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Cognitive Function Differences on Elderlies (> 50 years) Examined from Daily Physical Activity Intensity Differences

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Abstrak

Umumnya usia pensiun seseorang adalah 50-60 tahun terkait asumsi bahwa seiring bertambahnya usia seseorang akan mengalami degenerasi sel otak yang mengakibatkan penurunan fungsi kognitif sehingga mempengaruhi kualitas kerja dan produktivitas. Kebiasaan aktivitas fisik dipercaya membantu mengurangi penurunan fungsi kognitif lansia dan memberi kesempatan memperpanjang masa produktif. Penelitian ini mempelajari perbedaan fungsi kognitif pada lansia yang aktif secara fisik dan lansia yang kurang aktif secara fisik, serta mempelajari hubungan tingkat aktivitas fisik harian dengan fungsi kognitif lansia. Penelitian ini merupakan studi analitik observatif pada 90 lansia (>50 tahun) yang dikelompokkan menjadi 2 kelompok berdasarkan intensitas aktivitas fisik harian. Instrumen pengukuran tingkat aktivitas fisik adalah GPAQ sedangkan instrumen pengukuran fungsi kognitif adalah MMSE. Data yang diperoleh dianalisis menggunakan uji t independen dan uji korelasi. Hasil analisis menunjukkan adanya perbedaan signifikan ($p<0,05$) fungsi kognitif pada kelompok aktivitas fisik tinggi (KT) dengan kelompok aktivitas fisik rendah (KR). Uji korelasi menunjukkan adanya hubungan yang kuat ($p<0,05$) antara intensitas aktivitas fisik harian dengan fungsi kognitif lansia.

Abstract

The general retirement age is 50-60 year old related to the assumption that, as people get older, a person will experience degeneration of brain cells which results in cognitive function decrease that affects work quality and productivity. Physical activity is believed to help reduce the cognitive function decrease in elderlies and provide opportunities to extend the productive period. This study was aimed at finding out the cognitive function differences in physically active elderlies and physically inactive elderlies, as well as the relationship between the level of daily physical activity and cognitive function of the elderlies. This study was an observative analytic study involving 90 elderlies (> 50 years) grouped into 2 groups based on the intensity of their daily physical activities. The instrument used for measuring physical activity level was GPAQ and the cognitive function measurement instrument was MMSE. The data obtained were analyzed by independent t-test and correlation test. The results showed a significant cognitive function difference ($p <0.05$) in the high physical activity group (KT) and the low physical activity group (KR). Correlation test showed a strong relationship ($p <0.05$) between the intensity of daily physical activity and the cognitive function of the elderlies.

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INTRODUCTION

The number of elderlies in South East Asia nowadays reaches 142 million and keeps increasing up to three times in total in 2050 (Kemenkes, 2018). The number of elderlies in Indonesia (>60 years) in 2000 was 17.8 million or 8% of the number of total citizen. In 2006, the number increased to 19 million or 8.4% from the total number of citizen. In 2010, the number increased to 24 million or 9.77% of the total number of citizen. In 2020, the number of elderlies will be about 27.08 million or 11,4% from the total number of citizen with the average of life expectance 71,1 years (Infodatin, 2017). The total number of elderlies living in urban area in Indonesia in 2010 were around 12.4 million or about 9,58%, while elderlies living in rural area were about 15,7 million or 9,97% from the total citizen. The number of the data proved that the number of elderlies is increasing every year (Nugroho, 2008).

The late adulthood age is about 50-60 year and elderlies is started after retirement age, usually >60 years (Dewi & Sofia Rhosma, 2014). The increase of the number of elderlies is affected by the development of health care, the decrease of infant mortality, and betterment in nutrition. The increase of the number of elderlies has another problem, including the aging process.

The aging process is a natural process that could affect physical, social, and mental of a person. The aging process brings consequences on the degeneration of cognitive function. As a person getting older, the cognitive function and motoric function are decreasing (Terrando et al., 2011). The physical degeneration will have impact on physical activity and directly influence a person's performance at work. However, some companies still hires employee whose ages exceed the retirement age.

The general problems usually occur when a person is getting older is the degeneration of the quality of health. One of the health problems in elderlies is the degeneration of central nerve cell that has impact on the cognitive function. Cognitive function is an individual's ability in processing their thinking, learning new things and experiences, the ability in evaluating, planning, considering, solving problems, and storing memories. The degeneration of cognitive function could cause the degeneration in concentration, vigilance, and the ability to memorize (Ismail & Andar, 2009).

The understanding about the degeneration of cognitive function is importance. This understanding is important to know and to identify elderlies with cognitive problem risk. In general, the degeneration of cognitive function is influenced by many factors including unhealthy lifestyle, smoking, drinking alcohol, depression, less social support, physical condition, and less physical activity (Gallo, Reichel, 2010).

The impact of the degeneration of psychomotor function caused by aging process includes problem in movement, attitude, coordination, could decrease a person ability in responding stimuli, thus they become less agility (Thong, 2011). In the aging process, some cognitive aspects such as the ability in memorizing, especially working memory, that has important role in daily activity will decrease that explains why elderlies have difficulties in remembering or easy to forget things (Nagamatsu et al., 2013). The degeneration of cognitive function and motor aspects become the reasons to decrease working load of employee who are in retirement age (50-60 years), since the degradation in cognitive function in elderlies is considered to have impact in the decrease in productivity of a company that would decrease the income of the company itself. The degeneration of the cognitive function could affect the quality and the productivity of a person. If a person have a good working quality in their old age, they would have a chance to extend their working perion, since a company would consider their working quality and productivity although they are in their retirement age.

Other impacts that occur to elderlies that are caused by the degeneration of cognitive function is the decrease of their role in society and family. It is because they become menyendiri, selfish, and hard to accept advices. It could make elderlies feel alienated in society, thus they would think that they tidak dibutuhkan by the society. The impact of the degeneration of elderlies' ability affects their social interaction, their role in society is replaced by younger generations. A person will inevitably experience this condition when they are getting older (Stanley, M. & Beare, 2007).

To deal with the degeneration of cognitive function on elderlies, a preventive effort of the degeneration

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of cognitive function should be taken. An aspect that is considered to have impact in preventing the degeneration of cognitive ability is physical activity or sports. Physical activity is an activity that is conducted by using part of our body. Generally, physical activity is related to sport (Almatsier, 2003). Physical activity used energy to move muscle. A person activity that involves movement activity during work that use part of their body to do activity, belongs to physical activity.

Physical activity that involve the series of muscle movement need nutrition to produce energy. With physical activity, a person could do various daily activity. Immunity of a person who rarely do physical activity will decrease and have cardio metabolic risk. Physical activity is activity that require energy, for example walking, doing house chores, laundering, bicycling, or doing gymnastics. A routine physical activity with structured and repetitive activity in a period of time that will improve fitness is sport. When getting older and physical ability decreases, physical activity could prevent and delay the degeneration of our body function (Azizah, 2011).

Sport or exercise that is conducted properly could memperlambat the process of cognitive function degeneration, since exercise could improve memory or concentration (Busse, Gil, Santarém, & Jacob Filho, 2009). The effect of the memory and cardiovascular fitness improvement from exercise could improve the ability to memorize in short term or long term period. Besides improving memorization ability, exercise could also improve concentration, thus we could have a better focus. A light aerobic exercise for 20 minutes could give a positive impact such as improving our concentration and focus.

Being healthy physically could help our brain to be healthy until elderly. Brisk walk for 30-45 minutes, three times a week, could help prevent cognitive problems. Besides that, exercise to improve balance, coordination, and kelincahan give positive impact on brain and cognitive function in elder age. Weight lifting twice a week could improve muscle condition. Dancing for an hour per week, for six months, could improve physical, social, cognitive stimuli and prevent brain aging. It is shown that higher physical activity have higher impact in preventing cognitive problems in the future (Onate, 2015).

Therefore, this study would examine the effect and correlation of physical activity on elderlies (>50 year) cognitive ability. It is expected that the result of this study would be a solution in reserving cognitive function of elderlies as the effort to keep the work productivity and creating higher chance in extending the working period of elderlies. Furthermore, the elderlies could live healthy with physical activity.

METHODS

The This research is an analytic observative study. This study was aimed at examining the cognitive function differences on physically active elderlies and sedentary elderlies. This study was also aimed to learn the correlation between the daily intensity of physical activity and cognitive function of elderlies.

The population of this study was Dukuh Purbo, Jolotigo, Talun District, Pekalongan Regency, citizen. Respondents needed for this study were 90 male elderlies (>50 year). Male respondents were selected since female respondents experience menopause period. Inclusion criteria used including health, the ability to communicate, more than 50 year old, and willing to participate by filling in informed consent. The exclusion criteria are the criteria that are considered out of inclusion criteria. The independent variable of this research was daily physical activity intensity, while the dependent variable in the elderlies' cognitive ability.

The instrument used to measure the level of physical activity was Global Physical Activity Questionare (GPAQ), while the instrument of measure cognitive ability is Mini Mental State Example (MMSE) (Folstein, Folstein, & McHugh, 1975 ;Pangman, Sloan, & Guse, 2000).

The data collection technique was conducted by door to door technique where the researcher directly came to where the respondents live. Every respondent only followed the measurement once with interview method. Before answering the questionnaire, the respondents filled in a consent form.

In this research, respondents were divided into two groups including low physical activity intensity (KR) and high physical activity intensity group (KT). The group was divided based on the physical activity inten-

sity obtained from GPAQ instrument taken by interview technique. Data from GPAQ were only used to find out the level of physical activity of elderlies.

GPAQ is a questionnaire developed by WHO (World Health Organization) to supervise the physical activity in various countries worldwide. The GPAQ instrument provides information related to the level of physical activity of person daily that contains 16 questions. The questions include activities in working place, transportation, and recreation activity. The data of GPAQ results in the final satuan MET/week. The category of high physical activity is when the result shows >3000 MET/WEEK, the moderate category is 600-3000 MET/week, and low category is <600 MET/week, besides other consideration in GPAQ assessment guidance (World Health Organization, 2010).

Data of cognitive function was obtained from Mini Mental Stateexample (MMSE) instrument. MMSE is a standard structured form containing 11 questions with score 1 for each question. MMSE is beneficial to predict the level of severity and cognitive development. MMSE test is used to measure and to find out the level of cognitive function of a person, to find out the diseases they experience during their cognitive function degeneration period. MMSE is conducted to evaluate place and time orientation, to test short term and long term memory, counting, language ability, and constructional ability. MMSE is commonly used to assess the mental status of elderlies as they getting older.

In MMSE instrument, there are two question sections. The first section is to evaluate the time orientation, concentration, attention, and memory. The second section is to find out the ability to write a sentence spontaneously, to mention name of a given object, to find out the ability to follow an order, and redraw a complex pattern design. The score of each point is 1 for the correct answer and 0 for the wrong answer. The total score of MMSE test is 30. MMSE involves:

Orientation, this section includes question related to place and time. It contains five questions with the total score 10. Registration, this section contains questions related to three objects that had been prepared. By mentioning the three objects in 1 second for each object, conducting repetition until the respondent could answer. The score is 1 for the correct answer and 3 for the total answer.

Attention and calculation, this section contains questions related to the ability in counting (counting the subtraction of 100 subtracted by 7). The score is 1 for the correct answer and stop the question when the respondent has gave 5 correct answer. For a person who could not count, we could use a word containing 5 alphabets and spell each word backward. The total score is 5.

Memorization, this section contains questions related to the ability in memorizing by mentioning the name of objects stated in registry section, 1 score for each correct answer.

Language, this section contains questions related to a person response by mentioning 2 name of objects that have been prepared, repeating words, following orders, writing a sentence, and redraw a pattern. The total score is 9.

The score of MMSE test for normal cognitive is 24 -30, for probablecognitive impairment is 17-23, and for definite cognitive impairment is <16 (Ridha & Rossor, 2005). The result of MMSE test of the two groups were analyzed by normality test to see the normality of the data distribution. The data were then processes statistically by using independent t-test to see the difference of the MMSE test result of the two groups (KR & KT) and correlation test to find out the relationship between the elderlies physical activity and cognitive function test result (Dahlan & Sopiyudin, 2014).

Statistical Analysis

Normality test was used to test the normality of a data. The test used was kolmogrov smirnov test. Then t-test to find out the difference between two independent groups. This test was used to find out the difference between the results of MMSE of two groups (KR & KT). Correlation Test is used to find out if there is a relationship between the score of physical activity intensity from GPAQ with cognitive function that were taken from MMSE test of the respondents.

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RESULT

The Table 1 shows that elderlies with high physical activity (KT) is 45 persons (50%) and elderlies with low physical activity (KR) is 45 persons (50%). Data shows that elderlies with high physical activity (KT) who experience probable cognitive impairment is 5 persons(5,55%) and other 40 persons (44,44%) are in the normal category.

According to the normality test Kolmogorov-Smirnov, it was found p=0,133 (>0,05) and indicates that the data were distributed normally thus the independent t-test and correlation test could be conducted. According to the t-test, it is found that there is a significant difference (p<0,05) between MMSE score of elderlies with high physical activity level (KT) and elderlies with low physical activity level (KR). It could be

Table 1. Data description

Physical Activity Category	MMSE Category						Total	
	Definite Cognitive Impairment		Probable Cognitive Impairment		Normal			
	N	%	N	%	N	%	N	%
High	0	0	5	5,55	40	44,44	45	50
Low	13	14,44	28	31,11	4	4,44	45	50
Total	13	14,44	33	36,66	44	48,88	90	100

Table 2. The result of independent t-test

	t	df	Sig. (2-tailed)	Mean difference	Std. Error difference	95% confidence interval of the difference	
						lower	upper
Value MMSE	10,359	88	0,000	6,289	0,607	5,082	7,495
	10,539	61,722	0,000	6,289	0,607	5,075	7,503

Table 3. Correlation Test

		MMSE Score	Physical Activity Level
MMSE Score	Person Correlation	1	,727**
	Sig. (2_tailed)		,000
	N	90	90
Physical Activity Level	Person Correlation	,727**	1
	Sig. (2_tailed)	,000	
	N	90	90

The data of elderlies with low physical activity (KR) and have definite cognitive impairment were 13 persons (14,44 %), probable cognitive impairment were 28 (31,11%) and normal category were 4 persons (4,44%). The data show that elderlies with high physical activity tend to have normal cognitive function and elderlies with low physical activity experienced definite cognitive impairment and probable cognitive impairment.

assumed that the significant difference of the cognitive function of the two groups is influenced by the difference in the level of physical activity intensity daily.

Correlation test shows that the physical activity level has a correlation with MMSE score (p<0,05). The value of the correlation in this research was 0,727 that shows a high correlation between physical activities with MMSE score. Therefore, it concludes that there is a strong correlation between physical activity intensity of the elderlies and cognitive function.

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DISCUSSION

The result of the study shows that there is a strong correlation between daily physical activities with cognitive function on elderlies. Proven by the respondents who have high physical activity level tend to gain normal cognitive function (44,44%) with the statistical test p=0,000. The result of this study shows that the respondent who have high physical activity level gained high MMSE score compared to those who have low physical activity level.

In a study conducted by Clouston and Auyeung, it is stated that physical activity has a relationship with cognitive function on elderlies, a person will experience a degeneration of cognitive function if they have low physical activity and muscle training (Auyeung et al., 2008; Clouston et al., 2013).

Physical activity could stimuli the neuron growth. Therefore, elderlies could avoid the degeneration of cognitive function (Muzamil & Martini, 2014). When a person is doing physical activity, protein in their brain will improve, the protein is generally called Brain Derived Neutrophic Factor (BDNF).

The BDNF protein is highly needed by our body to keep the neuron healthy and fit, but when a person rarely do physical activity that the BDNF protein stop its production, our body would be easy to get some diseases, such as forgetful (Antunes, Santos, Cassilhas, Bueno, & Mello, 2006). The inability in remembering or easily forgetting thing are caused by the aging. In the aging process or when someone gets older, the degeneration of physical ability becomes the main factor of the degeneration of cognitive function. Brain would degenerate caused by the aging process (Yuniati & Riza, 2004).

The physical activity is related to cognitive function, by doing physical activity, the blood pressure will be controllable, and lipoprotein will increase and make the brain stronger. The effect of physical activity for brain is to maintain the structure of the brain and expanding the nerve (Weuve J, Kang J.H, 2004).

Exercise and foods are affective strategies to combat neurologic problems (otak dan saraf) and cognitive problems (Gomez-Pinilla & Hillman, 2013). By doing physical activity such as aerobic for 3 hours per week, it would increase and expedite the blood stream to our brain, producing new cells in brain. Aerobic exercise would affect parts of our brain, such as corpus coliseum, the physical change of brain, and influence brain or cognitive function (Novia, 2010).

Doing exercise program or physical activity in short term could repair the cognitive function of elderlies. Meanwhile, doing regular physical activity or sport regularly could improve the physical ability of elderlies and improve the cognitive function to be better. Doing physical activity could help repair the cognitive function and the development of cognitive impairment in elderlies (Carvalho, Rea, Parimon, & Cusack, 2014).

According to Naqvi, physical activity especially endurance training, shows potential benefits in preventing the degeneration of cognitive function in elderlies (Naqvi, Liberman, Rosenberg, Alston, & Straus, 2013). Physical activity could expedite blood circulation to brain, thus the nutrition could be used maximally. If a person rarely do exercises, the blood circulation will be disturbed and causes the deficiency of oxygen (Marhamah, 2002).

Three times a week exercise, a structured exercise, low to moderate intensity, minimum 30 minutes duration, is a suitable program for elderlies, that would have impact on physical and fitness improvement (Kirk-Sanchez & McGough, 2013). Type of activities or exercise that could be used as an effort to prevent cognitive function according to Katty are aerobic exercise, muscle strengthen training, flexibility and balance exercise (Kathy Gunter, 2002).

Physical activity that is suitable for elderlies is conducted at least 30 minutes every day in a week with moderate intensity. Physical activity that could be conducted includes gardening, walking, bicycling, doing house chores, gymnastics, and other activities. By doing these activities, the expected target could be accomplished. Physical activity for elderlies over 60 years should be done with moderate intensity with movement that do not burden and are not tiring for the elderlies. Elderlies who are new to physical activity are suggested to start from low intensity and improve the intensity individually according to the ability of the elderly.

Exercise that categorized as aerobic activity is an exercise that could push heart and lung to be harder. A good physical condition is necessary since the body

needs more oxygen. The example of the exercise is walking, bicycling, swimming, and running.

Exercise should be conducted at least five times a week and conducted for 30 minutes with moderate intensity or three times a week conducted for 20 minutes with vigorous intensity. Besides aerobic activity, physical training that is suggested for elderlies is muscle strength training. Muscle fitness could be used for daily activity. Since elderlies physical ability is in the aging process, this training could help them to do activities independently. The muscle strength training could help muscle to be strong and able to support muscle and jaringan ikat.

Muscle strength training should be conducted at least twice a week. Training should be started from the lightest weight up to the elderlies' ability. Flexibility and balance exercise are to keep the balance and agility of the elderlies. A good joint condition is needed, thus, to keep it, a suitable training is needed. Balance exercise is highly needed by elderlies to do daily activities, as the aging process degenerate elderlies' physical condition.

Flexibility exercise should involve main joints of the body, such as shoulder, knees, hip, pelvis, back, and neck. This exercise could keep the joint movement ability thus the elderlies could do their activity well. The duration needed for flexibility exercise is 2 until 3 times a week and conducted along with aerobic and muscle strengthening exercise. To avoid injury, the intensity of exercise should be considered, such as warming up, stretching for 10-30 seconds with 3-4 times movement. Stretching involves major and minor muscle, yoga for example.

Balance training for elderlies with degeneration of physical condition could help elderlies to maintain their balance in doing daily activities. Training that could be done by the elderlies is training with low intensity 3 times a week. Activities that can be done includes tai-chi, walking, bicycling, or other sports that could improve the balance of the body.

The benefit of sport is important for our body. Especially for elderlies, sport could keep their health. Besides that, exercise that suggested for elderlies is beneficial for heart health, heart strength, and improve immunity. The strong cardio will decrease the risk of heart attack. Sport could memperlancar blood circulation and improve the elasticity of blood vessels, since we move our body. Therefore, it could minimize high blood pressure and blood vessels rupture. By doing physical activity, our body could burn fat in our body and elderlies could minimize the risk of obesity and keep the ideal body shape and weight.

The aging process has impacts on the degeneration of body function and ability. Exercise could restore the strength of the muscle and prevent rheumatoid. Besides that, exercise could improve immunity and protect the body from diseases. Moreover, exercise could be used to relieve stress.

Exercise with moderate intensity could give a good impact on elderlies, the real impact is in cardiovascular and mental control. The exercise that could be done by elderlies such as walking, is a beneficial exercise that is safe and affordable. The arrangement of physical exercise program for elderlies should be done carefully so that they could exercise optimally depends on their physical condition.

Environment and sport facilities should be considered so that elderlies could do their physical activity optimally. For example, elderlies with eyesight problem are suggested to use static bicycle that regular bicycle in public place. Exercise for elderlies is suggested to add the warming up and cooling down time, so that the elderlies could avoid injury risk and they could get physical benefit, avoid diseases and improve their employment period.

CONCLUSION

The conclusion of this study is that there is a meaningful difference in MMSE score of elderlies who have high physical activity intensity and those who have low physical activity intensity. Elderlies with high physical activity tends to have a normal MMSE score compared to those who have low physical activity who tend to have probable cognitive impairment.

RECOMMENDATION

The result of the study could be a suggestion or knowledge for elderlies or society related to the effort

to prevent the cognitive function degeneration through physical activity. In addition, the type and the intensity of physical activity of the elderlies should be suitable for their ability to minimize injury. Therefore, the elderlies could have a good physical condition and have a chance to have longer working period.

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