

Sleep disturbance scale for children as a diagnostic tool for sleep disorders in adolescents

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Abstract

Background Inadequate sleep may affect mental, emotional, and physical health, as well as the immune system. If sleeping time is not sufficient, then sleep disturbance may occur. Objective assessments of sleep quality can be done by polysomnography and actigraphy. Subjective assessments of sleep quality and quantity can be done with questionnaires or interviews. *The Sleep Disturbance Scale for Children* (SDSC) is a multi-dimensional sleep assessment questionnaire.

Objective To compare the SDSC to wrist actigraphy for assessing sleep quality in adolescents.

Methods We conducted a diagnostic study with a cross-sectional method, from March to April 2015 at elementary schools in Manado. The inclusion criteria were healthy adolescents aged 10 to 12 years, who agreed to fill the questionnaire and underwent wrist actigraphy. Data were analyzed using Chi-square test and 2 x 2 table to assess sensitivity, specificity, positive predictive value, and negative predictive value.

Results Of 60 adolescents, 31 were female and 29 were male, with a mean age of 11.39 years. The sensitivity of SDSC was 80.6%, specificity 37.9%, positive predictive value 58.1%, and negative predictive value 64.7%, when compared to wrist actigraphy as the gold standard of measuring sleep quality.

Conclusion The SDSC is a good screening tool for early detection of sleep disorders in adolescents. The Sleep Disturbance Scale for Children has a sensitivity of 80.6% and specificity of 37.9% for diagnosing sleep disturbances, as compared to the gold standard of wrist actigraphy. [*Paediatr Indones.* 2018;58:9133-7; doi: <http://dx.doi.org/10.14238/pi58.3.2018.133-7>].

Keywords: *Sleep Disturbance Scale for Children; SDSC; adolescent; sensitivity; specificity*

While sleep is essential for every individual, sleep needs differ by age. The total amount of required sleep decreases gradually over childhood into adulthood.^{1,2} The process of growth and development from intrauterine life, to childhood, to puberty, and to adulthood is continuous.³ Sleep disturbances in adolescents may involve one or more basic mechanisms: inadequate sleep duration for age, disordered and fragmented sleep, or a discrepancy of sleeping time period. Sleep quality is often assessed by polysomnography and actigraphy. The wrist actigraph requires computer software and specialized training to interpret results.⁵ For subjective assessment of quality and quantity of sleep, questionnaires or interviews can be used. *The Sleep Disturbance Scale for Children* (SDSC) is a sleep assessment questionnaire with advantages over other questionnaires because it includes multidimensional measurements.⁴ The aim of this study was to compare the SDSC to wrist actigraphy for assessing sleep disorders in adolescents.

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Methods

We conducted a diagnostic study with a cross-sectional method from March to April 2015 in three elementary schools in Manado. Schools and subjects were selected by two-stage random sampling. Inclusion criteria were healthy adolescents aged 10 to 12 years, who were willing to answer the questionnaire and undergo wrist actigraphy. Subjects' parents provided written informed consent. Adolescents who were sick during wrist actigraphy, diagnosed and undergoing therapy for sleep disturbances, had chronic illnesses like hypertension, diabetes, or anemia, and with incomplete addresses or phone numbers were excluded from this study. The criterion for dropping out was an improperly attached wrist actigraph. The minimum required sample size was 57 subjects. This study was approved by the Ethics Committee for Research, Sam Ratulangi University Medical School.

The *Sleep Disturbance Scale for Children* used in this study assessing six categories of sleep disorders (1) sleep breathing disorders, (2) start and maintain sleep disorders, (3) consciousness disorders, (4) sleep-awake transition disorders, (5) excessive somnolent disorders, and (6) hyperhidrosis during sleep. Direct interviews were conducted by researchers on parents and children who were included in the study. The score of sleep disturbance defined based on intensity or frequency of each category above: score 1 for never, score 2 for seldom (≤ 1 -2 times/month), score 3 for sometimes (1-2 times/week), 4 for frequent (3-5 times/week), and 5 for always (daily). The cut off point of total score was 39, hence sleep disturbance was diagnosed if the total score was more than 39.⁶

Subjects were diagnosed with sleep disturbances if one or more of three sleep parameters showed abnormal patterns in wrist actigraphy. The three parameters are effectivity of sleeping less than 85%, sleep onset latency (SOL) of more than 20 minutes, and wake after sleep onset (WASO) of more than 40 minutes. Data were analyzed using Chi-square test and 2 x 2 table to show sensitivity, specificity, positive predictive value, and negative predictive value of the SDSC compared to wrist actigraphy as the gold standard.

Results

A total of 60 adolescents were included after randomization, with the mean age of 11.39 (SD 0.64) years (Table 1). Subjects' mean sleep time began at 21:19 hours, mean time to get up was 5:28 hours, and mean total sleep time was 7 hours 31 minutes. In our study, 19 subjects with sleep disturbances watched TV for more than 3 hours per day. Forty-three subjects were diagnosed to have sleep disturbance using the SDSC (Table 2). Using wrist actigraphy, 31 subjects were found to have sleep disturbances, including 10 subjects with sleep efficiency of less than 85% and WASO more than 40 minutes. The mean sleep onset latency was 14.4 (SD 21.3) minutes; mean sleep efficiency was 85.2 (SD 6.9) %, and mean wake after sleep onset was 41.3 (18.9) minutes (Table 3). The diagnostic test to compare the SDSC to wrist actigraphy showed sensitivity of 80.6%, specificity

Table 1. Characteristics of subjects

Variables	N=60
Mean age (SD), years	11.39 (0.64)
Sex, n(%)	
Female	31 (51.7)
Male	29 (46.3)
Mean body weight (SD), kg	33.7 (8.89)
Mean body height (SD), cm	140.25 (7.6)

Table 2. Subjects' sleep assessment by the SDSC

SDSC results	N=60
No sleep disturbance, n (%)	17 (28.3)
Sleep disturbance, n (%)	43 (71.7)
Type of sleep disturbance, n (%)	
Disorders of initiating and maintaining sleep	15 (34.9)
Sleep breathing disorders	7 (16.3)
Disorders of arousal	4 (9.3)
Sleep-wake transition disorders	9 (20.9)
Disorders of excessive somnolence	7 (16.3)
Sleep hyperhidrosis	1 (2.3)

Table 3. Quality of sleep measured by wrist actigraphy

Variables	N=60	95%CI
Mean sleep onset latency (SD), min	14.4 (21.3)	0.0 to 103.7
Mean sleep efficiency (SD), %	85.2 (6.9)	65.1 to 93.4
Mean wake after sleep onset (SD), min	41.3 (18.9)	10 to 127.2

of 37.9%, positive predictive value of 58.1%, and negative predictive value of 64.7% (Table 4). There was no significant difference in results from SDSC compared to wrist actigraphy in determining the presence of sleep disturbance (P=0.055).

and mean total sleep time was 7 hours 31 minutes. A previous study in Hong Kong found that adolescents aged 12-19 years had a mean total sleep time of 6.3 hours, beginning at 00:03 hours and waking at 06:33 hours.¹² Another study in South Korea found that

Table 4. Comparison between wrist actigraphy and SDSC to assess sleep disturbance

		Wrist actigraphy		Total
		Sleep disturbance	No sleep disturbance	
SDSC	Sleep disturbance	25	18	43
	No sleep disturbance	6	11	17
	Total	29	60	

Discussion

Sleep is a regular resting condition with reduced characteristic gestures and decreased level of awareness of surroundings. It is reversible and rapid. Sleep is essential, but the need for sleep differs according to age.⁷⁻⁹ Adolescence is a phase of dynamic development, characterized by accelerated physical, mental, emotional, and social development.¹ Early adolescence starts from the age of 10-12 years, with dramatically increased physical and psychological growth. Sleep quality is closely linked to the overall welfare of adolescents, including their physical, emotional, cognitive, and social health.¹

To subjectively assess quality and quantity of sleep, questionnaires or interviews are often used in epidemiological studies. The questionnaire is easy to use and analyze. The SDSC is a sleep assessment questionnaire with advantages over other questionnaires, as it is a multi-dimensional assessment.¹⁰⁻¹³

Wrist actigraphy is the standard benchmark to evaluate sleep disturbances in adolescents. Adolescent body movement is recorded by the actigraph tool and used to determine the presence or absence of sleep disturbances. A sleep disorder is diagnosed when wrist actigraphy records at least one of three parameters: sleep efficiency < 85%, sleep onset latency > 20 minutes, and WASO > 40 minutes.¹¹

In our study, subjects' mean sleep time began at 21:19 hours, mean time to get up was 5:28 hours,

young people aged 10-14 years had a mean sleep time of 6.6 hours per day.¹³

Wrist actigraphy revealed that 31 children experienced sleep disturbances, including 16 (51.6%) girls. Wrist actigraphy began at 18:00 hours and continued until the morning of the next day. Data were collected and processed by Actiware software.

Using the SDSC, we found that 43 (71.7%) adolescents experienced sleep disturbances. The most common type of sleep disorder was initiating and maintaining sleep (insomnia) in 15 (34.9%) adolescents. Haryono et al. in Jakarta found that 62.9% of adolescents aged 12-15 years experienced sleep disturbances using the SDSC. The most common sleep disorders were sleep-wake transition disorders, suggesting that sleep disturbances are commonly found in adolescents.¹⁴

Disorders of initiating and maintaining sleep (insomnia) were seen in 34.9% of subjects with sleep disturbances by SDSC. This result was greater than that of Hysing et al. in Norway, who reported the prevalence of insomnia in adolescents aged 16-18 years to be 23.8%.¹⁵ In a 2012 study on 384 adolescents aged 13-18 years, Dohnt et al. found that the prevalence of insomnia was 34.6%.¹⁶ The most common causes of insomnia in adolescents is the excessive use of technology, such as a mobile phone and television.¹⁷

We compared subjects' SDSC results to their wrist actigraphy results and found that the SDSC sensitivity was 80.6% and specificity was 37.9%.

Chi-square analysis revealed no significant difference between the two tests ($P=0.055$). Natalita *et al.* obtained SDSC sensitivity and specificity of 71.4% and 54.5%, respectively. They also reported that McNemar test revealed no significant difference in SDSC and wrist actigraphy ($P=0.832$).¹⁰ However, the specificity in our study was 37.9%, suggesting that clinical judgment is still required from the examiner to determine the absence of a sleep disorder. Hence, the SDSC questionnaire can be used to screen for sleep disturbances in adolescents, as an easy-to-use and low cost tool.

The SDSC is easier to use than the gold standard. Wrist actigraphy is expensive and requires specialized training and software to interpret the results. *The Sleep Disturbance Scale in Children* is a multi-dimensional assessment questionnaire with advantages over other questionnaires because it includes a multi-dimensional measurement.

Limitations of this study were that the subjects' activity levels were not monitored, nor was more than one night of sleep (wrist actigraphy) monitored. Thus, we are unable to speculate on the causes of sleep disturbances in our subjects.

In conclusion, the *Sleep Disturbance Scale for Children* has a sensitivity of 80.6% and specificity of 37.9% for diagnosing sleep disturbances, as compared to the gold standard of wrist actigraphy. Therefore, the SDSC questionnaire is a good screening tool for early detection of sleep disturbances in adolescents.

Conflict of Interest

None declared.

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