

The Relationship Between Age and Stress on Sleep Quality

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ABSTRACT

Introduction: Sleep quality in late adolescence was often compromised by late-night sleeping habits. In addition, sleep quality was also influenced by biological factors, age, and psychological disorders such as stress. The purpose of this study was to analyze the relationship between age and stress on sleep quality in late adolescents. **Methods:** This type of research was an observational-analytical research with cross sectional research design. The study sample consisted of late adolescents aged 17 to 25 years who were identified using simple random sampling technique. The instruments used were Perceived Stress Scale-10 to measure stress levels and Pittsburgh Sleep Quality Index to measure sleep quality. Data analysis was performed multivariately using multiple linear regression. **Results:** As age increased, the mean sleep quality score increased by 0.112 units compared to younger ages, but this did not prove statistically significant ($b = 0.112$; 95% CI = -0.501 to 0.724; p -value = 0.717). Late adolescents with high stress scores had a mean sleep quality score 0.099 units higher than adolescents with low stress scores, and this proved statistically significant ($b = 0.099$; 95% CI = 0.000 to 0.198; p -value = 0.050). Age and stress were factors that affect sleep quality by 2.88%, and the rest was influenced by other factors. **Conclusion:** Sleep quality was shown to be significantly affected by stress, but clearly not by age.

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INTRODUCTION

Sleep plays an important role in the functioning of the human body which is controlled by neurobiological processes as a physiological need. In adolescence, there are often changes in sleep activity, especially related to sleep time, namely sleeping late at night and having difficulty getting up early. This condition causes sleep disorders such as insomnia and poor sleep quality. Sleep quality is a complex concept that can be assessed objectively and subjectively. Poor sleep quality has been reported as a common occurrence among adolescents (Albqoor & Shaheen, 2021).

Sleep disorders characterized by poor sleep quality result in increased sleep fragmentation, decreased sleep efficiency, and daytime sleepiness. Sleep disorders often occur physiologically with age and are also caused by degenerative stages. Studies have shown that poor sleep quality is associated with poorer cognitive function, affecting daily physical activity and mental health (Casagrande et al., 2022).

Psychopathology begins early in life and an increase in internalizing symptoms is likely with the transition to adolescence. During this phase, mental disorders such as anxiety and depression increase dramatically. Internalizing characteristics in adolescence are closely related to sleep quality, and adolescence is a time when mental disorders tend to overlap (Madrid-Valero et al., 2020).

Several previous studies have shown that there is a bidirectional relationship between stress and sleep quality, leading to poor health outcomes. In addition, as adolescents age, their perception of stress increases, and the impact on women is greater. High levels of stress, anxiety, and negative emotions lead to longer sleep onset rates, shorter nightly sleep duration, shorter total sleep time, and poor sleep quality (Brink et al., 2021).

Poor sleep quality can be associated with impacts on physical health and academic performance. Past research has shown that poor sleep quality increases the risk of emotional regulation, poor mood, and self-harm. Observational studies have also shown that metabolism and obesity are correlated with sleep duration, and poor sleep is associated with weight gain. This may be due to changes in leptin and ghrelin, hormones that play a role in regulating satiety. Poor sleep quality has also been reported to impair cognitive abilities and lead to decreased academic performance (Kansagra, 2020).

Based on this background, the researcher wants to conduct a study to analyze the relationship between age and stress on sleep quality in late adolescence. The novelty of this study is to evaluate sleep quality based on seven evaluation dimensions. Multivariate analysis was used to assess the relationship of age and stress to sleep quality.

LITERATURE REVIEW

Sleep is a natural cycle of human life and is necessary for good health. Sleep is a state in which motor activity ceases and perception of external stimuli is reduced. Sleep has multifactorial effects on the body, including promoting the recovery of energy stores in the brain, reducing energy expenditure, contributing to memory consolidation, and modulating adaptive and innate immune responses. Sleep changes with age, but the decline in sleep quality is not universal. Sleep quality can be influenced by various factors, including genetics, activity patterns, diet, and environment (Sejbuk et al., 2022).

Sleep quality can be assessed using aspects of sleep history, such as mean time to sleep onset or "sleep onset latency", typical sleep duration, number of awakenings, typical sleep onset time, morning awakening, and presence or absence of daytime sleepiness, and use of certain medications (Feinsilver, 2021). Poor sleep quality leads to sleep disorders and the risk of health problems, both infectious and non-communicable diseases. Sleep disorders are commonly associated with impaired memory consolidation and disposal of synaptic metabolites such as beta-amyloid, which is involved in neurogenesis. Sleep activity plays an important role in cognitive reserve. In addition, good sleep can restore neurobehavioral functions and psychological aspects (Casagrande et al., 2022).

During adolescence, stress increases, sleep quality decreases, and the risk of mental health disorders increases. Mental illnesses such as stress are said to be associated with decreased sleep quality. Sleep reactivity, a sleep disorder often caused by chronic stress, is associated with an increased risk of depression. Decreased heart rate variability indicates decreased parasympathetic function. People with this condition are more likely to have poor sleep quality and an increased risk of chronic stress-related depressive symptoms than people with high heart rate variability (Da Estrela et al., 2021).

A study on analyzing differences in sleep quality and physical fitness based on age in athletes concluded that there were no significant differences. Biological gender factors are stated to hinder the improvement of balance and strength performance between athletes aged 13 and 17 years, while age factors affect agility and endurance performance (Guembri et al., 2023). In this study, the

age factor was not limited to 2 groups, data analysis was carried out multivariately with a continuous data scale in the age range of 17 to 25 years.

Articles presenting literature studies from adolescents and adults found no difference in the influence of mental disorders on sleep disturbance. In addition, it was noted that the quality relationship was not clear (Bruce et al., 2017). In this study, the relationship between stress factors and sleep quality was analyzed multivariately with a continuous data scale by controlling for other variables.

METHODS

This observational analytical study with a cross-sectional study design uses a direct interview survey method. The research instrument was a questionnaire with data collection techniques through interviews. This research was conducted at the Department of Physiotherapy, Poltekkes Kemenkes Surakarta. The age of adolescents in the final category is the research population. According to the Krejcie table contained in Prof. Dr. Sugiyono's book, the calculation of sample size with an error of 5% for a population of 85 late adolescents aged 17 to 25 years, the minimum sample is 70. The sample of this study was determined with a simple random sampling approach and 71 respondents were obtained.

Sample inclusion criteria, namely late adolescents aged 17 to 25 years and male and/or female who are willing to become research respondents by agreeing to informed consent. The sample exclusion criteria, namely having a history of sleep disorders based on a doctor's diagnosis. The independent variables were age and stress, while the dependent variable was sleep quality.

Age is the length of time a person lives in the world starting from the day of birth. Age is calculated by reference to the day of birth until the day of data collection and is reported in years. The final results are reported on a continuous data measurement scale.

Stress is the emotional, mental, or psychological state of a person when exposed to pressure in the environment. Stress levels were measured using the Perceived Stress Scale-10 (PSS-10) which consists of 10 questions about respondents' feelings and thoughts over the past month (Baik et al., 2019). The PSS-10 was found to be adequate for the entire sample on both the 6 negative question items ($\alpha = 0.89$), as well as the 6 positive question items ($\alpha = 0.78$), and was also found to be significantly valid ($p < 0.001$). Each question on this questionnaire was rated on a 5-point likert scale (Mozumder, 2022). The final results are reported on a continuous data measurement scale.

Sleep quality is the satisfaction felt by a person towards all aspects of sleep so as to get freshness after waking up from sleep. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) questionnaire consisting of 18 items (Zitser et al., 2022). The PSQI was found to be adequate for the entire sample ($\alpha = 0.79$), with a content validity value of 0.89 which was significant ($p < 0.001$) and a sensitivity value of one at a specificity of 0.81. The measurement results will be accumulated into 7 aspects, namely subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, medication use, and daytime dysfunction (Spira et al., 2012). The final results were reported on a continuous data measurement scale.

The study data were analyzed univariately, bivariately, and multivariately. Univariate analysis aimed to describe the sample characteristics data and describe the study variables by reporting frequency distribution, percentage, minimum value, maximum value, mean, and standard deviation (SD). Bivariate analysis with simple linear regression aimed to analyze the relationship between age and sleep quality and the relationship between stress and sleep quality. Multivariate analysis with multiple linear regression aimed to analyze the relationship between age and stress with sleep quality.

The main research material is a questionnaire. The main equipment needed in this research process is a gadget as a medium for data collection which is carried out directly on all respondents at any time. The first research stage is to explain the research scheme to the sample. If the sample meets the criteria and is willing to become a respondent, then the agreement process is legalized in an informed consent sheet. The next stage is that respondents are asked to fill out a questionnaire that has been prepared by the researcher in the form of a google form. This process was guided by the enumerator with the hope that each question was perceived the same by all respondents and answered as accurately and realistically as possible. This also aims to minimize bias. The ethical

feasibility of this research has been approved with code number DP.04.04/F.XXV.1/7430/2023 obtained from the Health Research Ethics Committee of the Surakarta Poltekkes Kemenkes.

RESULTS AND DISCUSSION

The study was conducted in Surakarta with the respondents being physiotherapy students of Surakarta Health Polytechnic. Characteristics of respondents including gender, age, stress level, and sleep quality are presented in Table 1. Of the 71 physiotherapy students involved as research respondents, 71.83% were female and the remaining 28.17% were male. The average age of respondents in this study was 20.155 years. Based on the measurement of stress levels using the PSS-10 questionnaire, the average score was 16.422. Sleep quality was measured using the PSQI questionnaire and the average score was 9.732.

Table 1. Characteristics of respondents (N=71).

Item	Frequency n (%)	Mean	Standard Deviation	Min	Max
Gender					
Male	20 (28.17)	-	-	-	-
Female	51 (71.83)				
Age	71 (100)	20.155	0.729	19	23
Stress Level					
Low	34 (47.89)	16.422	4.503	7	28
High	37 (52.11)				
Sleep Quality					
Good	29 (40.85)	9.732	1.804	5	13
Poor	42 (59.15)				

According to the study of starting time at night, the earliest time to start falling asleep is at 9pm and the latest time to start sleeping is at 5am. There were 3 respondents (4.23%) who reported starting sleep at 9pm, 23 respondents (32.39%) reported starting sleep at 10pm, 26 respondents (36.62%) reported starting sleep at 11pm, 14 respondents (19.72%) reported starting sleep at 12pm, 4 respondents (5.63%) reported starting sleep at 1am, and 1 respondent (1.41%) reported starting sleep at 5am. This finding is enough to illustrate that late adolescents experience sleep cycle problems, namely in the form of sleeping late at night.

Based on the length of time it takes to fall asleep at night, 32 respondents (45.07%) took less than 15 minutes, 28 respondents (39.44%) took less than 16 to 30 minutes, 10 respondents (14.08%) took less than 31 to 60 minutes, 1 respondent (1.41%) took more than 60 minutes.

Observations on cold complaints felt by respondents during the past month, it was found that 23 respondents (32.39%) stated that they had no complaints, 17 respondents (23.94%) stated that there were 1 complaint per week, 7 respondents (9.86%) stated that there were 2 complaints per week, and 24 respondents (33.80%) stated that there were more than 3 complaints per week. This finding suggests that a decrease in ambient temperature that affects body temperature will have an impact on sleep quality among late adolescents.

Observations on complaints of overheating felt by respondents during the past month, it was found that 36 respondents (50.70%) stated that they did not experience complaints, 17 respondents (23.94%) stated that there were 1 complaint per week, 5 respondents (7.04%) stated that there were 2 complaints per week, and 13 respondents (18.31%) stated that there were more than 3 complaints per week. This finding suggests that an increase in ambient temperature that affects body temperature will have an impact on sleep quality among late adolescents.

A description of the sleep quality indicators divided into seven aspects is presented in Table 2. Subjective sleep quality measurements with "good" results were only felt by 2.82% of respondents. Good sleep latency was owned by 21.13% of respondents. None of the respondents in this study got the amount of healthy sleep exceeding the age group recommendation, which is 7 hours per day. The majority of respondents, 88.73 students, had a sleep efficiency of less than 65%. As many as 98.59% of respondents complained of sleep disorders. Sleep problems experienced by respondents

even resulted in about 8.45% of respondents having to take sleeping pills. Disability in the form of daytime dysfunction was also reported by 88.46% of respondents.

Table 2. Description of sleep quality indicator aspects (N= 71).

Item	Frequency	Percentage (%)	Cummulative (%)
Subjective of Sleep Quality			
Good	2	2.82	2.82
Fair	50	70.42	73.24
Poor	18	25.35	98.59
Bad	1	1.41	100
Latency of Sleep			
Good	15	21.13	21.13
Fair	31	43.66	64.79
Poor	19	26.76	91.55
Bad	6	8.45	100
Duration of Sleep			
> 7 hours	-	-	-
6-7 hours	28	39.44	39.44
5-6 hours	38	53.52	92.96
< 5 hours	5	7.04	100
Efficiency of Sleep			
> 85%	-	-	-
75-84%	-	-	-
65-74%	8	11.27	11.27
<65%	63	88.73	100
Sleep Disorder			
No Disturbance	1	1.41	1.41
Slightly Disturbed	48	67.61	68.01
Disturbed	22	30.99	100
Severely Disturbed	-	-	-
Use of Sleeping pills			
Never	65	91.55	91.55
Once in a Week	6	8.45	100
Twice in a Week	-	-	-
Three Times in a Week	-	-	-
Daytime Dysfunction			
No Distractions	8	11.27	11.27
Slightly Disturbed	35	49.30	60.56
Disturbed	24	33.80	94.37
Very Annoyed	4	5.36	100

Bivariate analysis (Table 3) showed an association between age and sleep quality. This relationship was very weak and negative, and not statistically significant. This study found that stress was associated with sleep quality. This relationship was weak and positive, and proved to be statistically significant.

Table 3. Bivariate analysis of the association between age and stress with sleep quality

Sleep Quality	Pearson Product Moment Correlation Test	
	Coefficient (r)	p-value
Age	-0.0332	0.7837
Stress	0.2339	0.0496

Late adolescent respondents with increasing age had a mean sleep quality score 0.112 units higher than those with younger age, but this was not statistically significant ($b = 0.112$; 95% CI = -

0.501 to 0.724; p -value = 0.717). Late adolescent respondents with elevated stress scores had a mean sleep quality score 0.099 units higher than those with low stress scores, and was found to be statistically significant ($b = 0.099$; 95% CI = 0.000 to 0.198; p -value = 0.050). Age and stress are factors that influence sleep quality by 2.88% and the rest is influenced by other factors not analyzed in this study.

Table 4. Multivariate analysis with multiple linear regression ($n=71$).

Sleep Quality	Coefficient	Standard Error	t	p-value	95% CI		Adj R-Square
					Lower	Upper	
Age	0.112	0.307	0.36	0.717	-0.501	0.724	0.0288
Stress	0.099	0.049	2.00	0.050	0.000	0.198	
_cons	5.847	6.493	0.90	0.371	-7.109	18.803	

The findings of this study that increasing age will increase the average sleep quality score by 0.112 units, but it was not proven to be statistically significant. This is consistent with previous studies that showed no significant difference between age and various sleep quality parameters. Increased sleep quality parameters are also associated with decreased sleep quality (Guembri et al., 2023).

It is said that sleep disorders become very common with age. For example, a person may fall into a short period of deep sleep with slow waves, wake up in the middle of the night, or be unable to wake up in the morning. A study found that biological factors such as age are important factors that can affect biological delays in sleep duration (Rasekhi et al., 2016). Other factors that cause poor sleep quality in adolescents include body mass index, gender, daily physical activity, and diet, including coffee consumption (Bruce et al., 2017).

This study also found that the higher the level of stress, the statistically significant increase in mean sleep quality score of 0.099 units higher. This is in accordance with previous research that showed a significant correlation between stress and sleep. Stress is also thought to affect the relationship between students' physical activity and sleep quality. Physical activity and stress management have also been reported to improve and enhance sleep quality (Zhai et al., 2021).

Studies examining the relationship between occupational stress and sleep quality show that workers with chronic occupational stress are more likely to suffer from sleep disturbances, and sleep-deprived workers are at higher risk of occupational stress (Semplonius & Willoughby, 2018). This mechanism may be related to brain derived neurotrophic factor (BDNF) a neurotrophin involved in the maintenance of neurons that play a role in emotional and cognitive functions. Sleep activity plays an important role in cognitive function as it participates in increased neuroplasticity, which is closely related to BDNF. Exposure to stress disrupts the response of the hypothalamus, pituitary gland and adrenal glands to increased cortisol levels. Cortisol can also improve sleep disturbances and brain functions that affect cognitive performance, so reducing stress can improve sleep quality (Pistollato et al., 2016).

Gender is a biological factor that causes stress. Observations show that women receive more negative emotions (Semplonius & Willoughby, 2018). Responses to negative stimuli in women's frontal lobes are faster and more pronounced than in men, as measured by brain waves and electrophysiological signals. The noradrenergic locus coeruleus (LC), an arousal center in the brain, was found to be more active in women in coping with emotional changes (Kato et al., 2018).

This study proved that age and stress are factors that affect sleep quality by 2.88%. Managing stress by increasing physical activity is an effective strategy to improve sleep quality. Sleep is considered an activity that plays an important role in the long-term and short-term health of adolescents, therefore, educational strategies that integrate a culture of healthy living are needed to help adolescents achieve mental and physical balance (Bruce et al., 2017).

The implication of the findings of this study is that the effectiveness of sleep to restore physical fitness after physical activity in a day is not only determined by the duration or quantity of sleep, but also determined by the quality of sleep. Sleep quality includes aspects of subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, drug use, and daytime

dysfunction. In this case, sleep quality is influenced by biological factors such as age and psychological factors such as stress.

The limitation of this study is that the psychological factors measured only focused on stress problems, not measured comprehensively by examining mental health as a whole. Future research is recommended to examine aspects of mental health and physical activity. The burden of physical activity in a day has an impact on the occurrence of physical fatigue, where sleep is one of the solutions to recover physical fatigue.

CONCLUSIONS

Age, as a biological factor, had a very weak association with sleep quality, but was not shown to be statistically significant. Stress, as a psychological factor, was reported to have a weak relationship with sleep quality and proved to be statistically significant. Based on the results of the study, optimal sleep quality can be achieved by taking management actions to suppress the acceleration of age-related degenerative processes and managing or controlling stress to create a healthy mental state.

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