Original Article

Academic achievement of junior high school students with sleep disorders

Fijri Auliyanti, Rini Sekartini, Irawan Mangunatmadja

Abstract

Background Sleep disorders are prevalent in adolescents and may influence their academic achievement. To date, no study has been done in Indonesia on academic achievement in students with sleep disorders and its related factors.

Objective To assess for relationships between academic achievement and related factors, including gender, motivation and learning strategies, IQ level, maternal educational level, socioeconomic status, family structure, after-hours education program, presence of TV/computer in the bedroom, sleep duration during school days, as well as bedtime and wakeup time difference in junior high school students with sleep disorders.

Methods This cross-sectional study was performed from January to March 2013. Subjects were students from five junior high schools in Jakarta who fulfilled the criteria for sleep disorders based on the *Sleep Disturbance Scale for Children* questionnaire.

Results There were 111 study subjects. The prevalence of sleep disorders was 39.7%, mostly in difficulties initiating and maintaining sleep (70.2%). Below-average academic achievement was seen in 47.6% of subjects. Factors significantly related to below-average academic achievement were after-hours education program (prevalence ratio 5.6; 95%CI 1.36 to 23.18; P = 0.017), average IQ level (prevalence ratio 3.26; 95%CI 1.38 to 7.71; P = 0.007), and male gender (prevalence ratio 2.68; 95%CI 1.06 to 6.78; P = 0.037).

Conclusion Among junior high school students with sleep disorders, factors related to below-average academic achievement are after-hours education program (more than 2 types), the average IQ level, and male gender. **[Paediatr Indones. 2015;55:50-8.].**

Keywords: *sleep disorders, academic achievement, related factors*

Sleep plays a vital role in the child development, especially with regards to their attention span and cognitive function.[1,2] Sleep patterns change as children progress from infancy to adolescence. Adolescents require 8-9 hours of sleep per day and their sleep patterns differ from other ages because of hormones and changes in circadian rhythm.[3]

Several "self-report" studies found that adolescents have inadequate sleep, have late bedtimes, and sleep more on weekends.[4-9] Adolescents have been reported to sleep at an average time of 10:12 pm, wake up at 05:55 am, and have a total sleep duration of 6 hours and 47 minutes.[10] Children's sleep problems include nightmares, night terrors, sleep talking, sleep walking, bedwetting, teeth grinding, and snoring. Even if sleep disorders are short in duration, they may have long term consequences and affect the whole family.[11] Sleep disorder prevalence in junior high school students was found to be as high as 62.9%,[12] with mostly difficulties initiating and maintaining sleep.[11]

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High school students with higher grades had significantly earlier bedtimes and were less sleepy than students with lower grades.[13] Studies in Italy,[14] Belgium,[15] and the United States[16] reported significant relationships between academic achievement in adolescents and their sleep patterns, sleep habits, and sleep disorder scores. Parental educational level, enuresis, and fatigue also influenced academic achievement.[14,15]

Junior high school students in Indonesia have longer daily school time duration than daily sleep duration (7 hours 30 minutes - 8 hours vs. 6 hours 47 minutes).[10] They start school at 6:30 am, go home at 2:00-2:30 pm, and 76% of them engage in after-hours education program.[17] To date, academic achievement evaluation in adolescents with sleep disorders had not been done. We aimed to assess the prevalence of sleep disorders in adolescents, as well as factors related to academic achievement in junior high school students with sleep disorders.

Methods

This cross-sectional study was conducted between January and March 2013 in five junior high schools (JHS) in Jakarta (SMP 75, SMP 30, SMP 216, SMP 115, and SMP 255). Subjects were JHS students with sleep disorders, diagnosed on the basis of the *Sleep Disturbance Scale for Children* (SDSC). We excluded children with chronic diseases (asthma, tuberculosis, heart and renal diseases, thalassemia major, and malignancy) and had been diagnosed having sleep disorders. Subjects were considered to have dropped out if they did not completely fill or return the questionnaires, and never had IQ score examination before.

The minimum required sample size was 96 for bivariate analysis, and 110 for multivariate analysis, calculated with the rule of thumb. Subjects were recruited by two-stage cluster sampling. First, we randomly selected 5 schools from all international-standardized junior high schools in Jakarta, to represent different areas: West, North, Central, South, and East Jakarta. Second, we randomly chose 3 classes from 5 JHS, consisting of 7th, 8th, and 9th grades.

The SDSC, a 26-item instrument for evaluating sleep in children aged 3–18 years, was developed by Bruni *et al*. in 1996. It is used to assess a variety of behavioral patterns relating to children's sleep. This instrument is recognized to be reproducible and valid, with internal consistency, and is useful for distinguishing six groups of sleep disorders common among children and adolescents: disorders in initiating and maintaining sleep, breathing, arousal, sleep–wake transition, excessive somnolence, and sleep hyperhydrosis.[11] The SDSC has been validated for use in Indonesian.[10,12]

All students in 7th, 8th, and 9th grades were given complete explanations of the study. Students and parents provided filled SDSC questionnaires, written informed consent, and information on baseline characteristics. Parents were asked to monitor their children's sleep habits for 3 days before answering the SDSC questionnaires. We scored the SDSC and included children who met the sleep disorder criteria with total scores of 46 or higher.

Subjects who met the inclusion criteria were asked to fill *Motivation, Learning and Strategy Questionnaires*. We also collected subjects' school performance reports from December 2012. Their IQ scores were assessed using the *Intelligence Structure Test* (IST). Baseline characteristics were measured and recorded. Maternal education categorized based on Undang-Undang Republik Indonesia 2003 No. 20 article 17-20 about *Nasional Educational System* as follow: basic (elementary school and *madrasah ibtidaiyah/MI* or others equal and also junior high school and *madrasah tsanawiyah/MTs*, or equal); middle (senior high school, *madrasah aliyah/MA*, or others equal); high (diploma, scholar, postgraduate, specialist, dan doctoral). Bedtime difference defined as the difference between time to start sleeping in school days and weekend, which considered "different" if the difference more than 1 hours. Wake-up time difference is the difference between time to wake up in school days and weekend, which considered "different" if the difference more than 1 hours. Week-end duration of sleep categorized as: less than adequate if sleep duration less than 8 hours, adequate if sleep duration 8-9 hours, or more than adequate if sleep duration more than 9 hours. School-day duration of sleep classified into: less than adequate if sleep duration less than 8 hours, adequate if sleep duration 8-9 hours, or more than adequate if sleep duration more than 9 hours. Regarding the IQ, we categorized it as:

below-average (IQ score 80-89), average (IQ score 90-109), above-average (IQ score 110-119), superior (IQ score 120-129), and very superior (IQ score ≥ 130). Students with below average IQ level were excluded from analysis.

Subjects were asked to fill *Motivation, Learning and Strategy Questionnaires.* The authors counted the score, the median, and standard deviation. The median was 118 and SD 9.36. Motivation and learning strategies were divided into 3 categories: less if subjects' score ≤ 108 (median – SD), fair if subjects' score 109-127 (median – SD until median + SD), or good if subjects' score ≥ 128 (median + SD). After-hours education program was divided into 3 categories: no activities, ≤ 2 types (ex. basketball and kumon), or more than 2 types (math course, English course, and kumon). Based on the activities we further divided it into 3 categories: academic (activities directly related with their school curriculum, i.e. mathematic and English course, science, after-school tutoring, kumon), non-academic [activities not directly related with their school curriculum, i.e. music (piano lessons, guitar lessons), sports (basketball, football club, futsal), cheerleader, martial activities (pencak silat, taekwondo, yudo)], flag hoisting troop, scout; or mixed activities (activities consisted of academic and non-academic).

Chi-square and logistic regression tests were used to perform bivariate and multivariate analysis, respectively. Statistical analysis were performed using *SPSS 17.0.* This study was approved by the Ethics Commitee of the University of Indonesia Medical School.

Results

From five JHSs, 491 students were screened by SDSC questionnaires. Of these, 332 students returned the questionnaires and written informed consents. Seven students were considered to have dropped out because they did not completely fill the SDSC questionnaires. From 129 students who met the inclusion criteria, 5 dropped out because they have not had IQ score examination before. Furthermore, the other 13 students were excluded from analysis because of their IQ level was in below average level, leaving 111 students included in analysis (**Figure 1**).

The median age of subjects was 13 years. Most subjects were of middle-to-low socioeconomic status. The 124 students with sleep disorders consisted of 29% males and 71% females. Subjects' characteristics are shown in **Table 1.**
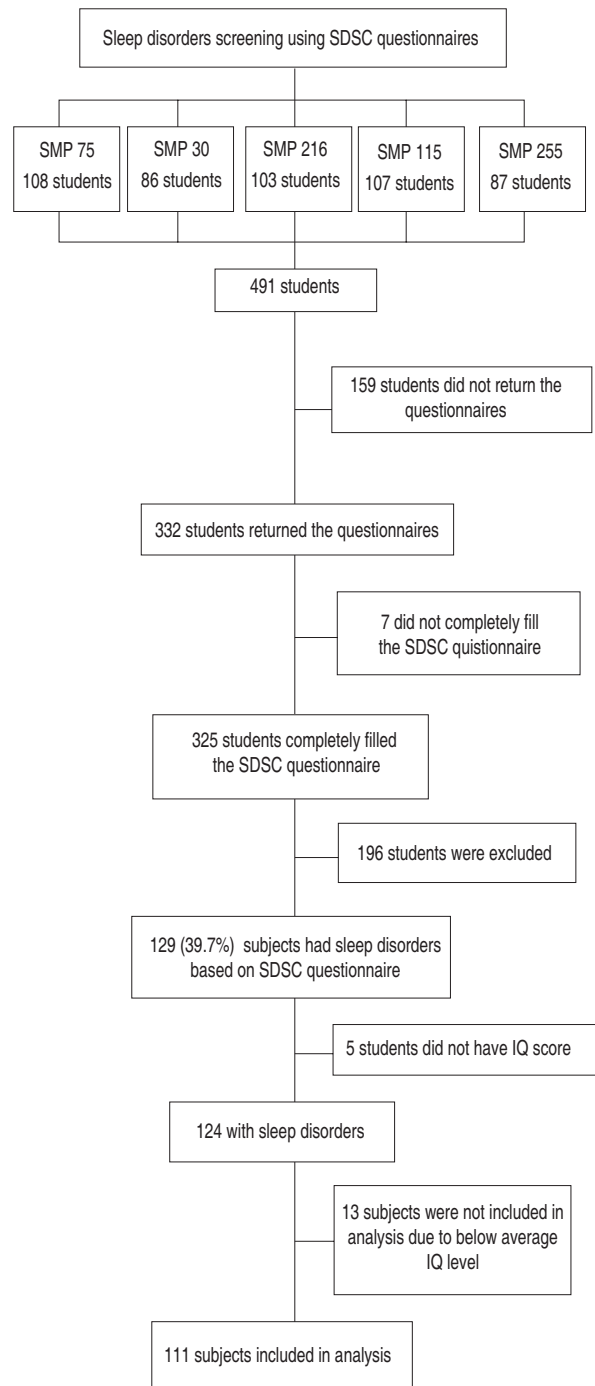

Figure 1. Flow chart of patients selection

Table 1. Baseline characteristics of 124 students with sleep disorders

Characteristics		n (%)
Age		
12 years		30 (24.2)
13 years		47 (37.9)
14 years		41 (33.1)
15 years		6 (4.8)
Gender		
Male		36 (29)
Female		88 (71)
School grade		
7th		28 (22.6)
8th		51 (41.1)
9th		45 (36.3)
Family structure		
Single parent		4 (3.2)
Nuclear family		96 (77.4)
Extended family		24 (19.4)
Maternal educational level		
Basic		1 (8)
Middle		37 (29.8)
High		86 (69.4)
Socioeconomic status		
Low		17 (13.7)
Low-to-middle		73 (58.9)
Middle-to-high		29 (23.4)
High		5 (4)
Computer in the bedroom		
Yes		66 (53.2)
No		58 (46.8)
Television in the bedroom		
Yes		47 (37.9)
No		77 (62.1)
Sleep habits		
Bedtimes difference	Different	40 (32.3)
	Indifferent	84 (67.7)
Wakeup times difference	Different	92 (74.2)
	Indifferent	32 (25.8)
Weekend duration of sleep	Less-than-adequate	37 (29.8)
	Adequate	51 (41.2)
	More-than-adequate	36 (29.0)
School day duration of sleep	Less-than-adequate	99 (79.8)
	Adequate	25 (20.2)
IQ level		
Below-average*		13 (10.5)
Average		55 (44.4)
Above-average		22 (17.7)
Superior		20 (16.1)
Very superior		14 (11.3)
Motivation and learning strategies		
Less		17 (13.7)
Fair		90 (72.6)
Good		17 (13.7)
After-hours education program		
More than 2 types		23 (18.5)
1-2 types		86 (69.4)
None		15 (12.1)

*Subjects were not included in the bivariate and multivariate analysis because they had below-average IQ level.

The median school day bedtime was 10 pm (range 8 pm - 00:30 am), wake-up time was 5 (range 4-5:45) am, and sleep duration was 7 hours. Subjects' sleep habits are shown in **Table 2.**

Out of 124 students with sleep disorders, as many as 52 (41.9%) subjects' parents believed that their children did not have sleep disorders, only 27 (21.8%) subjects' parents knew their children had sleep disorders and 45 (36.3%) did not know. The prevalence of sleep disorders was 39.7%, mostly with difficulty in initiating and maintaining sleep (70.2%), followed by sleep wake transition disorders (56.4%), as shown in **Table 3.**

Academic achievement was assessed by taking the average of their December 2012 marks. The average mark of subjects was 86.13 (range 80 - 91). There were 65 (52.4%) subjects with above-average (≥ 86.14) academic achievement and 59 (47.6%) with below-average (≤ 86.13) academic achievement. Of the 95 subjects who participated in after-hours education program 23 subjects were involved in more than 2 types education (5 academic, 7 non-academic, and 11 mixed activities) and 72 subjects were in 1-2 types (24 academic, 46 non-academic, and 2 mixed activity), as shown in **Table 4**.

As many as 17/29 subjects who participated in academic activities had above-average academic achievement; 23 subjects who participated in non-academic activities had above-average academic achievement (**Table 4**). There were 3 of 5 subjects participated in after-hours education program (academic and more than 2 types) had below-average academic achievement, while 8 of 11 subjects involved in after-hours education program (mixed activity and more than 2 types) had above-average academic achievement. All subjects participated in after-hours education program (non-academic and more than 2 types) had below-average academic achievement.

Bivariate analysis using Chi-square test and logistic regression revealed 5 factors with significant associations to academic achievement: (1) gender, (2) socioeconomic status, (3) IQ level, (4) motivation and learning strategies, and (5) after-hours education program. These results are shown in **Table 5.**

We used logistic regression test with a backward stepwise method for multivariate analysis. This analysis revealed that the following factors were significantly related to below-average academic achievement: after-hours education program (> 2 types), average IQ level, and male gender (**Table 6**).

Table 2. Sleep habits of subjects

Sleep habits	Median	Minimum	Maximum
Weekend bedtime	23:00	20:00	04:00
Weekend wake-up time	08:00	04:30	12:00
School day bedtime	22:00	20:00	00:30
School day wake-up time	05:00	04:00	05:45
Weekend sleep duration, hours	8.5	5	15
School day sleep duration, hours	7	4	9

Table 3. The type of sleep disorders according to SDSC questionnaire

Type of sleep disorders	Subjects (n=124)	Percentage (%)
Difficulty in initiating and maintaining sleep	87	70,2
Sleep disordered breathing	18	14,5
Disorders of arousal	39	31,4
Sleep wake transition disorders	70	56,4
Excessive somnolence	57	45,9
Sleep hyperhidrosis	12	9,7

*1 subject may had 1 or more type of sleep disorders

Table 4. Academic achievement of subjects participating in after-hours education program (n=95)

Education program	Academic achievement		Total
	Below-average	Above-average	
Academic	12	17	29
Non-academic	30	23	53
Mixed activities	3	10	13
Total	45	50	95

Table 5. Distribution of academic achievement and its related factor

Related factors	Academic achievement		PR (95% CI)	P value
	Below-average n=48 n (%)	Above-average n=63 n (%)		
Gender				
Male	19 (61)	12 (39)	2.78 (1.18 to 6.54)	0.017*
Female	29 (36)	51 (64)		
Maternal educational level				
Basic-middle	13 (42)	18 (58)	0.93 (0.4 to 2.15)	0.86*
High	35 (44)	45 (56)		
Socioeconomic status				
Low and low to middle	40 (50)	40 (50)	2.87 (1.15 to 7.19)	0.021*
Middle to high and high	8 (26)	23 (74)		
Family structure				
Single parent	2 (50)	2 (50)	1.56 (0.21 to 11.6)	0.665#
Extended family	12 (60)	8 (40)	2.34 (0.87to 6.31)	0.094
Nuclear family	34 (39)	53 (61)	Reference	
IQ level				
Average	31 (56)	24 (44)	2.96 (1.36 to 6.46)	0.006*
Above average	17 (30)	39 (70)		
Motivation and learning strategies				
Less	10 (71)	4 (29)	3.88 (1.14 to 13.27)	0.023*
Fair-good	38 (39)	59 (61)		
School day duration of sleep				
Less-than-adequate	39 (43)	51 (57)	1.02 (0.39 to 2.66)	0.968*
Adequate	9 (43)	12 (57)		
Bedtime difference				
Different	19 (51)	18 (49)	1.64 (0.74 to 3.63)	0.223*
Indifferent	29 (39)	45 (61)		
Wake-up time difference				
Different	37 (44)	48 (56)	1.05 (0.43 to 2.55)	0.912*
Indifferent	11 (42)	15 (58)		
TV/computer inside bedroom				
Yes	31 (43)	41 (57)	0.98 (0.45 to 2.15)	0.957*
No	17 (44)	22 (56)		
After-fours education program				
>2 types	14 (61)	9 (39)	6.74 (1.49 to 30.49)	0.009*
≤2 types	31 (43)	41 (57)	3.28 (0.86 to 12.5)	0.07
None	3 (19)	13 (81)	Reference	

PR = prevalence ratio; *Chi-square test; #Logistic regression test; P < 0.05 (statistically significant)

Table 6. Stepwise analysis of relationships between academic achievement and gender, IQ level, family structure, after-hours education program, socioeconomic status, motivation and learning strategies

	Variables	Coefficient	PR	95% CI	P value
Step 1a	Gender (1)	0.837	2.310	0.82 to 6.53	0.115
	IQ level (1)	1.228	3.415	1.42 to 8.20	0.006
	Family structure (1)	0.186	1.205	0.38 to 3.80	0.750
	After-hours education program (1)	1.589	4.899	1.18 to 20.27	0.028
	Socioeconomic level (1)	0.834	2.303	0.81 to 6.57	0.119
	Motivation and learning strategies (1)	0.930	2.534	0.65 to 9.90	0.181
	Constant	-3.301	0.037		0.000
Step 2a	Gender (1)	0.907	2.477	0.96 to 6.38	0.06
	IQ level (1)	1.230	3.420	1.42 to 8.21	0.006
	After-hours education program (1)	1.598	4.944	1.19 to 20.57	0.028
	Socioeconomic level (1)	1.870	2.388	0.85 to 6.68	0.097
	Motivation and learning strategies (1)	0.915	2.497	0.64 to 9.7	0.186
	Constant	-3.316	0.036		0.000
Step 3a	Gender (1)	0.986	2.680	1.06 to 6.78	0.037*
	IQ level (1)	1.183	3.265	1.38 to 7.72	0.007*
	After-hours education program (1)	1.724	5.607	1.36 to 23.18	0.017*
	Socioeconomic level (1)	0.992	2.695	0.99 to 7.36	0.053
	Constant	-3.405	0.033		0.000

a. Variables included in step 1: (A) gender, (B) IQ level, (C) family structure, (D) After-hours education program, (E) socioeconomic level, and (F) motivation and learning strategies (6 variables).
*P < 0.05 (statistically significant)

Discussion

There have been few sleep disorder studies in Indonesia, and none have evaluated academic achievement in adolescents with sleep disorders. This study is the first involving adolescents from five junior high schools in Jakarta. Several limitations of this study are recall bias, and the use of passive questionnaires. Schools also influence academic achievement, therefore this study was held in five Jakarta schools considered to be of superior quality.

The prevalence of sleep disorders in our study was 39.7%, most commonly difficulty in initiating and maintaining sleep. Previous studies by Haryono *et al.* and Natalita *et al.* found higher prevalences: 62.9% and 62.5%, respectively. One reason for their higher figures was that both studies used a total SDSC score of > 39 to fulfill the sleep disorder criteria.[10, 12] Haryono *et al.* found sleep wake transition disorders to be the most common sleep disorder.[12]

The majority of subjects had different wake-up times. Normal duration of sleep was found more frequently during weekends than school days (41.1% vs. 20.2%), similar to reports from Haryono *et al.*[12] and Mak *et al.*[18]

Adolescent sleep is characterized by changes in their circadian cycle and sleep patterns. They tend to go to sleep later at night and find it difficult to wake up in the morning. In this study, the median bedtime during school days was 10pm and median wake-up time was 5am, whilst during weekends the median bedtime was 11pm and wake-up time was 8am. These findings are consistent with adolescent sleep patterns in other Asian countries, such as Japan and Korea.[13] Natalita *et al.* also found that bedtime started at 10:12pm and wake-up time at 05:55am.[10]

The majority of subjects' parents felt that children did not have sleep disorders. Blunden *et al.* reported that only 4.1% of parents were aware of their child's sleep problems.[19] Only 30% of children were assumed to have significant sleep disorders, both by the parents and/or by the child himself.[20]

We found a significant relationship between below-average academic achievement and male gender, similar to a previous study.[21] We also found that an average IQ level was related to below-average academic achievement. Leeson *et al.* reported that cognitive function may influence a person's academic achievement.[22] Children who are motivated for success have better academic achievement.[23] Sedaghat *et*

al. found this to be the case, with a significant relationship between lower motivation and learning strategies to below-average academic achievement.[24]

Rezeki *et al.* did not find a relationship between after-hours education program and academic achievement.[17] On the contrary, we found a significant relationship between after-hours education program (> 2 types) and below-average academic achievement. However, Rezeki *et al.* only used a "yes/no" category for the after-hours education program variable.[17] Morina *et al.* found that students who attended after-hours education program (academic type) had better academic achievement compared to those who joined sports after-hours education program.[25] We found that students involved in mixed activities had better academic achievement compared to those who joined the academic type, although the difference was not statistically significant. We did not assess the quality of after-hours education program attended by our subjects. We also did not evaluate subjects' willingness to participate in after-hours education program. Furthermore, we did not assess the number of after-hours education program activities nor the time spent on those activities, as these factors varied greatly among subjects. For example, there were subjects who reported attending more than 4 types of after-hours education program, occurring every day of the week and at times involving more than 1 activity per day.

Uwaifo[26] reported that children who lived with their nuclear family seemed to be more emotionally stable and have fewer emotional problems. Rezeki *et al.*[17] found that subjects with a nuclear family had better opportunity to gain academic achievement compared to those who came from a non-nuclear family (57.1% vs. 38.7%, respectively). We also found that subjects with a nuclear family had a better opportunity for good academic achievement (60.9%) compared to those who came from a non-nuclear family (single parents or extended family). (41.7%)

Higher socioeconomic status increases a child's opportunity for better education.[23] Sharif *et al.* found that higher family income improved academic achievement.[21] We found no significant relationship between low-middle class socioeconomic status and below-average academic achievement.

The negative influence of television is due to recreational points, instead of the informational and educational aspects.[27] Schochat *et al.* reported that electronic media in bedrooms and watching television more than 3 hours per day may increase the risk of sleep latency and reduce sleep duration, thus influencing academic achievement.[28] However, we did not find relationship between the presence of a television/computer in the bedroom and academic achievement.

Our multivariate analysis showed that the most statistically significant factors related to academic achievement were (1) after-hours education program, (2) IQ level, and (3) gender. Male subjects with below average IQ level and attending after-hours education program had a 62% higher probability of below-average academic achievement.

In conclusion, the prevalence of sleep disorders is 39.7%, with the most common being difficulty in initiating and maintaining sleep (70.2%). Duration of sleep is 7 hours in school day and 8.5 hours at weekend. The difference between bedtime in school day and weekend is 1 hour, whilst the wake-up time difference is 3 hours. The proportion of below-average academic achievement in adolescents' with sleep disorders is 47.6%. Factors which are significantly related to below-average academic achievement: after-hours education program (> 2 types), average IQ level, and male gender.

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