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## CORRELATION BETWEEN PHYSICAL ACTIVITY AND SLEEP QUALITY IN MEDICAL STUDENTS DURING COVID-19 PANDEMIC

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### ABSTRACT

A downward trend of physical activity level within the population of college students was observed during the COVID-19 pandemic. Various adjustments within their daily habits caused changes to the population's sleep quality and physical activity level. The purpose of this study is to research study the correlation between physical activity level and sleep quality in preclinical medical students in Udayana University. This study was conducted using an analytic cross-sectional method and consecutive sampling technique involving 282 preclinical medical students of Udayana University from academic year of 2018, 2019, and 2020. The data were obtained via the scores of Global Physical Activity Questionnaire and Pittsburgh Sleep Quality Index. The GPAQ score showed that 123 (43.6%), 127 (45%), and 32 respondents (11.4%) respectively had a low, moderate, and high level of physical activity. Meanwhile, the PSQI score showed that 102 respondents (36.2%) had a good sleep quality, and 180 respondents (63.8%) had a bad sleep quality. The average PSQI score of the respondents was 5.23 (cut off = 5). The correlation between the level of physical activity and sleep quality was analyzed using the Chi-Square method and was deemed found in non-significant ( $p = 0.172$ ; 2-sided). The majority of preclinical medical students had low-to-moderate level of physical activity and bad sleep quality. No significant correlation was found between level of physical activity and sleep quality in preclinical medical students during the COVID-19 pandemic. Further studies are needed to determine other factors that might affect physical activity level and sleep quality within the population.

**Keywords :** *Physical Activity Level; Sleep Quality; GPAQ; PSQI; COVID-19*

### INTRODUCTION

During the COVID-19 pandemic, the behavior of sedentary lifestyle within the population of productive young adults had been on the rise due to multiple factors such as lowered discipline, long self-quarantine period, as well as an increase in indolence. College students are one of the most susceptible populations which could be seen from the findings of a decrease in physical activity level and sleep quality within its midst<sup>1,2</sup>. Previous literatures have reviewed the effects of the pandemic on global health from various angles, including direct causes such as physical activity level; sleep quality; depression and anxiety levels, as well as other social factors such as familial issues; unrest caused by misinformation; financial stress; job instability; decreased global economic output; et cetera<sup>1-3</sup>.

To a certain extent, the population of medical students is also likewise affected. In this manner, physical activity level and sleep quality are two simple health indicators that could be used to infer the extent of the effects of COVID-19 within the population. Previous studies have produced results which

that evidenced showed the decrease of physical activity level and sleep quality in students during COVID-19 pandemic<sup>1-5</sup>. It is known from those studies that physical activity and sleep quality had a bidirectional relationship which affected each other both positively and negatively according to specific situations, e.g., a decreased level of physical activity caused a lower sleep quality in young adults, or a higher level of physical activity caused a better sleep quality in older populations, et cetera<sup>1-5</sup>. A study by Zheng et al found that a long period of lockdown and a series of other self-quarantine measures caused the emergence of a sedentary lifestyle, which in turn affected the physical activity level of young adults<sup>4</sup>. Another study by Marelli et al also found that up to 40% of students and university staffs had insomnia after COVID-19 pandemic due to mental stress and other aforementioned causes<sup>5</sup>. At this stage, a lot of changes have made place within the daily lives of people, and therefore, this study aims to further elaborate the relation between physical activity and sleep quality in one of the population of young adults, i.e., preclinical medical students.

According to previous inferences, medical students are affected because of their tight and stressful education schedules, causing the population to be more susceptible to a sedentary lifestyle. Previous studies done in two different medical universities in Indonesia found that the majority of most medical students had low physical activity level and bad sleep quality<sup>6,7</sup>. Therefore, combined with the fact that COVID-19 also causes negative additive effects to daily activities, this study was proposed to discover the correlation between physical activity level and sleep quality in medical students during this period.

## METHODS

### a. Methodology

#### *Study design*

This study used a cross-sectional approach as the main research method.

#### *Subjects recruitment*

The study was approved by Medical Faculty of Udayana University/Sanglah Hospital Denpasar with ethical clearance number 391/UN14.2.2.VII.14/LT/2021. An explanation of the procedures and benefits of the study was conducted on all respondents before the study began via informed consent. Participants in this study were undergraduate/preclinical medical students from academic year of 2018, 2019, and 2020. The eligibility criteria in this study were preclinical students with active status and are willing to participate in the study. Subjects who are currently on an academic leave and/or did not fill in the data as instructed were excluded from this study.

#### *Sampling technique*

Samples were selected through a consecutive sampling method from August to September 2021. All subjects who filled the questionnaires and had been screened through the eligibility and exclusion criteria were included in the study. A total of 282 samples were obtained in this way.

### b. Material and procedure

This study used a cross-sectional approach as the main research method. The study was approved by Medical Faculty of Udayana University/Sanglah Hospital Denpasar with ethical clearance number 391/UN14.2.2.VII.14/LT/2021 B/396/UN14.2.2.V.1/PT.01.04/2021. An explanation of the procedures and benefits of the study was conducted on all respondents before the study began via informed consent. Participants in this study were undergraduate/preclinical medical students from academic year of 2018, 2019, and 2020. The eligibility criteria in this study were preclinical students with active status and are

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Physical activity level and sleep quality were measured through the Global Physical Activity Questionnaire (GPAQ) and Pittsburgh Sleep Quality Index (PSQI) respectively.<sup>8,9</sup> The physical activity level was determined through the calculation of the participants' Metabolic Equivalent of Task (MET) per week according to the GPAQ. The intensity of the physical activity level is divided into low, moderate, and high using the criteria provided by the World Health Organization (WHO). On the other hand, the overall sleep quality was determined by PSQI through the total sum of seven components, i.e., sleep duration; sleep disturbance; sleep latency; daytime dysfunction; sleep efficiency; subjective sleep quality; and the use of sleeping medication. Each component can score at minimum 0, and maximum 3. The participants with a total score of less than five were categorized into subjects with good sleep quality, while participants with a total score of more than five were categorized into subjects with bad sleep quality. All data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26, in which One-way ANOVA and Chi-square Test were used to find the corresponding p-value between sleep quality and physical activity level.

## RESULTS

This study was done via online means. The questionnaires were distributed to medical students in the academic year of 2018, 2019, and 2020 through google form. The online form was open from August to September 2021, and a total of 326 people had responded. After the eligibility criteria were applied, 44 respondents were removed from the study due to incomplete and/or incorrect data inputs. Thus, a total of 282 samples was included in this study. The sample distribution can be observed in the table below.

Table 1. Sample distribution based on academic year and gender

| Variable      |        | Frequency (n) | Percentage (%) |
|---------------|--------|---------------|----------------|
| Academic year | 2018   | 121           | 42.9           |
|               | 2019   | 56            | 19.9           |
|               | 2020   | 105           | 37.2           |
| Gender        | Male   | 99            | 35.1           |
|               | Female | 183           | 64.9           |
| Age           | 18     | 17            | 6.0            |
|               | 19     | 88            | 31.2           |
|               | 20     | 76            | 26.9           |
|               | 21     | 91            | 32.3           |
|               | 22     | 10            | 3.6            |

From Table 1, it could be seen that the subjects were divided into groups of academic year and gender. The number of subjects from year 2018 was the highest with 121 people (42.9%), followed by year 2020 with 105 people (37.2%), and year 2019 with 56 people (19.9%). The majority of the respondents were females compared to males, with a number of 183 people (64.9%) and 99 people (35.1%) respectively.

Table 2. Physical activity level frequency based on academic year and gender

| Physical Activity Level | Academic Year |            |            | Gender     |            |            |
|-------------------------|---------------|------------|------------|------------|------------|------------|
|                         | 2018          | 2019       | 2020       | Male       | Female     |            |
| Low                     | 123 (43.6%)   | 50 (41.3%) | 29 (51.7%) | 44 (41.9%) | 40 (40.4%) | 83 (45.4%) |
| Moderate                | 127 (45%)     | 57 (47.1%) | 21 (37.5%) | 49 (46.7%) | 44 (44.4%) | 83 (45.4%) |
| High                    | 32 (11.4%)    | 14 (11.6%) | 6 (10.7%)  | 12 (11.4%) | 15 (15.2%) | 17 (9.3%)  |

According to Table 2, 123 respondents (43.6%), 127 respondents (45%), and 32 respondents (11.4%), had a low, moderate, and high level of physical activity respectively. When viewed from the variable of academic year, it could be seen that the proportions of physical activity level in each group were similar. The table showed that the majority of the respondents had low-to-moderate levels of physical activity.

Table 3. Sleep quality frequency based on academic year and gender

| Sleep Quality | Academic Year |          |            | Gender     |            |             |
|---------------|---------------|----------|------------|------------|------------|-------------|
|               | 2018          | 2019     | 2020       | Male       | Female     |             |
| Good          | 102 (36,2%)   | 40 (33%) | 24 (42.9%) | 38 (36.2%) | 40 (40.4%) | 62 (33.9%)  |
| Bad           | 180 (63,8%)   | 81 (67%) | 32 (57.1%) | 67 (63.8%) | 59 (59.6%) | 121 (66.1%) |

From Table 3, it could be seen that the majority of preclinical medical students had a bad sleep quality. The average score of PSQI in preclinical medical students was 5.23 (cut-off value = 5). From 282 total population, 102 respondents (36.2%) had good sleep quality, while the other 180 respondents (63.8%) had bad sleep quality. The highest percentage of respondents with bad sleep quality was found in the academic year of 2018, which covered 81 respondents or 67% of its own population proportion.

Table 4. Sleep quality based on different levels of physical activity levels

| PSQI Component             | Physical Activity Level (SD) |             |             | P value |
|----------------------------|------------------------------|-------------|-------------|---------|
|                            | Low                          | Moderate    | High        |         |
| Subjective Sleep Quality   | 1.03 (0.71)                  | 0.98 (0.67) | 0.91 (0.73) | 0.63    |
| Sleep Latency              | 0.76 (0.83)                  | 0.98 (0.95) | 1.00 (0.88) | 0.09    |
| Sleep Duration             | 1.27 (0.83)                  | 1.21 (0.77) | 1.38 (0.90) | 0.58    |
| Sleep Efficiency           | 0.02 (0.15)                  | 0.02 (0.12) | 0.06 (0.24) | 0.31    |
| Sleep Disturbance          | 0.73 (0.44)                  | 0.87 (0.33) | 0.81 (0.39) | 0.01    |
| Use of Sleeping Medication | 0.05 (0.33)                  | 0.06 (0.35) | 0.00 (0.00) | 0.61    |
| Daytime Dysfunction        | 1.25 (0.73)                  | 1.31 (0.66) | 1.13 (0.70) | 0.41    |
| Global PSQI Score          | 4.96 (2.13)                  | 5.46 (2.16) | 5.34 (2.13) | 0.17    |

Table 4 showed the results of sleep quality based on different levels of physical activity among the subjects using the One-way ANOVA test. Between the groups, only the score of sleep disturbance differed significantly according to the level of physical of physical activity ( $p < 0.05$ ). Similar results of global PSQI score were observed, although the p-value shown were not statistically significant. also seen within the other groups .

Table 5. Cross tabulation between physical activity level and sleep quality

| Physical Activity Level | Sleep Quality |            | Total | P value |
|-------------------------|---------------|------------|-------|---------|
|                         | Good          | Bad        |       |         |
| Low                     | 51 (41.5%)    | 72 (58.5%) | 123   |         |
| Moderate                | 43 (33.9%)    | 84 (66.1%) | 127   |         |
| High                    | 8 (25%)       | 24 (75%)   | 32    |         |
| Total                   | 102           | 180        | 282   | 0.172   |

Table 54 showed the results of cross tabulation between physical activity level and sleep quality, which explained the correlation within the two of them. In preclinical medical students with low physical activity level, 51 subjects (41.5%) had a good sleep quality and 72 subjects (58.5%) had a bad sleep quality. In the group of students with moderate physical activity, 43 subjects (33.9%) had a good sleep quality and 84 subjects (66.1%) had a bad sleep quality. Meanwhile, for students with high physical activity level, 8 subjects (25%) had a good sleep quality and 24 subjects (75%) had a bad sleep quality. The cross tabulation showed an inverse curve in the relation between physical activity level and sleep quality. The results were then analyzed via Chi-square function in SPSS 26, and the p value obtained was 0.172. Therefore, there was no significant correlation between physical activity level and sleep quality in preclinical medical students during COVID-19 pandemic.

## DISCUSSION

The results of this study showed that the majority of preclinical medical students in Udayana University during COVID-19 had a low-to-moderate level of physical activity. After the scores of GPAQ were calculated according to the definition of MET from World Health Organization (WHO), it was found that 123 respondents (43.6%), 127 respondents (45%), and 32 respondents (11.4%) had a low, moderate, and high level of physical activity respectively.

The proportion of respondents with high level of physical activity was higher in the males (15.2%) compared to the females (9.3%), although. no significant statistical differences were found when physical activity level was observed from the aspect of gender academic year (Pearson's  $r = -0.07$ ). The respondents were also tested on the matter of subjective perception involving individual physical activity level before and after COVID-19 pandemic hit through the question, "Have you felt that your daily activities were more sedentary (lowered physical activity) during the COVID-19 pandemic compared to before?" The result of the subjective questionnaire showed that 38 respondents (13.5%) said "Maybe," 28 respondents (9.9%) said "No," and the other 216 respondents (76.6%) said "Yes." These findings were consistent with the research result of Zheng et al in 2020, where it was found that there was a downward trend of physical activity level in the population of young adults (average age = 21.1 years old;  $SD \pm 2.9$ ) up to 72.3% ( $n=621$ )<sup>4</sup>. This inactive behavior was thought to be a result of

travel restrictions due to the emergence of COVID-19 pandemic. Other related factors such as stay-at-home orders, social distancing, and quarantines also had visible effects to the willingness of people to do physical activities, thus causing the escalation of widespread sedentary lifestyle, which in turn caused a lower level of physical activity during COVID-19 pandemic <sup>8,9,10,11</sup>.

When observed from the aspect of sleep quality, it was found that 102 respondents (36.2%) had a good sleep quality, and 180 (63.85%) respondents had a bad sleep quality. The population of females (66.1%) had a higher proportion of subjects with bad sleep quality compared to males (59.6%), although the difference was not significant. The average score of PSQI in preclinical medical students was 5.23 (cut-off = 5), signifying that a greater portion of the subjects enrolled the majority of them truly had a bad sleep quality. From the scores of the individual PSQI components, it can be seen that the students had a relatively lower score on sleep efficiency and the use of sleeping medication.

From the scores of PSQI, many medical students had a slightly worse performance in sleep latency, sleep duration, sleep disturbance, and daytime dysfunction. On the other hand, the scores of sleep efficiency and the use of sleeping medication were relatively ordinary.

This phenomenon in preclinical medical students was also researched by Wondie et al and Bianca et al in two different universities. In the research results of Wondie et al, the proportion of medical students in Ethiopia (n=576) with bad sleep quality was as high as 62% of its total population (95% CI; 57.9%-65.3%) and was associated with level of depression; stress level; sleep routines; and a poor social condition.<sup>12,10</sup> Meanwhile, in Bianca et al's research, it was also found that in the population of preclinical medical students in Udayana University, 60 (58.3%) out of 103 subjects had a bad sleep quality <sup>7</sup>.

When paired with the situation during COVID-19 pandemic, it is evident that a change within daily lives' structure and schedules had varying amounts of negative effects toward overall health condition, viewed from the physical and mental aspects. A study that compared sleep quality and mental health in 63 countries reported that 50% (n=1745) of its participants experienced a lower sleep quality compared to pre-COVID-19 era and had negative reactions toward words that were associated with financial abilities <sup>3</sup>. Various studies had reported that people with bad sleep quality had a high level of anxiety, depression, as well as moderate stress after linked with other individual factors, e.g., loneliness, financial difficulties, and human-to-human relationships <sup>3,8,10,13,14</sup>.

Similar results were also obtained in a study that was conducted in England, where the policy of lockdown was applied in response to the incidence increase of COVID-19 cases <sup>15</sup>. Although public health at the national stage got better concerns improved after the policy was in effect, the social condition within the population became more complex as stable channels of income continued to decrease was affected as a consequence of unrest. The changes in daily schedules, the stigma of acquiring COVID-19, and fears related to job termination were correlated with a worsening mental health level, which caused a rise in unhealthy behaviors, for example, higher consumption of alcohol, irregular diet, lowered sleep quality, and physical inactivity. This multifactorial problem was then correlated with a bad mental health outlook, thus creating a negative feedback loop causing public health problems.

In this study, the data of physical activity level and sleep quality were analyzed using SPSS, where it was found that the distribution of the data were abnormal. The correlation between the two variables were tested using Chi-square test and the p value obtained was 0.172, meaning the data were not statistically significant. Therefore, there was no correlation found between physical activity level and sleep quality in preclinical medical students during COVID-19 pandemic. This result could be modified by other variables such as education level, profession, age group, economic level, et cetera.

As a comparison, there was a study in Japan that evaluated physical activity level by comparing it with subjective health perception and sleep quality <sup>14,16</sup>. The result of the research that involved 1410 people

from age 20 to 86 showed that routine physical activity was correlated with better subjective health perception and sleep quality in middle-aged population. However, the same study also noted that there was no significant correlation found in the young and old populations. A study by Diniz et al that involved 1874 adult volunteers (average age 38.30 years old; SD  $\pm$ 13.09) further corroborated that bad sleep quality was correlated with a decreased frequency of physical activity level, rather than a person's physical activity level itself<sup>15</sup>. A disruption in daily physical exercise routine increased the risk of sleep disturbance up to 1.5 times the normal value, causing a lowered sleep quality within the population.

Thus, the COVID-19 pandemic could be said to have an all-encompassing negative effect on global health. In its relation with physical activity, a sudden change in exercise routine may cause problems on the body viewed from the neuromuscular, cardiovascular, as well as metabolic aspects, e.g., the decrease of lean body mass and an increase in visceral adipose tissue. Other than that, sociodemographic differences which covered age, body mass index (BMI), ethnicity, and living environment also caused variations toward a person's physical activity level and sleep quality. Other studies had also hinted that sleep quality was affected by a certain range of physical activity intensity and routine, denoting that its correlation with physical activity level did not adopt a linear growth curve model. Further studies in this topic are required to ascertain the specific range and relationship. Therefore, in the meantime, it can be concluded that physical activity level could not be directly correlated with sleep quality in preclinical medical students during COVID-19, but instead, other considerations such as daily exercise routines and sociodemographic factors also contributed to it.

This research study used online means via google form to distribute the questionnaires to preclinical medical students in the academic year of 2018, 2019, and 2020 at Udayana University during COVID-19 pandemic. Therefore, the researchers could not monitor the process when the students were filling out the questionnaires which might result in a selection bias. Other social factors such as education level, profession, age group, and economic level might also play a part in determining the end result.

## CONCLUSION

According to the research results, the majority of the preclinical medical students in Udayana University had a low-to-moderate level of physical activity and a bad sleep quality. A larger part of the students also had bad sleep quality, where the average score of PSQI across all subjects was found to be higher than the cut off value. In preclinical medical students at Udayana University, only sleep efficiency and the use of sleeping medications were relatively ordinary. The correlation between physical activity level and sleep quality were tested via Chi-square test, and the p value obtained was 0.172, meaning there was no significant correlation between the two variables. This result could be affected by other individual components, i.e., sociodemographic factors and mental health condition.

Further studies are required to elucidate the correlation between physical activity level and sleep quality. Current researches have pointed out that various factors within physical activity such as duration, routine, and intensity might have different correlations with the average sleep quality. It might be good for medical students to pay attention to their workload and rest, as well as daily exercises to maintain their health. In the future, it is hoped that further researches would consider the possibility of other factors that may affect the correlation between physical activity and sleep quality.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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