

THE EFFECT OF PHYSICAL ACTIVITY AND SLEEP DURATION ON STUDENTS SLEEP QUALITY IN EAST JAVA DURING COVID-19 PANDEMIC

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Abstract Due to covid-19 pandemic, the government has set a policy for the Community Activity Restrictions Enforcement (CARE) and online learning for students. On the other hand, this policy has had an impact on the physical and psychological health of students. Previous study showed that health problems in adults during lockdown due to the covid-19 pandemic are associated with increased anxiety, lack of physical activity and poor sleep quality. This study aims to investigate the level of physical activity, sleep duration and sleep quality of undergraduate students in East Java during the covid-19 pandemic; and at the same time prove whether the level of physical activity and sleep duration affect the sleep quality of students. The respondents of the research were 188 students, and the data analysis used included descriptive statistics and multipl regression. The results of this study indicate that most students have mild to moderate levels of physical activity (72.43%), lack of sleep duration (74.47%), and poor sleep quality (66.49%). Physical activity and sleep duration have a significant negative effect on the sleep quality of students.

Keywords: physical acitivity, sleep durations, sleep quality, pandemic, online learning

1. Introduction

The COVID-19 pandemic has changed various policies in Indonesia to overcome the pandemic, one of them is through the implementation of online learning in all education levels. In addition, the government has also imposed The Community Activities Restrictions Enforcement (CARE) or Pemberlakuan Pembatasan Kegiatan Masyarakat (PPKM), resulting in heavy migration from 'Work from Office' towards 'Work from Home' activities. These policies have certainly had some impacts on physical and psychological health of students.

A study conducted by Chouchou *et al.* ¹ shows that health issues among adults (≥ 18 y.o) during Covid-19 lockdowns are mostly influenced by increasing anxiety, lacking physical activities, and reducing sleeping quality. Research from Browning *et al.* ² points that online learning has caused students (within age range 18-24) to spend more than 8 hours of screen time daily, this impacts on their low physical activities and moderate to high emotional pressure. Online learning has triggered sedentary lifestyle and low physical activity due to their limited mobility. Increasing stress and anxiety caused by activity restrictions during Covid-19 pandemic has also triggered coronasomnia. Coronasomnia is a new term referring to insomnia problem caused by anything related to Covid-19 ³. Thus, work from home policy can be said of having impact on the lack of physical activities and sleeping deprivation among society, particularly students.

Besedovsky *et al.* ⁴ explains that sleeping is important to keep physical health and immune system working effectively. This is important to keep emotional health, stress, depression, and anxiety level. Covid-19 pandemic and work from home policy has caused 55% adults in Asia Pacific (not including Indonesia) of not having well quality sleeping, in which stress has been the main trigger. Average sleeping duration of the respondents is 6.9 hours per day, in which the recommended amount of time should be 7-9 hours per day ⁵.

Several previous research has pointed out relationship between physical activities and sleeping quality. Dugdill *et al.* ⁶ explains that low physical activities have impacted on poor sleeping quality. Based on systematic review conducted by Memon *et al.* ⁷, moderate to high physical activities are related to better sleeping quality. Research from Su *et al.* ⁸ points out that physical activities affect sleeping quality through anxiety and depression as mediating variables. Other research has also pointed out correlations between physical activities with sleeping quality ⁹. Nevertheless, research by Ni Bulan ¹⁰ shows no significance correlation between physical activity during Covid-19 pandemic and students' sleeping quality.

There has been no previous research investigating the level of physical activities, sleeping duration, and sleeping quality of students in East Java during the pandemic. Therefore, this research focuses on describing the level of physical activity, average sleep duration, and sleeping quality of students in East Java during Covid-19 pandemic. This research also aims to prove whether effects are existing between the level of physical activity and sleep duration towards the students' sleeping quality during Covid-19 pandemic.

Quality sleep improves brain cells, impacting on learning behavior, memory, and concentration which are essential for students ². This research is the steppingstone to find out factors influencing students' sleep quality during Covid-19 pandemic and new normal. After factors contributing to students' sleep quality are revealed, new strategies and efforts students need to conform can be developed, in order to improve their overall sleep quality.

2. Factor Influencing Sleeping Quality

Sleeping is one of the basic human needs. During sleeping, deformed cells are regenerated, thus refreshing human body. Quality sleeping is essential to keep both physical and mental health. Sleeping is an unconscious state that can be made conscious through sensory or other stimuli ¹¹. Sleeping is a particular period where our body and mind rest, as all muscles and mind are becoming inactive, despite some bodily activities remain active. Sleeping reduces metabolic pace in around 10-15% due to reduced skeletal muscle tone and nerve system activities ¹².

Processes happening during sleeping has important roles to consolidate memory and emotional memory processing. Emotional dysregulation is highly influenced by poor sleeping quality, which increases emotion and reduces someone's positive response ¹³. Sleeping eases vital organs after a day full of activities where deformed cells are being repaired and brings energy that are needed to perform other activities when someone wakes up. Factors influencing someone's sleep quality are elaborated in the followings, involving both quantitative and qualitative/subjective factors ¹⁴:

- a. Sleep Latency and Efficiency

Latency is the period of time spent between someone starts lying down until sleeping, while sleeping efficiency is the result of sleep duration divided by time spent on the sleeping place. Some aspects are related with sleep latency, such as dark room, the use of electronic devices before sleeping, anxiety, and other psychological issues.

b. Sleep Duration

Sleeping duration may differ between one person to another, and it is influenced by some other factors such as age, where higher age is recommended to have shorter sleeping duration. The recommendation of sleep duration for young adult (range within 18 to 25 years old) is 7 to 9 hours/day.

c. Sleep Deprivation

There are numbers of factors related with sleep deprivation, such as difficulties to start sleeping, unrefreshed feeling during waking up, pain/aching feelings, stresses, and dreams. Several things triggering sleep deprivation are such as stress, lifestyle, shift work (especially late-night shift), drugs consumption, environmental disturbances, and physical activities.

d. Physical Activities

Regulated physical activities may improve sleeping quality and at the same time, reduce stress and other psychological problems. Physical activities belong to the basic functions of human's life needed to fulfil his livelihood. Physical activities are indicated from the existence of human bodily movement resulted from skeletal muscle work by using some amounts of particular energy¹⁵. According to Thomas *et al.*¹⁶, physical activity involves all kinds of movement performed for daily and recreational activities, working, and exercising. Therefore, it can be said that physical activities refer to muscular (and its supports) movements performed in all kinds of activities by using energy in order to adjust weight, improve cardiovascular system and muscle strength, and to reduce stress and other health issues. Physical activities should be essentially perceived as one of the humans daily basic needs, particularly to improve immune system and health. Physical activity may influence someone's sleeping quality. Physical activity triggers the production of DIPS (Delta Inducing Peptide Sleep) protein, which eventually improves sleeping quality¹⁷.

e. Age and Gender

Age and gender influence sleeping quality, where woman and older people tend to have poorer sleeping quality and other sleeping issues.

3. Research Method

The data of this research was collected by questionnaire. The questionnaire itself was inspired and developed based on the literature review. The independent variables were physical activity and sleep duration, while the dependent was sleeping quality.

The questionnaire was divided into four parts, namely screening questions, respondent profile, physical activity, and sleep quality. A judgmental sampling method was utilized to collect data. The screening question section aims to find respondents according to the research criteria: undergraduate students who do online learning, lived in East Java, and have

not experienced health problems for the last seven days. The questionnaire has been tested for its validity and reliability and distributed online by utilizing google form to all respondents. The target respondents are 200 undergraduate students who live in East Java, based on the calculation of the minimum number of samples required (100 respondents) for this study.

In order to precisely measure sleeping quality, Pittsburgh Sleep Quality Index (PSQI) was utilized. This index measures seven aspects involving¹⁴: (1) subjective perception of sleep quality; (2) sleep latency; (3) sleep duration; (4) sleep efficiency; (5) sleep deprivation; (6) the use of sleeping drugs; (7) daytime dysfunction / disturbance caused by poor sleeping quality. Every question from each part is given score 0-3. Scores from those seven parts will then be added with scores ranging between 0-21. The lower the total score, the better the sleep quality. Respondents with total scores of PSQI < 5 can be diagnosed of having quality sleep, while PSQI score of ≥ 5 can be diagnosed otherwise.

Simple and practical measurement of physical activity intended for high amount of respondents can be performed by utilizing questionnaire. The questionnaire that was used to measure someone's physical activity in this research is Global Physical Activity Questionnaire (GPAQ). GPAQ is an instrument originally developed by the WHO to measure society physical activity. There are 16 question items involving three essential aspects: physical activities during working, activities during a trip, recreational activities, and sedentary behavior¹⁸. The result of someone's physical activities through GPAQ can be classified based on the value of Metabolic Equivalent (MET). MET itself is the ratio of metabolical pace at work, compared with the ratio of metabolical pace at rest. One MET refers to the amount of oxygen consumed while sitting down, equivalent with 3.5 ml/kg/minute. MET can be converted into kilocalories, where one MET = 1 kcal/kg/hour. Physical activities are grouped into 3 categories: low (<600 MET minute/week), moderate ($\geq 600 - 3000$ MET minute/week), and high (≥ 3000 MET minute/week).

4. Results and Discussion

4.1. Respondent's Profile

After data screening, 188 respondent data were collected and ready to be processed. From those 188 respondents, mostly are living in Surabaya, Jember, Lumajang, Banyuwangi, Malang, and Sidoarjo. There are 55% male respondents and 45% female. Respondents having normal Body Mass Index (BMI) is in amount of 47.87%, overweight and obese respondents are in amount of 43.62%, and the remaining 8.51 % are categorized underweight. From the perspective of daily screen time, most respondents are having 9-13 hours screen time daily (45.21%), 13-17 hours screen time daily (32.98%), ≥ 17 hours screen time daily (12.77%), and 6-9 hours screen time daily (9.04%). Online learning extends screen time and improves sedentary activities. Table 1 points out respondents' characteristics in this research. The characteristics of respondents are displayed in Table 1, where average age is known to be 20.51-year-old and having BMI in amount of 22.71 kg/m² (normal category). Average sleeping duration is in amount of 6.74 hours. This means that sleeping duration is lower than the normal, as the normal sleeping duration recommended for young adults should be 7-9 hours.

Table 1. Respondents' Characteristics

Characteristics	Average \pm SD*	Range
Age (year)	20.51 \pm 0.899	18.00 - 24.00
Weight (kg)	62.64 \pm 12.77	42.00 - 100.00
Height (cm)	165.49 \pm 8.74	147.00 - 189.00
BMI (kg/m ²)	22.71 \pm 3.34	16.59 - 32.18
Sleep Duration (hour)	6.74 \pm 1.06	5.00 - 9.00

Source: Private Document

SD = standar deviation

4.2. Levels of Physical Activity

Most respondents are categorized of having low physical activity level (51.06%), the amount of respondents performing high level physical activity is 27.66%, and moderate level of physical activity is 21.28%. The implementation of CARE and online learning impact on relatively low physical activities performed by respondents. In order to reveal whether there are differences towards levels of physical activity on the respondents, significant difference test is performed based on the respondents' characteristics. Respondents' characteristics here refer to gender, BMI, screen time, and sleep duration. Mann Whitney Test is performed only if there are two sample groups, and Kruskal Wallis Test, if more than two group of samples exist.

Based on Table 2, it can be inferred that significant difference on physical activity occurs on gender and sleep duration (p -value < .05). The comparison of physical activity based on gender points out that male tends to have higher level of physical activity. Based on sleep duration, the result points out that respondents with 7-9 hours sleep duration have higher level of physical activity.

Table 2. Significant Difference Test of Physical Activity Based on Respondents' Characteristics

Characteristics	Levels	Result
Gender	Male	.016*
	Female	
BMI	Normal	.336
	Above Normal	
	Below Normal	
Screen time	6 - 9 hours	.74
	9 - 13 hours	
	13 - 17 hours	
	\geq 17 hours	
Sleep duration	5 - 7 hours	.027*
	7 - 9 hours	

Source: Private Document

* p < .05

4.3. Sleep Quality

Most of the respondents' sleep quality belongs to poor category (66.49%), while the remaining number (33.51%) can be said of having better sleep quality. Respondents are classified of having better sleep quality if having PSQI value of < 5. Covid-19 pandemic has impacted on overall respondents' poor sleeping quality. This is supported by the result of The Philips 2021 global sleep survey ⁵, which points out that 45% of the respondents have not had quality sleep during Covid-19 pandemic, mainly caused by stress. In order to investigate

whether there are differences on sleep quality level among the respondents, significant difference test on sleep quality is performed based on the respondents' characteristics. Respondents' characteristics here refers to gender, BMI, screen time, and sleep duration. Table 3 points out that significant difference on sleep quality can be found merely on sleep duration (p -value < .05). Thus, the difference on sleep quality level based on the sleeping time points out that respondents who sleep 5-7 hours daily have poorer sleep quality than the ones who sleep 7-9 hours daily.

Table 3. Significant Difference Test of Sleep Quality based on Respondents' Characteristics

Characteristics	Levels	Result
Gender	Male	.251
	Female	
BMI	Normal	.295
	Above Normal	
	Below Normal	
Screen time	6 - 9 hours	.052
	9 - 13 hours	
	13 - 17 hours	
	≥ 17 hours	
Sleep duration	5 - 7 hours	.000*
	7 - 9 hours	

Source: Private Document

* $p < .05$

4.4. Sleep Duration

The result of data analysis points out that 74.47% of the students has sleep duration for 5-7 hours, while 25.53% other has 7-9 hours sleep duration. This can be interpreted that most of the undergraduate students in east Java are having poor sleeping duration. Recommended sleep duration for adults should be 7 to 9 hours a day. In order to investigate whether there are differences on sleep duration level among the respondents, significant difference test on sleep duration is performed based on the respondents' characteristics. Respondents' characteristics here refers to gender, BMI, screen time.

Table 4. Significant Difference Test of Sleep Duration based on Respondents' Characteristics

Characteristics	Levels	Result
Gender	Male	.803
	Female	
BMI	Normal	.175
	Above Normal	
	Below Normal	
Screen time	6 - 9 hours	.003*
	9 - 13 hours	
	13 - 17 hours	
	≥ 17 hours	

Source: Private Document

* $p < .05$

Table 4 points out a significant difference on sleep duration can be found merely on the characteristics of screen time (p -value < .05). The difference result on the sleeping duration based on the duration of screen time shows that respondents who have 6-9 screen time tends to have better sleep quality.

4.5. Regression Analysis

Regression model can be deemed acceptable if it has smaller error prediction. Therefore, a regression model should first and foremost fulfil the requirements of classic assumption testing consisting of normality test, heteroscedasticity test, and multicollinearity test. Based on statistical testing, regression model concerning physical activity and sleep duration towards the students' sleep quality has fulfilled classic assumption testing.

In order to investigate whether the regression can be effectively utilized to predict a dependent variable namely sleep quality, ANOVA test or F-Test is conducted. Based on ANOVA testing (Table 5), significance value (.000) is found to be smaller than α -value (.05), therefore, it can be concluded that the regression model can be utilized to predict sleeping quality of the students.

Table 5. ANOVA Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	396.672	2	198.336	44.397	.000*
Residual	826.451	185	4.467		
Total	1223.122	187			

Source: Private Document

* $p < .05$

T-test is conducted in order to investigate significance towards both constant value and independent variable namely physical activities and sleep duration. Table 6 explains that significance value of sleep duration (.000) and GPAQ (.000) are smaller than α -value (.05). This can be translated that both sleep duration and physical activities variables have negative effect towards sleep quality. The lower physical activities and sleep duration values, the higher sleep quality value (poorer sleep quality).

Table 6. Regression Output

Model	Coefficients	Sig.	R-Square	Adjusted R-Square
(Constant)	17.112	.000*	.324	.317
Sleep Duration	-1.165	.000*		
Physical Activity (GPAQ)	-.910	.004*		

Source: Private Document

* $p < .05$

The final part of regression analysis is observing the ability of independent variable to explain dependent variable. Table 6 points out adjusted r-square value of 31.7 %. This translates that 31.7% variation of the students' sleeping quality can be predicted through the variation of both physical activities and sleep duration, and 68.3% other is influenced by other factors.

4.6. Discussion

CARE and online learning policy during Covid-19 pandemic bring impact towards undergraduate students in East Java, particularly on their low physical activity, sleep duration, as well as sleep duration levels. This research shows that 72.34% of the students has low to moderate physical activity level; 74.47% is lacking sleep duration (5-7 hours); and 66.49% is having poor sleeping quality.

During restriction period of the pandemic, students' screen time is increasing. Ninety-point-ninety-six percent (90.96%) of the students is using gadgets ≥ 9 hours a day. This increase is originated from online learning, knowing that the students are having ≥ 4 hours online classes daily. This of course contributes on their low physical activity, sleep quality, and sleep duration level. The significant difference test result points out that those who have screen time 6-9 hours a day have better sleep quality. Research from Azzi *et al.* ¹⁹ also points out that online learning has contributed on relatively low physical activity level among women in Brazil. The result goes parallel to the result of this research, where male physical activity is found to be higher than female.

The result of this research proves that the students' sleep duration and physical activity possess significant negative effect with their sleep quality. Nevertheless, physical activities possess relatively lower effect with sleep duration, and this can be observed from very small coefficient value of physical activity (0.91).

Sleep duration is among the factors influential towards sleep quality. Lacking sleep triggers hormonal imbalance, which then causes issues on body metabolism, and impacts on poor sleep quality as well. Lacking sleep causes disturbances and resistances towards insulin hormone, increasing leptin, cortisol, and thyroid Stimulating Hormone/TSH ¹². This chain mechanism becomes the reason why sleep duration has significant influence on sleep quality. The significant difference test result also points out that the students who sleeps for 7-9 hours a day, have better overall sleep quality.

Sedentary behavior, stress, and lack of physical activity highly influence students' sleep and life quality ²⁰. Regulated physical activity has positive benefits and influence towards sleep quality; at the same time, it reduces sleep deprivation. Regular physical activity causes exhaustion which eventually triggers DIPS (Delta Inducing Peptide Sleep) protein and helps one's sleep quality becomes better ¹⁷. This means that someone's physical activity influences his sleep quality. The result of this research conforms with the one performed by Iqbal ⁹ and Su *et al.* ⁸, which pointing out that physical activity has significant impact towards sleep quality.

The result of this research has also pointed out the value of adjusted *r-square* in amount of 31.7%. This means that there are still other factors influencing the students' sleep deprivation during Covid-19. Marelli *et al.* ²¹ specifically mentions increasing sleep deprivation and longer sleep latency during the pandemic as the causes of worsening sleep quality. In addition, loneliness, and limitation in performing activities during isolation increase anxiety and fear which improve cortisol, reduce melatonin synthesis, and adjustment in biological rhythm. All of which eventually trigger worse sleep quality. Zhai *et al.* ²² has stated that screen time correlates with sleep quality. Therefore, further research may focus on the addition of other factors influencing sleep quality involving anxiety, depression, and other psychological issues; lifestyle; screen time; drugs consumption; sleep deprivation; and other conditions which become direct consequences of new normal adaptation caused by Covid-19 pandemic.

5. Conclusion

Based on the result, it can be inferred that most undergraduate students in East Java have relatively low to moderate physical activity levels (72.43%), low sleep duration (74.47%), and poor sleep quality (66.49%). The result of regression analysis shows that both sleep duration and physical activity possess significant negative effect towards sleep quality. The variation of the students' sleep quality can be predicted through the variation of both physical activities and sleep duration in amount of 31.7%, while the remaining amount of 68.3% is influenced by other factors.

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