\*p<0.001  
reference group: a Sleep duration ≤ 8.5h  
reference group: b watch TV time 2.1-3h  
reference group: c bedtime after 10:01  
reference group: d caregiver education was ≤  
<sup>2</sup>ΔR: adjusted R<sup>2</sup>; β: standardized regression coefficient

**Table 3:** Relationship between demographic variable and sleep habits and behavior in Taiwanese kindergarten children: A multiple regression analysis (N=1,204).

Stepwise multiple regression analyses revealed that the optimal variances associated with less daytime sleepiness in preschool children were as follows: sleep duration ≥ 10.01 hours (β=-.465), television-viewing time between 0.1 and 1 hour (β=-.221), a bedtime before 9:00 p.m. (β=-.117), ≥university education (β= -.091), and college education (β=-.087). Sleep duration was the strongest, accounting for 38.2% of the variance of daytime sleepiness in preschool children (Table 3). The regression model explained 43.2% of the variance of daytime sleepiness behavior.

Sleep durations of ≥10.01 hours (β=-.418) and 9.51–10 hours (β=-.209), bedtime before 9:00 p.m. (β=-.124), television-viewing time between 0.1 and 1 hour (β=-.115), caregiver education level of ≥university (β =-.112), caregiver education level of college (β=-.111), and an age of 6 years (β=-.009) associated with favorable attention behavior and explained 38.4% of the variance, with sleep duration ≥10.01 hours being the strongest related factor (Table 3).

## Discussion

### Association demographic variable, sleep habit (bedtime, sleep duration, TV watching time) and daytime sleepiness behavior

The 24-item behavior self-scale provides a valid and reliable means of obtaining an assessment of 3 to 6 year-old children's daytime sleepiness, inattention, and aggressiveness. In the present study, these were associated using sleep duration. Preschool children who slept more than 10.01 hours per night exhibited less daytime sleepiness, inattention, and aggressive behavior than did those who slept less than 9.5 hours. This study is consistent with the National Sleep Foundation recommends that 3 to 5 year olds and 5 to 10 year olds sleep on average 11–13 hours and 10–11 hours each night, respectively [24].

Excessive daytime sleepiness was the most common sleep problem (64.90%) among 2- to 6-year-old children in Tehran [25]. The prevalence of excessive daytime sleepiness was 17.90% [5]; learning and attention deficit were sequelae of excessive daytime sleepiness among 5- to 12-year-old children [4,5]. The prevalence of excessive daytime sleepiness in children has varied substantially across studies, ranging from 17.90% to as high as 64.90% [5,25]. In the present study, the behavior of daytime sleepiness was close to the “sometimes” frequency. Sleep duration ≥10.01 hours was the strongest factor against

daytime sleepiness in preschool children. A shorter sleep duration yielded greater daytime sleepiness. Li et al. [26] reported similar findings.

### Association demographic variable, sleep habit (bedtime, sleep duration, TV watching time) and inattention behavior

In our study, the most common behavior in Taiwanese kindergarten children was inattention, of which the frequency was close to the “sometimes to usually” category. Insufficient or short sleep duration may play a role in children with attention deficit hyperactivity disorder [27,28]. This finding revealed that kindergarten children who were 6 years old and girl had longer attention spans than 3 or 4 year olds and boy, respectively. Attention performance of kindergarten children in central Taiwan shows significant differences due to differences in young children's age and sex, older and girl preschool children had better performance of three sustained, divided, and selective attention [29]. We found that a sleep duration ≥10.01 hours was the most crucial factor in attention performance among preschool children, compared with bedtime, television-viewing time, caregiver education level and children's age. Short sleep duration and irregular bedtime are associated with increased attention problems among Japanese preschool children [1]. Friend et al. [3] and Scharf et al. [30] indicated similar findings that manipulating sleep duration alters attention performance in children.

### Association demographic variable, sleep habit (bedtime, sleep duration, TV watching time) and aggressive behavior

In our study, the mean frequency of caregiver-reported aggressive behavior in kindergarten children was close to the “never” category, there were no significant differences between children ages and sex, but children whose caregivers with high education level (college) were significant less aggressive behavior. Survey study found that boys and older preschool children from kindergartens in Shanghai had higher levels of parent- and teacher-reported proactive and reactive aggression [14]. Aggressive behaviors in children are affected by numerous factors including personal beliefs, family background, parenting style, and educational and social environments [14,31,32]. The findings of the present study differ from those of Jia et al. [14]. We speculate this may be caused by differences in the evaluation instruments used, persons evaluating aggressive behaviors, and geographical areas of the two studies. A sleep duration ≥10.01 hours, a television-viewing time between 0.1 and 1 hour, caregiver education level ≥ college, and bedtime before 9:00 pm has been associated with less aggressive behavior, with sleep duration being the strongest related factor. In a 2008 survey, 26.90% of preschool children aged 2 to 6 years in Japan reported watching television two hours or more per day [33]. In the present study, more than one quarter (28.91%) of preschool children in Taiwan were reported to watch television for two hours or more on weekdays. A short sleep duration combined with a television time of more than two hours per day has been associated with high emotional lability or aggressive behavior in children [2,34].

The prefrontal cortex plays a critical role in the executive control of information processing, emotional control, and behavioral expression; impairment of any of these functions could promote aggression [35]. The prefrontal cortex is the primary generator of slow electroencephalogram waveforms and this cerebral region is among the most sensitive to sleep disruption [35]. Exposure to artificial light associated with evening behaviors, such as watching television, has been shown to affect circadian physiology and latent sleep onset

[36,37]. The American Academy of Pediatrics and Committee on Public Education identified possible negative health effects of television viewing on children and adolescents, including violent or aggressive behavior, and recommends limiting children's total time spent using electronic media to no more than 1 to 2 hours per day [38]. In the present study, preschool children with 0.1–1 hours or no television viewing exhibited significantly less daytime sleepiness, inattention, and aggressive behavior than did those who watched television for more than 2.1 hours. Short nighttime sleep duration or watching television for more than one hour each day is associated with a high likelihood of aggression in preschool children, according to parental reports [6,28].

Our results suggest that public health strategies, focused on favorable sleep habits should include an innovative approach to ensure an adequate bedtime, duration of sleep at night, and limiting children's total time spent watching television to no more than 1 hour per day are crucial for preventing daytime sleepiness, inattention, and aggressive behavior especially in kindergarten children.

## Limitations

This study assessed the relative contribution of potential risk factors for adverse neural behavior in preschool children relating to sleep habits, including bedtime, mean sleep duration, and television-viewing time. However, this study has certain limitations that require careful consideration when interpreting its findings. First, because this was a cross-sectional study, we could not fully assess the relationship between sleep habits and behavior. The association between sleep and behavior is likely bidirectional; although it is likely that sleeps influences behaviour is also influence sleep. Thus, our findings should be interpreted as correlational and not causal. Second, in this study, behaviors in preschool children were reported by primary caregivers. Future researchers should consider using behavior reports from primary caregivers and teachers who interact with preschool children in various contexts and therefore have observed diverse samples of behavior. Third, in addition to bedtime, night time sleep duration, and television-viewing time, other aspects of sleep habits (e.g., sleep environment and co sleeping) should be investigated in relation to behavior in preschool children.

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