

The Influence of Quality of Sleep and Physical Activity on Physical Fitness

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Abstract: This research intends to investigate the effect of sleep quality and physical activity on cardiorespiratory fitness of students of Faculty of Sports Science (FIK) UNY. The research method used was survey which used questionnaire and measurement tests. The measurements involved several instruments: Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep quality; Global Physical Activity Questionnaire (GPAQ) was used to measure physical activity; multi stage fitness test was used to measure cardiorespiratory fitness. The research population was FIK students. Data analysis technique employed regression test. The research result indicates that both sleep quality and physical activity have a significant effect on physical fitness.

1 INTRODUCTION

Recently, the development of technology and economic globally are facing very rapid changes marked by emergence of industrial revolution 4.0. The industrial revolution 4.0 begins in this century. These technological and economic development have both huge positive and negative impacts on humans. Positively, of course, humans can easily access broader insights, get more modern knowledge from scientific studies, and be helped in daily activities. Technology and health have huge influence. The field of technology develops rapidly and it seems that humans can be 'harmed' by the ease of using technology; convenience offered by it causes people to be lazy to move so that they tend to be more sedentary.

The above phenomena also affect children. The rapid development of technology makes elementary school students tend to be lazy to move. World Health Organization (WHO) states that non-communicable diseases become global problems in the world. Lack of physical activity is one of the causes of non-communicable diseases, including diabetes mellitus, heart disease, stroke, kidney disease, and cancer. These diseases today are the highest factors causing death and unfortunately, the occurrences are always increasing.

Riskerdas's research shows that non-communicable diseases and their prevalence tend to

decrease (asthma), but for other non-communicable diseases, they tend to increase. Cancer in Special Region of Yogyakarta (DIY province) ranks first with 4.9%, stroke (14.7%). DIY is ranked second for kidney failure (38.7%) after Jakarta, while for diabetes mellitus, DIY is ranked second (Indonesia Ministry of Health, 2018). Non-communicable diseases are seen from proportion of overweight and obesity in adolescents, with age ≥ 18 in 2007 up to 2018 experiencing an increase. The increase of overweight in 2007 is 8.7%, 11.5% in 2013, and 13.6% in 2018. While for obesity, in 2007 amounted to 10.5%, in 2013 amounted to 14.8%, in 2018 took 21.8% (Ministry of Health, 2018).

93.6% of Indonesian people consume less vegetables and fruits. 48.3% of Indonesian people over 10 years old lack physical activity (based on Health Research and Development Agency, Ministry of Health, 2013). The percentage of women who lack physical activity is 54.4%, higher than men who have the percentage of 41.4%. In addition, these results also strengthen that urban areas have greater percentage (57.6%) compared to rural areas (43.3%). Data from Basic Health Research 2013 (Riskesdas, 2013) show that in Indonesia, the proportion of population aged ≥ 10 years classified as having less physical activity is 26.1%. Furthermore, there were 22 provinces which exceeded that number. The five highest are DKI Jakarta (44.2%), Papua (38.9%), West Papua (37.8%), Southeast Sulawesi, and Aceh (37.2%). For Special Region of Yogyakarta, the

proportion of population who have less physical activity is 20.8%.

The research results are supported by the condition of children who do more sitting activities than other activities. The term 'sitting is the new smoking' refers to sitting for a long time which can cause someone to get metabolic syndrome like smoking. Even when adults meet physical activity guidelines, sitting for long period of time can disrupt metabolic health. Sitting too long in car can increase the risk of death (Owen, Healy, Matthews, and Dunstan, 2010). Children have high prevalence rates of overweight and obesity (Cardon, De Craemer, De Bourdeaudhuij, and Verloigne, 2014). One of possible causes is lack of physical activity. This is also reinforced by WHO which states that physical activity is fundamental in achieving energy balance and weight control. Physical activity reduces the risk of heart disease by 30%, diabetes by 27%, and breast and colon cancers by 21% 25% (WHO, 2017).

Lack of physical activity is a main cause of death. The development of technology also causes children and adolescents to spend more time on smartphones until late night, causing poor rest patterns (reduced sleep quality). Low sleep quality and physical activity can influence someone's physical fitness levels. Physical fitness is one indicator to assess whether someone is fit or not. A person who has good fitness is someone who can perform daily activities well and without suffering excessive fatigue. Thus, from the above problems, the quality of sleep and physical activity are shown to be important in everyday life and they influence cardiorespiratory fitness. Based on that, this research intends to determine the effect of sleeping quality and physical activity on cardiorespiratory fitness of Faculty of Sport Sciences of Universitas Negeri Yogyakarta (FIK UNY) students.

2 THEORETICAL REVIEW

2.1 Quality of Life

Individuals are required to fulfill basic human needs in order to maintain their life. One of the basic needs that human need is sleeping. Sleep is basically needed by everyone. Sleep is an unconscious state when individual is awakened by giving stimuli (Guyton and Hall, 2007). Sleep is a condition when the recovery process for body and brain occurs and is very important for achieving optimal health (Maas, 2011). Everyone needs to have adequate sleep so the body can function normally. Sleep is one of the important

factors for basic human physiological needs. Sleep needs are included in physiological needs or primary needs which are basic requirements for human survival and this depends on the quality of sleep. Sleep quality will affect someone's psychological and physical health; low sleep quality makes daily life more stressful or causes someone to become less productive.

Sleep needs of each individual varies, depending on their age. Each individual must fulfill his/ her sleep needs so that he/ she can do activities well. Sleep quality is where a person can easily start sleeping and maintain his or her sleep. A person's sleep quality can be described by the length of sleep and complaints that are felt during sleep or after waking up. Adequate sleep needs are determined by sleep quality and sleep hours factor. Furthermore, some of factors that affect sleep quality are physiological, psychological, environmental, and lifestyle factors. Physiological factor has impacts, such as decrease in daily activities, fatigue, weakness, decreased endurance and instability of vital signs (Potter and Perry, 2010).

Whether someone is able to sleep or not is influenced by several factors (Chen, et. Al., 2016) as follows: (1) Health Status, Someone who has healthy body is able to sleep well, while those who is not healthy, being able to sleep well will be challenging; (2) Environment, The environment can have influence on someone' sleep. Clean environment, cold temperatures, calm atmosphere, and adequate lighting will facilitate a person to sleep well, and vice versa, dirty environment, hot temperatures, crowded atmosphere, and very bright lighting lead to worse quality of sleep; (3) Psychological Stress, Anxiety and depression will cause sleep frequency disorder. This is because anxious conditions increase blood norepinephrine through sympathetic nervous system. This substance will reduce NREM and REM Stage IV: (1) Diet, Foods that contain lots of L-tryptophan such as cheese, milk, meat, and tuna can cause someone to sleep easily. Conversely, drinks containing caffeine or alcohol will cause sleep disorder; (2) Lifestyle, Fatigue felt by someone can also affect quality of his/ her sleep. Suffering from middle level fatigue, people still can sleep well, whereas excessive fatigue will cause shorter period of REM (Rapid Eye Movement) sleep; (3) Medicine, Consuming medicine affects someone's sleep. Drugs may increase the arcing of noradrenergic neurons which stimulates real sleep decrease in REM sleep (neuron REM-off) and increases wakefulness.

2.2 Physical Activity

Physical and health activities have very close correlation and are the basis when a child or adult can enjoy daily physical activity (Weiyun Chen, et al., 2016). High level of physical activity will have influence at the end of life when it is associated with the risk of several chronic diseases and all causes of death (Nelson, et al., 2007). A person who has passive lifestyle or is not physically active is prone to diabetes and other diseases that can cause death (Tao Chen, et al., 2015). The results of Taras's study (2005) reveal that physical activity will improve learning achievement. Physical activity is related to improving overall health and can improve socialization and mental health skills.

2.3 Physical Fitness

Cardiovascular endurance is the ability of a person to do physical activities in relatively long time with sub-maximal weight (Nurhasan, 2005). Cardiovascular endurance is the ability of lungs, heart, and blood vessels to convey oxygen and nutrients to cells to meet the needs of physical activity that lasts for a long time (Hairy, 2007). Cardiovascular fitness is very important to support muscle work by taking oxygen and channeling it to all active muscle tissues, so that it can be used for metabolic processes. Therefore, cardiovascular fitness is considered the most basic component of physical fitness and the most important component that must be improved so that physical fitness is always in a good condition (Hairy, 2007). Cardiorespiratory endurance is the ability of the heart and lungs to take oxygen and deliver the amount of oxygen adequately to working muscles used in performing activities that involve large amount of muscles (for example: running, swimming and cycling) for a long time. Based on the opinions above, it can be concluded that what is meant by cardiovascular endurance is the ability of the heart and lung muscles to supply oxygen optimally throughout body in relatively long time. This means that functional cardiovascular can improve quality of life.

Department of National Education (Depdiknas, 2000) states that factors which affect heart and lungs endurance are as follows: (1) heredity (Genetic), From research conducted, it is concluded that 93.4% ability of $VO_2 Max$ is determined by genetic factors which can only be changed by training/ exercise. Genetic factors that play role can distinguish capacity of heart, lungs, red blood cells, and hemoglobin; (2) Age, from children up to about 20 years old age, the

endurance of heart (cardiovascular) increases. It then reaches its maximum limit on the age of 20-30 years. The endurance is then inversely proportional to the age, meaning that people who are 70 years old have resistance of 50% of those who are aged 17 years old. This is caused by the decrease in the organ transport and the use of O_2 as the results of increasing age. However, this decline can be reduced if people do aerobic exercise; (3) Sex, until the age of puberty, there is no difference in pulmonary heart endurance (cardiovascular) between men and women. After that age, the women endurance is 15-25% lower than men. This difference is caused by difference in maximal muscular power related to body surface, body composition, muscle strength, hemoglobin amount, lungs capacity, and so on; and (4) Physical activity, rest in bed for 3 weeks will reduce heart's endurance (cardiovascular). Doing aerobic exercise for 8 weeks after rest shows an increase in endurance of the lungs and heart. The type of physical activity will affect the capacity of higher cardiovascular endurance compared to those who do gymnastic and fencing. In obese patients, directed physical activity also increases physical fitness in addition to weight loss.

Various types of tests to measure endurance of heart and lungs or cardiovascular endurance as follows (Suharto, et al., 2000): (1) 4,800-meter Brisk Test, the 4800-meter brisk test aims to measure ability and willingness of someone's physical work. This method measures travel time needed to complete 4,800-meter brisk walk (fast walking). On the 4,800-meter brisk test, several officers are required, namely the officer who gives the sign to start; some timekeepers; several field supervisors; security officers; health workers; liaison officer; general assistant. For timekeepers, the number is adjusted to the needs. Facilities and infrastructure needed include 4,800-meter flat line / track; stopwatch or other time meter that can show time, either hours, minutes, or seconds; start flag; chest number, form and stationery; and other supporting infrastructures. In this test, there are several requirements that must be met by participants and its organizer. For the participants, their ages must be over than 13 years old, having healthy condition, prepared for the test, and wearing sport clothes. The test should be done in the morning, no more than 11.00 a.m. In term of the rules, the participants should walk as fast as possible, but they are not allowed to run; during the test, participants are not allowed to stop or take a rest; (2) 2,400-meter run test, the aim of 2,400-meter run test is to measure ability and readiness of someone's physical works. This method measures travel time

required to complete 2,400-meter run. Almost the same as brisk test, it requires several officers, namely the officer who gives the sign to start; some timekeepers; several field supervisors; security officers; health workers; liaison officer; general assistants. For timekeepers, the number is adjusted to the needs. The facilities and infrastructure needed include 2,400-meter flat track / lane; stopwatch or other time meter that can show time, either hours, minutes, or seconds; start flag; chest number, form and stationery; other supporting infrastructures. In this test, there are several requirements that must be owned by participants and its organizers. For the participants, their ages must be over than 13 years old, having healthy condition, prepared the test, and wearing sport clothes. The test should be done in the morning, no more than 11.00 a.m. In term of the rules, the participants should walk as fast as possible, but they are not allowed to run; during the test, participants are not allowed to stop or take a rest; (3) Harvard Step-ups Test, this test is the oldest measurement (made by Brouha in 1943) which is used to determine aerobic ability, or sometimes called as heart-lungs ability, cardiovascular endurance, aerobic power, cardiovascular endurance, cardio respiration endurance, and aerobic fitness (they all have the same meaning). The purpose of this test is to measure the ability or readiness of one's physical works. Equipment needed include: 19-inch Harvard bench for male and 17 inches for female; stop watch to record the time; metronome to adjust up and down rhythm; stethoscope to count the pulse (or fingers if there is no stethoscope); form/ table and stationery; and (4) MFT (Multistage Fitness Test), Junusul Hairy (2007) states that the most appropriate way to find out components of endurance is through tests. One of the field tests used to find out VO_2 Max level is by multistage test. Multistage Fitness Test (MFT) is a type of endurance test that aims to determine VO_2 Max. In Indonesia, people usually call it Tung Test (Bleep Test). Unit of this test is cc/ Kgbb/ minute.

This research employed the MFT (Multistage Fitness Test) as cardiovascular endurance test.

3 RESEARCH METHOD

3.1 Research Design

The research employed survey method in the form of correlational research type that aimed to find out the correlation between sleep quality, physical activity and physical fitness.

3.2 Research Subject

The population of the research was the students of Faculty of Sport Sciences. Sampling technique used was random sampling. Number of samples was 194 students.

3.3 Instrument and Data Analysis Technique

The sleep quality instrument employed in this study is Pittsburgh Sleep Quality Index (PSQI), physical activity and Global Physical Activity Questionnaire (GPAQ), while the instrument for cardiorespiratory fitness employed multistage fitness test. The data were analyzed by using multiple regression analysis.

4 RESULTS AND DISCUSSION

4.1 Prerequisite Test

The prerequisite test results which employed normality test shows that the data were normally distributed with $\alpha = 0.584 > 0.05$. Another prerequisite test employing heteroscedasticity test shows that there is inequality of variance from the residual for all observations in regression model. If $\text{Sig} < \alpha$, it means that there is heteroscedasticity, while if $\text{Sig} > \alpha$, this means that there is no heteroscedasticity. The analysis shows that sleep quality $\text{sig} = 0.620 > 0.05$ which implies that heteroscedasticity did not occur. The result of physical activity test shows that $\text{sig} = 0.495 > 0.05$, meaning that there is no heteroscedasticity. Furthermore, residual assumption was normally distributed; multicollinearity did not occur; heteroscedasticity did not occur; the regression equation was feasible.

4.2 Hypothesis Test

Regression tests shows that the correlation coefficient between sleep quality and physical fitness = -0.083 and $\text{sig} = 0.011$ with $\text{Sig} < \alpha$ ($0.011 < 0.05$). It means that sleep quality has a significant effect on physical fitness. Negative correlation coefficient (-0.083) means that the higher the sleep quality score is, the lower the physical fitness score is (VO_2 Max), whereas the lower the sleep quality score is, the higher the physical fitness score (VO_2 Max) is.

Based on the study, correlation coefficient between physical activity and physical fitness is =

0.290 and $\text{sig} = 0.000$ with $\text{Sig} < \alpha$ ($0,000 < 0,05$). It means that physical activity has a significant effect on physical fitness. The positive correlation coefficient (0.290) means that the higher the physical activity score (MET) is, the higher the physical fitness score (VO2 Max) is, and the lower the physical activity score (MET) is, the lower the physical fitness score (VO2 Max) is.

Linearity test for physical fitness and sleep quality shows $\text{Sig} > \alpha$ ($0.953 > 0.05$), indicating that physical fitness data and sleep quality data are in a linear relationship. Moreover, linearity test for physical fitness and physical activity shows $\text{Sig} > \alpha$ ($0.053 > 0.05$), implying that physical fitness data and physical activity data is also in a linear relationship.

The correlation coefficient of sleep quality and physical activity simultaneously with physical fitness = 0.327 and F count = 11,457 with $\text{sig} = 0,000$. $\text{Sig} < \alpha$ ($0,000 < 0,05$), indicating that the quality of sleep and physical activity have a significant effect on physical fitness. The brief explanation of it can be seen in the figure below.

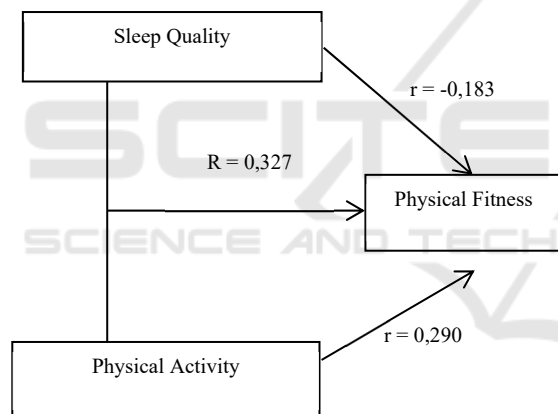


Figure 1: The effect of sleep quality and physical activity on physical fitness

4.3 Discussion

In essence, there is a correlation between physical activity and sleep quality. Regular physical activity results in faster and better sleep (Nelson, 2007). Physical activity and light exercise are healthy activity which cause someone to fall asleep. Exercise and fatigue can affect quality and quantity of sleep because fatigue suffered from high activity can require someone to have more sleep so as to maintain energy balance that has been released. People who have done activities and suffer fatigue will be able to fall asleep faster because the slow-wave sleep phase (NREM) is shortened (Hidayat, 2007).

Sleep relieves works of vital organs during daily activities. Cells damaged during works are repaired and when someone awakens, his or her body regains energy to do next activities. Someone who has good sleep quality will also have good performance on his/her physical activities. Once the energy has been fulfilled, people can do exercise and their fitness stays well. On the other hand, if someone has poor sleep quality, he or she will experience barriers in performing physical activities. Loss of sleep can cause difficulty in concentrating, changes in bodily, mental and emotional functions (Hardinge and Shryock, 2001). This can lead to obstruction of physical activity which should be done properly. Even if a person can do exercises with poor sleep quality, his/ her appearance will be different from those who have good sleep quality. Lack of sleep results in decrease in someone's physical and mental health, such as excessive fatigue, pain, anxiety, depression, and decreased quality of life (Anderson, 2003). Someone who is in the long run experiences of sleep disorder can possibly damage his/ her body or increase the risk of heart attack (Barnard, 2002).

Sleep quality and physical activity can affect someone's physical fitness. Physical fitness is one indicator to assess whether someone is fit or not. Someone is considered to have good fitness if he or she can do daily activities well and does not suffer excessive fatigue. Cardiovascular fitness is very important to support muscle's work by taking oxygen and channeling it to all active muscle tissues, so that it can be used for metabolic processes. Therefore, cardiovascular fitness is considered the most fundamental component of physical fitness and the most important component that must be improved so that physical fitness is always in a good condition (Hairy, 2007).

The purpose of performing physical activities is to improve health status, maintain fitness, and prevent disease. One's bustle causes lack of physical activity which can trigger diseases such as heart disease, high blood pressure, and stroke (Griwijoyo, 2013). On the other hand, busy activities cause someone to suffer fatigue which affects his or her sleep quality. The higher the level of fatigue suffered by someone, the better the quality of sleep he or she has (Safriyanda, 2015). Results of a study conducted by Safaringga (2018) regarding the correlation between physical fitness and sleep quality of the last semester students of physical education program show that physical fitness can adequately affect one's sleep quality and vice versa, if the physical fitness level is not good, one's sleep quality will decrease. Furthermore, based on the results of the study, the level of physical fitness

of the majority of the students (24 students) is in unfit category (63.2% of the population), while 12 students (31.6%) are below the average level and the remaining (2 students or 5.2% of the population) are not very fit. The factors which influence the result are the lack of exercise and quality of sleep. From the research results, the number of students who had average quality of sleep and severe problems is 28 (73.7%). They had poor sleep quality which means that they experienced severe problems. While the remaining 10 students (26.3%) faced medium problems. Students' poor sleep quality is influenced by physical activity factors; students who are in their last semester rarely do physical activities or sports.

Sleep quality and physical activity have influence on someone's physical fitness. Maintaining the quality of sleep means maintaining physical fitness. Furthermore, by supporting the quality of sleep with sports or physical activities, someone's physical fitness will get better.

5 CONCLUSION

Sleep quality and physical activity have a significant effect on physical fitness.

REFERENCES

- Anderson K.O, et al., 2003. Fatigue and sleep disturbance in patients with cancer, patients with clinical depression, and community-dwelling adults. *J Pain Symptom Manage* 25:307-18.
- Barnard, C., 2002. *Kiat jantung sehat*. (Terjemahan Sofia Mansoor). Penerbit Kaifa. Bandung.
- Depdiknas, 2000. *Pedoman modul pelatihan kesehatan bagi pelatih olahragawan pelajar*. Depdiknas. Jakarta
- Cardon G, De Craemer M, De Bourdeaudhuij I, Verloigne M., 2014. More physical activity and less sitting in children: Why And How?. *Science & Sports*. 29:S3-5
- Griwijoyo, S., 2013. *Ilmu kesehatan olahraga*. PT Remaja Rosdakarya: Bandung.
- Guyton & Hall, 2007. *Buku ajar fisiologi kedokteran*. EGC. Jakarta
- Hardinge, M.G., Shryock, H., 2001. *Kiat keluarga sehat mencapai hidup prima dan bugar*. (Terjemahan Ruben Supit). Indonesia Publishing House. Bandung
- Hairy, J., 2007. *Dasar-dasar kesehatan olahraga*. Universitas Terbuka Departemen Pendidikan Nasional. Jakarta.
- Kemenkes RI, 2013. *Strategi nasional penerapan pola konsumsi makanan dan aktifitas fisik untuk mencegah penyakit tidak menular*. Jenderal Bina Gizi dan Kesehatan Ibu dan ANAK. Kemenkes RI. Jakarta.
- Kemenkes RI, 2018. *Hasil utama riskesda 2018*. Kementerian Kesehatan Badan Penelitian dan Pengembangan Kesehatan. Jakarta.
- Maas, L. M., 2011. *Asuhan keperawatan geriatrik: diagnosis nanda*.
- Nelson, M.E., Rejeski, W.J., Blair, S.N., Duncan, P.W., Judge, J.O., King, A.C., Macera, C.A., Castaneda S. C., 2007. Physical activity and public health in older adults: Recommendation from the american college of sports medicine and the american heart association. *Circulation* 116, 1094-1105.
- Nurhasan, 2005. *Aktifitas kebugaran*. Jakarta: Departemen Pendidikan Nasional, Direktorat Jenderal Pendidikan Dasar Dan Menengah.
- Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W., 2010. Too much sitting: the population-health science of sedentary behavior. *Exercise and sport sciences reviews*, 38(3), 105.
- Potter, P. A., Perry, A. G., 2010. *Fundamental keperawatan*. SalembaMedika. Jakarta. 7th edition.
- Safaringga, E., 2018. Hubungan antara kebugaran jasmani dengan kualitas tidur. *Jurnal SPORTIF: Jurnal Penelitian Pembelajaran*, 4 (2).
- Sarfriyanda, J., Karim, D., Dewi, A. P., 2015. Hubungan antara kualitas tidur dan kuantitas tidur dengan prestasi belajar mahasiswa. *Jurnal Online Mahasiswa (JOM) Bidang Ilmu Keperawatan*, 2(2), 1178-1185. Retrieved from <https://jom.unri.ac.id/index.php/JOMPSIK/article/view/8282>
- Suharto., Dkk., 2000. *Ketahuilah tingkat kesegaran jasmani anda*. Pusat Pengembangan Kualitas Jasmani. Jakarta.
- Tao Chen, et al., 2015. Tri-Axial accelerometer-determined daily physical activity and sedentary behavior of suburban community-dwelling older japanese adults. *Journal of Sports Science and Medicine*, 14, 507-514
- Taras, H., 2005. Physical activity and student performance at school. *J.Sch Health*.
- Weiyun Chen, et al., 2016. Association of quality physical education teaching with students' physical fitness. *Journal of Sports Science and Medicine*, 15, 335-343