Original Article

Relationship between Sleep Habits and Nighttime Sleep among Healthy Preschool Children in Taiwan

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Abstract

__Introduction__: We examined the nighttime sleep habits associated with insufficient sleep quantity and poor sleep quality among healthy preschool-aged Taiwanese children. __Materials and Methods__: The study population of this cross-sectional survey was a stratified random sample of 3 to 6-year-old preschool children from 19 cities and counties in Taiwan. A caregiver-administered questionnaire was used to collect information on preschooler sleep quantity (sleep duration and sleep latency) and sleep quality (sleep disturbances and disruption) and potentially related sleep habits. __Results__: Of the 1253 children for whom analysable survey data were collected (children's mean age: 5.03 ± 1.27 years), more than half (53.07%) engaged in bedtime television (TV)-viewing, 88.95% required a sleep reminder, 43.85% exhibited bedtime resistance, 93.6% engaged in co-sleeping (bed-sharing or room-sharing), and only 33.72% slept in a well darkened bedroom. Bedtime TV-viewing, co-sleeping, bedroom light exposure, and bedtime resistance were the primary predictors, without a bedtime TV-viewing habit was the strongest predictor analysed; it explained 15.2% and 19.9% of the variance in adequate sleep quantity and improved sleep quality in preschool children. __Conclusion__: Sleep loss and poor sleep quality in preschool children could be alleviated, at least partly, by curtailing bedtime TV-viewing, limiting light exposure during sleeping, and reducing bed-sharing habit.

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Key words: Bedtime TV-viewing, Co-sleeping, Bedroom light exposure, Sleep quantity

Introduction

Both the quantity and quality of sleep affect the normal development of preschool children. Insufficient sleep quantity and poor sleep quality—defined as short sleep duration, long sleep latency, and low sleep efficiency— are common among schoolchildren and also preschool children.[1,2] Studies from Asia have shown that delayed bedtimes, reduced nighttime sleep duration, or increased sleep disturbances are common among preschoolers in China,[3-4] Japan,[5] Singapore,[6] and Taiwan.[7] The sleeping habits of children from distinct geographic locations, such as the habits of children from China and the United States, differ considerably.[2] However, little information is available regarding the association between the sleeping habits and the sleep quantity and quality of Taiwanese preschool children. Delayed bedtimes, difficulty in sleep initiation, and short sleep durations might be particularly acute in Taiwan preschool children because of their primary caregivers' demographic characteristics, including age, education, and monthly family income.[7]

Evening television (TV) viewers had significantly worse sleep quality (higher sleep disturbance including sleep terrors, nightmares, sleep talking, and tired when waking up) compared with preschool children who watched TV earlier during the day.[8] Melatonin is a hormone secreted by the pineal gland that helps maintain the body's circadian rhythm, and melatonin levels are drastically affected by light exposure to the eyes.[9,10] A previous study showed that as

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compared with exposure to dim light (<3 lux), exposure to room light (<200 lux) before bedtime more potently inhibited melatonin secretion, which resulted in a shortening of the melatonin duration by roughly 90 minutes and a delayed melatonin onset in 99% of healthy volunteers enrolled in the study.[11] A cross-cultural comparison revealed that in young children, sleep disruption and diminished total sleep duration associated with bed-sharing and room-sharing resulted from parental presence at bedtime; the behaviour of co-sleeping is more common in predominantly Asian regions than in predominantly Caucasian regions.[12]

Numerous factors might reduce sleep duration, increase sleep latency, increase sleep disturbances, and disrupt sleep among preschool-aged and school-aged children; some of these factors are increased TV-viewing,[8,13-14] light exposure of the sleeping environment,[9-11] sleep resistance,[4] and co-sleeping.[12] Previous studies addressing these factors have focused on children in Western and various Asian countries, but no study has evaluated the association between sleep habits and nighttime sleep in Taiwanese preschool children. The purpose of this study was to ascertain and investigate whether sleep habits predicted sleep quantity and quality among 3- to 6-year-old preschool children in Taiwan and to compare the results to those from existing studies.

Materials and Methods

Participants and Sampling

A cross-sectional study design was used, and 3- to 6-year-old children were recruited from certified public or private preschools in Taiwan.[15] We employed stratified random sampling and used the proportions of preschool children of 19 cities and counties in the northern, central, southern, and eastern regions of Taiwan in order to calculate the required sample number. The written informed consent for participation in the study was obtained from children's parents or guardians. Questionnaires were returned by the primary caregivers of 1450 (85.29%) out of 1700 preschool children enrolled in the study. After excluding incomplete or inconsistent questionnaires, 1253 (73.7%) preschool children were available for the final analyses.

Sleep Habits and Measures of Sleep Quantity and Quality

Based on relevant literature,[7,16,17] a researcher developed a self-administered questionnaire entitled 'Self-Designed Preschool Children's Sleep Habits and Quantity and Quality of Sleep'. The primary components of the questionnaire items were the preschool children's demographic characteristics, sleep habits, and sleep quantity and quality scale. The primary caregivers of the preschool children completed the multiple-choice questions in the following 3 categories:

1. Demographic characteristics of preschool children: this included gender, age, and area of residence.

2. Sleep habits of preschool children: these were defined as the sleep habits observed 7 nights per week. The questions were specifically related to the children's bedtime (after 7 pm) TV-viewing habit (yes or no), requirement of a bedtime sleep reminder (yes or no), bedtime resistance manifested in the form of calling out, crying, or leaving their room after bedtime (yes or no), co-sleeping (bed sharing: sleeping in the same bed with a caregiver or other family members [reasons:], room sharing: sleeping in the same room with a caregiver or other family members [reasons:], or sleeping alone [reasons:]), and bedroom lights (light switched off and no instructive light; night light [reasons:]; or room light [reasons:]).

3. Items of sleep quantity and quality scale: this scale included 13 items that were categorised into 2 subscales: a) Sleep Quantity, and b) Sleep Quality. The Sleep Quantity subscale included 4 items that asked about the likelihood of the preschool children's weekly sleep duration ("My child generally sleeps 10 to 11 hours every night on weekdays," "My child generally sleeps 10 to 11 hours every night on weekends") and sleep latency ("My child falls asleep within 15 minutes after going to bed," "My child needs at least 30 minutes to fall asleep after going to bed [negatively worded item]"). The Sleep Quality subscale included 9 items that enquired about the likelihood of the preschool children's sleep disturbances ("My child does not have 'sleep talking', 'primary snoring', 'enuresis', 'bruxism', 'sleep terrors [i.e., screaming, crying, and/or increased pulse rate and breathing during sleep but not remembering any detail of the dream after waking up]', 'nightmares [waking up from a bad dream and remembering details of the dream]', 'respiratory pause [i.e., snoring because of airway obstruction; in some instances, the apnoea lasts for at least 10 seconds]', and 'sleep walking')" and sleep disruption ("My child does not wake up in the middle of the night"). The scales of sleep quantity and quality were rated on a 4-point Likert scale. Primary caregivers of the preschool children answered each question by selecting one of 4 answer choices (1 = never, 2 = sometimes, 3 = usually, and 4 = always). Of the 13 questions listed in the scale, only 1 question was negatively worded; all other 12 questions were positively worded. For these 12 questions, answers "never," "sometimes," "usually," and "always" were given a score of 1, 2, 3, and 4, respectively. By contrast, for Question 4, the same answers were given a reverse score of 4, 3, 2, and 1, respectively. A high total score indicated having adequate sleep quantity and better sleep quality in the preschool children.

Reliability and Validity of Sleep Quantity and Quality Scale

Five experts (2 sleep medicine, 2 early childhood education and 1 preschool educator) were first invited

to examine the content validity of the first draft of the questionnaires. Each question was rated as "appropriate," "to be modified," or "to be deleted." The experts were then asked to offer their recommendations regarding the questionnaire content. After collecting the questionnaires, questions that were rated by 3 or more experts as "to be deleted" were removed, whereas those that were rated as "to be modified" were revised according to the reviewer's suggestion and related literature to make the questions easier to understand and answer. The revised questionnaire then served as the pretest questionnaire. Fifty pretest questionnaires were each distributed in northern, central, southern, and eastern Taiwan for a total of 200 pretest questionnaires. A total of 178 questionnaires were returned, of which 166 were valid. The reliability and construct validity of the scale were assessed using item and factor analyses and Cronbach's alpha (α). 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.[18] The significance level was α <0.05. A threshold of >0.3 for corrected item-total correlation and t value >3.0 for critical ratio were considered sufficient. Items were eliminated if their elimination caused an increase in the Cronbach's α 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.[18] Items not clearly loading on any factor were excluded. For the factor analysis, all requirements were fulfilled. The KMO criterion was fair (0.916). The Bartlett test was significant (χ^2 = 5075.70; P <0.000). Two factors were extracted according to the KMO criterion. On the VARIMAX rotation method, all items showed clear loadings (>0.30) on 1 of the 2 factors. The principal component analysis with VARIMAX was performed for the remaining 13 items (9 items for sleep quality, and 4 items for sleep quantity), resulting in a two-factor solution: Factor 1 (sleep quality, Items 5-13, eigenvalue = 5.54), Factor 2 (sleep quantity, Items 1-4, eigenvalue = 1.38).

The 2 dimensions of quantity of sleep and quality of sleep yielded Cronbach's α values of 0.87 and 0.89, respectively. The scale of sleep quantity and quality among preschool children exhibited acceptable internal consistency reliability values, and 50.02% of the total variance of the 2 dimensions was explained.

Statistical Analysis

All data were coded, entered, and analysed using Statistical Package for Social Sciences (SPSS Chinese Version 12.0). The descriptive results were expressed as numbers (n), percentages (%), and means (M) ± standard deviation (SD). Continuous variables were analysed using an independent t test or a one-way analysis of variance (ANOVA). The Scheffe test (homogeneity of variance) or the Games-Howell test (heterogeneity of variance) was performed as a posthoc test. Stepwise regression included regression models in which the predictive variables were selected using an automatic procedure. All results were considered statistically significant at P <0.05.

Results

Sample Characteristics

Questionnaires were completed for 1253 preschool children: 633 girls (50.52%) and 620 boys (49.48%). The age distribution of these 3- to 6-year-old children is as follows: 36 to 47 months, 10.03% (n = 126); 48 to 59 months, 28.73% (n = 360); 60 to 71 months, 49.12% (n = 615); and 72 to 75 months, 12.12% (n = 152). The mean age was 5.03 years (SD = 1.27 years). Of these, 39.03% (n = 489), 27.93% (n = 350), 24.34% (n = 305), and 8.7% (n = 109) resided in northern, central, southern, and eastern Taiwan, respectively. The urban-rural distribution of preschool children is as follows: approximately 58% (n = 726) of the preschool children lived in urban areas and 42.06% (n = 527) lived in rural areas.

Sleep Habits Prevalent among Preschool Children

The results of the caregiver survey revealed the following sleep habits of the preschool children (Table 1): More than half (53.07%) of the children engaged in bedtime TV-viewing, 88.95% required a sleep reminder, and 43.85% exhibited bedtime resistance. In terms of co-sleeping, the prevalence rates measured for bed-sharing, room-sharing, and sleeping alone were 65.94%, 27.66%, and 6.40%, respectively; thus, 93.6% of the children slept in their caregiver's or other family member's bed or room. The reasons of bed-sharing and room-sharing were obtained from 129 and 146 caregiver as follows: children unwilling to sleep alone, insufficient bedroom, convenient child care or enhance parent-children relationship. In 80 sleeping-alone children, only 5 caregivers cited the reason as "training children to be independent". Lastly, 66.28% of the children slept in an environment that was poorly darkened (i.e., they were exposed to nightlight or room light). Caregivers explained that fear of sleeping in the dark was a major cause for children sleeping in nightlight or room light.

Bedtime TV-Viewing and Sleep Quantity and Quality

Sleep quantity and quality were significantly different between preschool children who did and did not engage in bedtime TV-viewing (Table 2). Children who engaged in bedtime TV-viewing exhibited reduced quantity of

Table 1. Sleep Habits Prevalent among Preschool Children (n = 1253)

Sleep Habits	Item	n	%
Bedtime TV-viewing	1. Yes	665	53.07
	2. No	588	46.93
Sleep reminder requirement	1. Yes	1115	88.95
	2. No	138	11.05
Bedtime resistance	1. Yes	549	43.85
	2. No	704	56.15
Co-sleeping	1. Bed-sharing	826	65.94
	a) No explanation	697	55.63
	b) Children unwilling to sleep alone	87	6.95
	c) Room insufficient	38	3.04
	d) Convenient child care	4	0.32
	2. Room-sharing	347	27.66
	a) No explanation	201	16.04
	b) Children unwilling to sleep alone	94	7.46
	c) Room insufficient	30	2.40
	d) Convenient child care	22	1.76
	3. Sleeping alone	80	6.40
	a) No explanation	75	5.99
	b) Training children to be independent	5	0.41
Bedroom lighting	1. Nightlight switched on	770	61.46
	a) No explanation	687	54.83
	b) Fear of sleeping in the dark	79	6.31
	c) Convenient child care	4	0.32
	2. Well darkened*	423	33.72
	a) No explanation	387	30.86
	b) Easily fall asleep	36	2.86
	3. Ordinary room lighting	60	4.82
	a) No explanation	31	2.48
	b) Fear of sleeping in the dark	28	2.34

*Defined as bedroom light switched off and no instructive light.

sleep (P <0.001) and lower quality of sleep (P <0.001) as compared with children who did not engage in bedtime TV-viewing.

Sleep Reminder Requirement and Sleep Quantity and Quality

The results in Table 2 indicate that sleep quality and quantity were not significantly different (P >0.05) in children who did and did not require a bedtime sleep reminder.

Bedtime Resistance Habit and Sleep Quantity and Quality

Preschool children who displayed bedtime resistance exhibited significantly reduced quantity of sleep (P <0.01) and lower quality of sleep (P <0.001) as compared with children who did not display bedtime resistance (Table 2).

Co-Sleeping Habit and Sleep Quantity and Quality

The results of one-way ANOVA indicated that the co-sleeping habit of preschool children was associated with sleep quantity and quality. Children who slept alone or who room-shared exhibited significantly enhanced quantity of sleep (P <0.001) and higher quality of sleep (P <0.001) as compared with children who slept in their caregiver's or other family member's bed (Table 3).

Bedroom Lighting and Sleep Quantity and Quality

Bedroom lighting was significantly associated with the sleep quantity and quality of preschool children (Table 3). Children who slept in well darkened bedrooms exhibited significantly increased quantity of sleep (P <0.001) and higher quality of sleep (P <0.001) as compared with children who slept in either nightlight bedrooms or bedrooms in which room lights were switched on. Moreover, preschool children who slept in nightlight bedrooms exhibited significantly enhanced quantity of sleep (P <0.001), and improved sleep quality (P <0.001) as compared with children who slept in a bedroom under room lighting.

Sleep Habits as Predictors of Both Sleep Quantity and Quality

Stepwise multiple regression analyses revealed that sufficient sleep duration in preschool children was predicted by without a bedtime TV-viewing habit (β = 0.23), sleeping alone (β = 0.15), a well darkened bedroom (β = 0.13), a nightlight bedroom (β = 0.09), and absence of bedtime resistance (β = 0.07). Bedtime TV-viewing, co-sleeping, bedroom light exposure, and bedtime resistance were the primary predictors, with the strongest being bedtime TV-viewing, which explained 15.2% of the variance of sleep quantity in preschool children (Table 4).

The results of stepwise multiple regression analysis indicate that those preschool children, without a bedtime TV-viewing habit (β = 0.45), a well darkened bedroom (β = 0.23), a nightlight bedroom (β = 0.14), sleeping alone (β = 0.07), and absence of bedtime resistance (β = 0.05) have better sleep quality and explained 29.5% of the variance. A

Table 2. Associations between Nighttime Sleep Habits (Bedtime TV-Viewing, Sleep Reminder Requirement, or Bedtime Resistance) and Sleep Quantity and Quality (n = 1253)

Sleep Habits	Aspects	Association	n	M	SD	T	Analysis
Bedtime TV-viewing	Sleep quantity	a) Positive	665	11.67	2.15	-4.56[†]	b) > a)
		b) No	588	12.94	1.99		
	Sleep quality	a) Positive	665	27.03	4.83	-5.81[†]	b) > a)
		b) No	588	29.57	4.47		
Sleep reminder requirement	Sleep quantity	a) Positive	1115	12.17	2.14	-1.02	NS
		b) No	138	12.46	2.45		
	Sleep quality	a) Positive	1115	27.37	4.80	-1.26	NS
		b) No	138	28.05	5.50		
Bedtime resistance	Sleep quantity	a) Positive	549	11.89	1.98	-3.02[*]	b) > a)
		b) No	704	12.47	2.02		
	Sleep quality	a) Positive	549	26.41	4.80	-4.87[†]	b) > a)
		b) No	704	28.01	3.86		

M: Mean; n: Number; NS: Not significant; SD: Standard deviation
[*]$P < 0.01$.
[†]$P < 0.001$.

habit of bedtime TV-viewing was the strongest predictor: it explained 19.9% of the variance in improved sleep quality in preschool children (Table 4).

Discussion

Bedtime TV-viewing has been associated with delayed bedtimes, difficulty in falling asleep, sleep disturbances, and reduced overall sleep among children.[8,13,19,20] Bedtime TV-viewing refers to TV-viewing after 7 pm (evening), given that the median bedtimes of 3 to 5-year-old children fall between 8 and 10 pm.[17] According to primary caregivers' ratings, the bedtime for 16.69% of Taiwanese preschool children is before 9 pm, and it is between 9.01 and 10 pm for 57.31% of the children.[7] This finding indicates that as compared with preschool children who did not engage in bedtime TV-viewing (after 7 pm), children who engaged in bedtime TV-viewing exhibited reduced quantity of sleep (shortened sleep duration and prolonged sleep latency), and lower quality of sleep (increased frequency of sleep disturbances and sleep disruption). Several potential mechanisms

Table 3. Associations between Nighttime Sleep Habits (Bedroom Lighting and Co-Sleeping) and Sleep Quantity and Quality (n = 1253)

Sleep Habits	Aspects	Item	n	M	SD	F	Posthoc Analysis[*]
Co-sleeping	Sleep quantity	a) Sleep alone	80	12.64	1.84	6.99	a) > c)
		b) Room sharing	347	12.34	1.61	$P < 0.001$	b) > c)
		c) Bed-sharing	826	11.21	1.77		
	Sleep quality	a) Sleep alone	80	28.79	4.14	5.83	a) > c)
		b) Room-sharing	347	27.87	4.29	$P < 0.001$	b) > c)
		c) Bed-sharing	826	26.64	3.97		
Bedroom lighting	Sleep quantity	a) Well darkened	423	12.68	2.11	6.12	a) > b)
		b) Nightlight	770	11.95	2.25	$P < 0.001$	a) > c)
		c) Ordinary room light	60	10.85	1.91		b) > c)
	Sleep quality	a) Well darkened	423	28.03	4.71	8.08	a) > b)
		b) Nightlight	770	26.46	4.93	$P < 0.001$	a) > c)
		c) Ordinary room light	60	25.92	4.04		b) > c)

M: Mean; n: Number; SD: Standard deviation
[*]Scheffe Test.

Table 4. Nighttime Sleep Habits as a Significant Predictor of Both Quantity and Quality of Sleep in Stepwise Multiple Regression Analyses (n = 1253)

Aspects	Variables	R	R^2	ΔR^2	F	B	β
Sleep quantity	Without bedtime TV-viewing[†]	0.390	0.152	0.152	141.35[*]	2.67	0.23
	Sleeping alone[‡]	0.435	0.189	0.037	91.65[*]	2.25	0.15
	Well darkened bedroom[§]	0.453	0.205	0.016	67.43[*]	2.12	0.13
	Nightlight bedroom[§]	0.464	0.215	0.010	53.65[*]	1.93	0.09
	Without bedtime resistance[I]	0.470	0.221	0.006	44.34[*]	1.07	0.07
Sleep quality	Without bedtime TV-viewing[†]	0.450	0.199	0.199	195.42[*]	3.96	0.45
	Well darkened bedroom[§]	0.520	0.270	0.070	144.82[*]	2.88	0.23
	Nightlight bedroom[§]	0.530	0.281	0.012	102.36[*]	1.56	0.14
	Sleeping alone[‡]	0.540	0.289	0.008	85.73[*]	1.22	0.07
	Without bedtime resistance[I]	0.540	0.295	0.006	75.02[*]	0.98	0.05

β: Regression coefficient R: Multiple correlation coefficient; R^2: Coefficient of determination; ΔR^2: Adjusted R^2

[*]$P <0.001$.

[†]Reference group: with bedtime TV-viewing.

[‡]Reference group: bed-sharing.

[§]Reference group: ordinary room lighting.

[I]Reference group: with bedtime resistance.

underscore the link between bedtime TV-viewing and sleep quantity and quality: TV-viewing at bedtime is associated with exposure to artificial light (from brightly lit screens), which might result in increased sympathetic activation due to hyperarousal,[21] disrupted melatonin secretion,[22-24] or latent sleep onset and effects on the endogenous circadian timing system;[25] thus, bedtime TV-viewing appears to be a major driver of sleep timing. Overall, this study indicates that a bedtime TV-viewing habit is highly predictive of nighttime sleep quantity and quality outcomes in preschool children, and further to that, to promote optimal sleep, TV-viewing after 7 pm must be limited.

Acquiring the ability to transition from being awake to asleep is a critical step in sleep development in preschool children.[26] "Should parents be required to remind their children that it is time to go to bed?" was used as the question to find out whether the young children followed their "bedtime routine" (i.e., the young children went to bed on their own at the designated bed time). Here, we estimated that 88.95% of the children included in the study required a sleep reminder and that this habit was not associated with sleep quantity or quality in a statistically significant manner. Bedtime resistance was previously defined as calling out, crying, or leaving the room after bedtime,[27] and the problem of sleep resistance was reported to be prevalent in 23.4% of Chinese preschool children.[4] Moreover, bed-sharing and room-sharing were suggested to be associated with increased probability of bedtime resistance and sleep disturbances (night waking, parasomnia, and sleep-disordered breathing).[28] In this study, 43.85% of the preschool children exhibited bedtime resistance, which

potentially exerted a negative influence on both sleep quantity and quality. Data analysis showed that of the 549 young children who experienced bedtime sleep resistance, 88% (n = 487) had the habit of watching TV before going to bed. The high percentage of overlap between bedtime sleep resistance and the habit of bedtime TV-viewing may indicate a correctable risk factor.

The prevalence of a co-sleeping habit decreases with an increase in age; whereas 70.5% of Chinese preschool children (mean age: 5.72 years) were reported to be unwilling to sleep alone,[4] the proportion dropped to 37.6% (23.0%, routine bed-sharing; 14.6%, room-sharing) in Chinese urban school-aged children (mean age: 9.00 years).[28] Co-sleeping was prevalent in Singaporean children aged 2 to 6 years (mean age: 4.1 years) with 80.9% of room-sharing and 42.2% of bed-sharing.[6] This finding revealed that the habit of co-sleeping was highly common (93.6%) among Taiwanese preschool children (mean age: 5.03 years): 65.94% of the children slept in their caregiver's or other family member's bed, 27.66% in their caregiver's or other family member's room. The prevalence of co-sleeping among Taiwanese preschool children is close to or higher than in China, Singapore, and Japan,[3] Asian and culturally similar countries.[4,6,28,29] The results show that the high prevalence of co-sleeping in Taiwan was partly due to children unwilling to sleep alone, insufficient bedroom, convenient child care or to enhance parent-children relationship. But most caregivers did not fill out reasons for co-sleeping. However, experts have thus far failed to reach a consensus on the distinct views on parent-child co-sleeping in various cultures. Co-sleeping habit was suggested to be

associated with increased probability of sleep disturbances and bedtime resistance.[6,28] Sleep quantity and quality were markedly diminished in preschool children who engaged in bed-sharing or room-sharing as compared with the sleep quantity and quality in children who slept alone; moreover, children who engaged in bed-sharing exhibited significantly shorter sleep times and a lower sleep quality than did children who engaged in room-sharing. This finding indicates that bed-sharing can potentially adversely affect children's sleep quantity and quality. Because the sleep quantity and quality of children whose parents co-sleep with them in the same room but on different beds is superior compared with that of those who co-sleep with their parents in the same bed, we recommend that parents who are incapable of training their children to sleep independently to at least sleep in the same room with their children.

The circadian rhythm is an internal 24-hour "clock" that plays a critical role in controlling the time at which humans fall asleep and wake up.[30] The suprachiasmatic nucleus (SCN) of the hypothalamus serves as the master biological clock in humans, and the timing and strength of SCN rhythmic signals are affected by light exposure. A cross-sectional survey indicated that the common sleep problems observed in children from China and the United States were a difficulty in falling asleep and a fear of sleeping in the dark.[2] An experimental study determined that melatonin was considerably more sensitive to light suppression in children than in adults, because children possess large pupils and pure crystal lenses; melatonin secretion was markedly suppressed by regular room lighting at home in children but not in adults.[9] This study has demonstrated that exposure to light (nightlight or room light) during sleep in preschool children markedly reduced sleep quantity and worsened sleep quality as compared with the sleep quantity and quality in children who slept in well darkened bedrooms. Furthermore, preschool children who slept in bedrooms under nightlight exhibited considerably longer nighttime sleep durations and higher sleep quality than did children who slept in bedrooms under room lighting. Therefore, if preschool children display a fear of sleeping in the dark, nightlight exposure could be maintained. These could be suggestive of allowing preschool children to control the amount of bedroom light before bedtime and gradually decreasing brightness after falling asleep.

This is the first study in Taiwan to assess the association between sleep habits and sleep quantity and quality in preschool children. However, this study has certain limitations that require careful consideration when interpreting its findings. Firstly, because this was a cross-sectional study, our findings should be interpreted as correlational and not causal. Secondly, as most caregivers did not fill out reasons of co-sleeping, sleeping in the nightlight or room light, and did not evaluate the amount of bedroom light, therefore we do not really know the level of illumination of nightlight and room light. Thirdly, although TV has been quickly replaced by computer, communication, and consumer electronics products, this study only questioned young children if they had the habit of watching TV before going to bed and did not question them about the amount of time that they spent on computers, smartphones, and/or tablet computers before going to bed. Researchers may wish to include these items in the future to elevate the value of the research. Finally, in addition to demographic factors[7] and sleep habits, other factors (positive reinforcement of bedtime activities such as reading books or bedtime routines) are associated with sleep quantity and quality among preschool children in Taiwan.

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