

# Association between Physical Activity Level and Sleep Quality in the Elderly

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## Abstract

**Introduction:** The increase in a person's age may cause degeneration in their physiological system, and these changes can affect various bodily functions, one of them is the sleep-wake cycle. The elderly usually have disturbed sleep-wake circadian rhythm that can cause sleep problems and decreased sleep quality. The action that can be done to increase sleep quality is doing physical activity.

**Methods:** This research used cross-sectional study design. The respondents were people who reside in Komplek Taman Pulo Indah and Perumahan Aneka Elok aged 60 and older and were not included in the exclusion criteria (n = 204). The instruments used were the Baecke questionnaire to measure physical activity level and the PSQI questionnaire to measure sleep quality. Data analysis was done in univariate and bivariate using chi-square test with significance level of  $p < 0.005$ .

**Results:** The prevalence of elderly with low physical activity levels and good sleep quality was 33.8%. Meanwhile, elderly with moderate physical activity levels and good sleep quality was 50%, and elderly with high physical activity levels and good sleep quality was 64,7%. Chi-square test was carried out and resulted in  $p = 0.002$  ( $p < 0.005$ ), which meant the null hypothesis was rejected.

**Conclusions:** There was an association between physical activity level and sleep quality in the elderly.

**Keywords:** elderly - physical activity level - sleep quality - baecke questionnaire - PSQI questionnaire.

## INTRODUCTION

As a person ages, degeneration may affect their physiological system structurally and functionally. These physiological changes affect various tissues, organ systems, and bodily functions, one of them is the sleep-wake cycle.<sup>1,2</sup> During a night sleep, a normal young adult will be awakened about 2-4 times. Meanwhile, the elderly will be awakened more

often. Elderly also tend to sleep and wake up earlier compared to younger individuals. Their sleep-awake circadian rhythms are usually disturbed as well.<sup>3,4</sup>

In addition to affecting the amount of several hormones, disturbances in the sleep-wake circadian rhythm can also cause sleep disturbances and decreased sleep quality.<sup>4</sup> The decrease in the sleep quality of the elderly

can cause excessive drowsiness during the day, leading to interferences in daytime functioning.<sup>5</sup> Poor sleep quality in the elderly can affect their cognitive performances and is a marker for memory impairment.<sup>6</sup>

One of the activities that can help improve sleep quality is physical activity.<sup>7</sup> Physical activity is a variety of body movements produced by skeletal muscles, which result in energy expenditure. Physical activity is divided into four categories: physical activity related to work, domestic activity, transportation, and leisure time.<sup>8</sup>

Research conducted by Yang et al.<sup>9</sup> showed that physical activity positively affected the sleep quality of middle-aged adults and elderly who had sleep disorders. Benloucif et al.<sup>10</sup> also mentioned that exposure to physical activity in the morning or evening consisting of stretch exercise, low-impact aerobic activity, and playing games improved the sleep quality of the elderly. Besides that, according to research by Hartescu et al., low-intensity physical activity could improve the sleep quality of the elderly, and a higher level of physical activity was associated with excellent sleep quality in elderly.<sup>11</sup> This study aimed to determine the association between physical activity level and sleep quality in elderly.

## **METHODS**

### **Study Design**

This study is a cross-sectional analytic descriptive study conducted on July 26 – October 16, 2019. This research was conducted after getting approval from the Ethics Commission of the Faculty of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia (18/07/KEP-FKUAJ/2019).

### **Subject and Sampling Method**

The respondents were elderly aged 60 years old and over who lived in Komplek Taman Pulo Indah and Perumahan Aneka Elok, with the total sample needed was 204 people, divided equally into three groups based on their physical activity level. The sampling was done with the purposive sampling method. The inclusion criteria were respondents aged  $\geq 60$  years and willing to be interviewed. The exclusion criteria were respondents who 1) refused to participate in this study, 2) had the habit of consuming black coffee more than two glasses and black tea more than five glasses every day 3-6 hours before sleep over the past month, 3) consumed sleeping pills, antidepressant drugs, antihypertension drugs (beta-blocker), antihistamine drugs, alcoholic beverages, 4) used air conditioner with the temperature below 20°C, and sleeping with the lights on. The drop-out criteria were

respondents who did not complete the questionnaire.

### **Data Collection**

We used the hand-delivered questionnaire as a data collection method. After getting informed consent, the researcher directly asked respondents for their demographic data and gave several questions to figure out whether the respondents met the requirements to become participants of this study. Baecke questionnaire was used to measure the physical activity level, and the PSQI questionnaire was used for the sleep quality measurement.<sup>12,13</sup>

#### **Baecke questionnaire**

The Baecke questionnaire was developed by Baecke et al.<sup>12</sup> to evaluate daily physical activity. Baecke questionnaire consists of 16 items divided into three categories. Items 1-8 are questions related to physical activity at work, items 9-12 are questions related to physical activity during exercise, and items 13-16 are questions related to physical activity during leisure time. The score for each item ranges from 1-5, except for items 1 and 9.

#### **PSQI questionnaire**

Sleep quality was assessed using the PSQI (Pittsburgh Sleep Quality Index) questionnaire. The PSQI consists of 19 questions that assess various factors related to sleep quality, including estimates of sleep

duration, latency, frequency, and severity of certain sleep-related problems. These 19 questions are grouped into seven components, each of which is scored 0-3. These seven components represent personal sleep quality, latency, duration, habitual sleep efficiency, sleep disturbances, use of sleeping pills, and daytime dysfunction. The sum of each score is defined as the global PSQI score, which has a range of 0-21. a high score indicating poor sleep quality.<sup>13</sup>

### **Statistical Analysis**

The data analysis was performed using SPSS version 23.0 in two ways: univariate analysis to describe and summarize data, and bivariate analysis using the chi-square test with a significance level of  $p < 0,005$ .

## **RESULTS**

Two hundred forty-one samples met the inclusion criteria, but 37 samples were not included in the research because the quota had been exceeded. The median age of the respondent was 65 years old, with the lowest age was 60 years old, and the highest age was 95 years old. The majority of the respondents were female (66.2%). The physical activity level of the respondents was evenly distributed, whereas the low, moderate, and high physical activity levels had the same amount of people, 68 people (33.3%). There was only a small difference between respondents with good sleep quality and poor

sleep quality, where the number of respondents with good sleep quality was 101 people (49.5%), and the number of respondents with poor sleep quality was 103 people (50.5%), see Table 1 below.

**Table 1.** The characteristics of the respondents

Variables	Median (minimum-maximum)		
	n	%	
<b>Age</b>	65 (60-95)		
<b>Sex</b>	Male	69	33.8
	Female	135	66.2
<b>Physical Activity Level</b>	Low	68	33.3
	Moderate	68	33.3
	High	68	33.3
<b>Sleep Quality</b>	Good	101	49.5
	Poor	103	50.5

The result of bivariate analysis using the chi-square test showed that there was an association between physical activity level and sleep quality ( $p < 0.005$ ) (Table 2).

**Table 2.** Association between Physical Activity Level and Sleep Quality in Respondents

Physical Activity Level	Sleep Quality				p
	Good		Poor		
	n	%	n	%	
<b>Low</b>	23	33.8	45	66.2	0,002
<b>Moderate</b>	34	50	34	50	
<b>High</b>	44	64.7	24	35.3	
<b>Total</b>	101	49.5	103	50.5	

## DISCUSSION

The majority of the respondents were female (66.2%), with a median age of 65 years old. This data was in agreement with previously published data of the elderly population in

Indonesia that showed the population of female elderly was bigger compared to male elderly.<sup>14</sup>

In this study, we measured respondents' physical activity level and sleep quality to determine if both variables were associated. Regarding sleep quality, 33.3% of respondents had low physical activity levels, 33.3% with moderate physical activity levels, and 33.3% with high physical activity levels. Interestingly, the proportion of good and poor sleep quality among the elderly was pretty balanced (50.5% vs 49.5%). In comparison with other studies, our findings were lower than the data from the research of Shim and Kang<sup>15</sup>, which showed 59.6% of the elderly had poor sleep quality, and the research by Khasanah and Handayani<sup>16</sup> which found 70.1% of the elderly had poor sleep quality. Many epidemiologic studies suggest that up to 50% of elderly individuals complain about poor sleep quality. Moreover, Vitiello et al.<sup>17</sup> showed a significant proportion of elderly with PSQI scores above 5, where a score above 5 indicates that someone has poor sleep quality. A similar result was encountered by Widyantera et al.<sup>18</sup> which also mentioned that there were more elderly with poor sleep quality compared to elderly with good sleep quality.

Poor sleep quality in the elderly is thought to be caused by physiological changes that occur in the elderly, where the NREM period is shortened, and the elderly are often awakened

from their sleep. Physiological disorders such as depression and anxiety can also cause poor sleep quality in the elderly, where research showed that depression affects the sleep quality of the elderly, and high depression and anxiety scores are associated with lower sleep quality.<sup>15</sup> In the present research, no further examination was carried out to find out whether the respondents had a physiological disorder, so it could not be confirmed if the sleep quality was affected by physiological disorder. There is also a change in circadian rhythm in the elderly that can affect the timing of the sleep period, and a decrease in the circadian rhythm amplitude can cause an increase in the frequency of awakening during the night and aggravate drowsiness during the day, which then can cause a decrease in sleep quality.<sup>19</sup>

The relationship between physical activity level and sleep quality can be seen from the data analysis, where the p-value was 0.002 ( $p < 0.005$ ). It indicated an association between physical activity level and sleep quality in elderly. There were 33.8% of respondents with low physical activity levels had good sleep quality, 50% of respondents with moderate physical activity levels had good sleep quality, and 64.7% of respondents with high physical activity levels had good sleep quality. The data was in line with the research conducted by Wu et al.<sup>20</sup> where respondents who have the habit of exercising or higher

physical activity levels will have a better sleep quality, and research by Sahin<sup>21</sup> showed that the elderly with high physical activity levels had good sleep quality. Another research by Gothe et al.<sup>22</sup> also supported the results of this study, where the elderly with moderate to high physical activity levels had better sleep quality.

Several pathways have been proposed to explain the relationship between physical activity and sleep, but the underlying mechanism is still unclear. Physical activity is thought to affect sleep through antidepressant effects, changes in body temperature, regulation of circadian rhythms, mood and anxiety symptoms, and an increase in energy consumption or metabolic rate.<sup>7,23</sup>

An increase in physical activity can increase the secretion of endogenous opioid peptides and endorphins, which can reduce the symptoms of depression and improve mood, where the symptoms of depression are associated with disturbed sleep, and the reduction in both symptoms can improve sleep.<sup>24,25</sup> An increase in core body temperature that occurs during and after physical activity will be followed by temperature downregulation, which is associated with the deepness of sleep.<sup>26</sup>

The underlying mechanism of physical activity to regulate circadian rhythm has not been clearly explained, but several studies have

shown that physical activity has an effect similar to light stimulus in modifying the circadian rhythm and sleep-wake cycle. In addition to circadian rhythm regulation, changes in skeletal muscles can also affect and regulate hormones, where physical activity can increase the production and release of melatonin which then will cause an improvement in sleep quality.<sup>27</sup> The effect of physical activity on growth hormone and cortisol secretion can induce an increase in glucose usage during REM sleep, an increase in glucose metabolism, and the continuous secretion of growth hormones is thought to cause changes in sleep.<sup>28,29</sup>

This research has several limitations. The data collection only relied on respondents' memory which could lead to recall bias and only measure subjectively. Other limitations include factors that could not be detected by the exclusion criteria questions that can affect the research results, such as the possibility of respondents with psychological disorders that had not been diagnosed.

## **CONCLUSION**

The prevalence of elderly with good sleep quality in Komplek Taman Pulo Indah and Perumahan Aneka Elok is 49,5%. Meanwhile, the prevalence of elderly with poor sleep quality is 50,5%. The prevalence of elderly with low, moderate, and high physical activity levels is each 33,3%. There is an association

between physical activity level and sleep quality in the elderly, wherein the higher the level of physical activity, the better the quality of sleep of the elderly.

Based on the limitations faced by the researcher, it is recommended for future research to add more exclusion criteria and thoroughly interview the respondents to reduce the possibility of factors that can affect the result of the research. Using a more detailed questionnaire like a sleep diary or physical activity diary can be used to prevent recall bias. The use of other measuring tools that can measure objectively, such as actigraphy, can also be used to obtain data more accurately.

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## **CONFLICT OF INTEREST**

No conflict of interest.

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