Optimization of Memory Capacity through the Granting of Physical Activity Type with Level of Intensity Low and Medium

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Abstract. The purpose of this study was to determine the effect of the type of physical activity with low and medium intensity level of the ability of memory (short and long term memory). Physical activity is provided in the form of physical activity a variety of physical activities that are categorized as serial skill and similar activities that are categorized as skill continuous. The research method uses Experiment with 2X2 factorial design. The samples were junior high school students who are not involved in sports activities in school or in a club. The sampling technique using Two stage/ Multistage-Random Sampling. These samples included 80 students divided into four groups provided treatments for 30 meetings. The instrument used is the letter test, Word test and Formative test. The results showed that physical activity diverse group in particular that of moderate intensity have average scores better than the other groups. There is an interaction between the type and level of intensity of physical activity on the ability of long-term memory only.

1. Introduction
Research World Health Organization (WHO) published in the blog of the World Health Organization in 2009 about Physical activity, that the lifestyle of sedentary work causes 1 in 10 deaths and disability and more than two million deaths each year are caused by lack of moving / activity physical. Advances in technology or modernization, seeing the children's lifestyle now [31]. Other facts, the number of Indonesian children and youth are less physical activity is quite large. Based on data from the Health Research (Riskesdas) in 2013, nearly half of the proportion of the Indonesian population over the age of 10, approximately 42%, has a relatively inactive lifestyle (sedentary / less physical activity). In the age group of children (10-14) who have inactive lifestyle, the percentage of 67%, and the class of adolescents and young adults (15-24) by 52% [14].

Based on field observation, physical education in schools is still considered important because there is no real contribution to the learning process and is considered to be the energy drain so students will experience fatigue that can cause lack of focus students in participating in the next lesson, hampered and lowers student achievement and no positive contribution to improve intelligence / cognitive abilities. In discover also how the policies of the principals that reduce or eliminate hours of lessons PJOK and prohibit the students final grade to engage in sports activities even, in Jakarta spread
news about teaching physical education transferred into extracurricular activities that are not required to be followed by students. [1]

It is very different when compared to the discretion of the principals in foreign countries like America and Australia that actually give more time and advised students to always engage in physical activity outside of school hours is required. In line with the explanation in [21] [19]. In some research articles were found, the experts explained that there is significant influence of physical activity or physical activity on cognitive abilities of man, among them: [17], Holmann, et al. [25], [6], [12]. This means that people who are active in physical activity has a tendency to be influenced positively in terms of development and improvement of cognitive ability, this occurs because of the number of existing synapses and interconnected with other synapse more numerous and stronger than in people who are less active in physical activity. Humans must move to develop and maintain the network ngosystem or memory, as soon as the brain begins to form neurons, synapses begin to form as the linkage between the wires with the neurotransmitter. As students become more active stimulation of the neurons. It added that the nervous system reorganization process flow corresponds to the dependence of the brain continue to occur throughout life [4]. Thus physical activity or sport becomes necessary precedence.

2. Method
Implementation of this study using an experimental research method. More specifically the design of the research is the study design with models 2X2 factorial randomized posttest only control group design. The target population in this study were all students of SMP / MTs throughout Indonesia, while being accessible population in this study were students of SMP / MTs Darul Hufadz which would then be used as a sampling of this research. The process of determining accessible population until the determination of the sample is done with a model two-stage / multistage random sampling [7] that combines the individual cluster random sampling and random sampling. Total sample of 80 male students. The instruments used are Letter Test and Word Test.

3. Result

| Group of Data | Mean  | t     | Sign. | Conclusion   |
|---------------|-------|-------|-------|--------------|
| STM A.        | 89,3540 | 2.408 | .018  | Significant  |
| STM B.        | 85,7880 |       |       |              |
| LTM A.        | 48,4997 | 1.265 | .209  | Not significant |
| LTM B.        | 43,4998 |       |       |              |

Table 2. Test Results Independent samples T Test Intensity of Physical Activity

| Group of Data | Mean  | t     | Sign. | Conclusion   |
|---------------|-------|-------|-------|--------------|
| STM A.        | 87,3820 | .246  | .806  | Not significant |
| STM B.        | 87,7600 |       |       |              |
| LTM A.        | 45,8327 | .084  | .934  | Not significant |
| LTM B.        | 46,1668 |       |       |              |
Table 3. Homogenous subsets test

| Group of Data         | STM Subsets | LTM Subsets |
|-----------------------|-------------|-------------|
|                       | N           |             |
| PA Similar - Low      | 20          | 85,5410     | 47,9995     | 47,9995     |
| PA Similar - moderate | 20          | 86,0350     | 39,0000     | -           |
| PA diverse - Low      | 20          | 89,2230     | 43,6660     | 43,6660     |
| PA diverse - moderate | 20          | 89,4850     | -           | 53,3335     |

Table 4. Test Results 2x2 factorial

| Source                  | Dependent variable | F    | Sign. | Conclusion       |
|-------------------------|--------------------|------|-------|------------------|
| Corrected model         | Short Term Memory  | 1.908| .135  | Significant      |
|                         | Long Term Memory   | 2.515| .065  | Not significant  |
| Type of Physical Activity | Short Term Memory | 5.655| .020  | Significant      |
|                         | Long Term Memory   | 1.681| .199  | Not significant  |
| Intensity of Physical Activity | Short Term Memory | .064 | .802  | Not significant  |
|                         | Long Term Memory   | .007 | .931  | Not significant  |
| Type*Intensity          | Short Term Memory  | 0.006| .939  | No Interaction   |
|                         | Long Term Memory   | 5.856| .018  | On Interaction   |

Figure 1. Graph of interaction test results

4. Discussion

Physical activity is not only a positive effect on the fitness of the body but also to improve the functioning of the brain, especially relating to the quality of the brain's memory owned. Good working memory ability in turn can improve learning outcomes or student achievement in school be better anyway. Exercise or physical activity can provide physiological benefits if done regularly and repeatedly so that the body can adapt to a given exercise load. Physical exercise load should be adjusted by taking into account the type, intensity, duration and frequency to provide the optimum fitness and benefits [29] [24] [27]. Physical activity shows can maintain cerebral blood flow and may also increase the supply of nutrients the brain. The activities of physical activity is also believed to facilitate the metabolism of neurotransmitters, may also trigger changes in molecular and cellular activities that support and maintain brain plasticity. Evidence of an animal studies have shown that physical activity is associated with cellular, molecular and neurochemical changes [23]. The level of regular physical activity as well as the quest to have a relationship with the high score of cognitive function and decline in cognitive function [30][10]. Sports with a frequency of three times a week is suitable for groups of elderly and will result in significant improvements to the overall body fitness [26].

There are three mechanisms that play a role that angiogenesis in the brain, synaptic changes reverse and eliminate the buildup of amyloid [18]. The mechanisms that explain the relationship between
physical activity and cognitive function, such as the regulation of blood pressure, increasing the levels of lipoproteins, increase production endothelial nitric oxide and ensure perfusion brain tissue strong, direct effect on the brain that maintain structure nerves and promote the expansion of nerve fibers, synapses-synapses and capillary [30]. Physical activity can stimulate neuronal growth and trophic factors is the possibility of these factors that inhibit decline of cognitive function and dementia [32]. Physical activity can improve vascularization in the brain, increase dopamine levels, and molecular changes in the factors nootropic useful as a neuroprotective function [23].

In some systems the physical activity of molecules that can play a role in things that are useful in the brains of one neurotrophic factor. Neurotrophic factor was mainly Brain-derived neurotrophic factor (BDNF), can improve the resilience and growth of several types of neurons. BDNF acts as a major mediator of synaptic efficacy, linking nerve cells and nerve cell plasticity. Changes in mRNA levels found in neurons, particularly in the gyrus dentatus, hilum, and CA3 regions. BDNF is a better candidate in mediating the long-term benefits of exercise on the brain [5].

Based on animal studies conducted [16] generally improving the function of the brain that are affected by physical activity occurs through three general mechanisms, namely: angiogenesis; neurogenesis; and increased production of neurotropic factors. Metabolism increases when physical activity triggers an increased need for oxygen, as occurs repeatedly it increases the production of certain growth factors through increased production of mRNA, one insulin like growth factor-1 (IGF-1). Angiogenesis occurs through an increase in IGF-1 molecule that is triggered by physical activity that is repetitive and regular. Increased IGF-1 regulates the work Vascular Endothelial Growth Factor (VEGF) which is known to induce the growth and formation of new blood vessels. In the brain, angiogenesis occurs in all parts, but the most significant in the motor cortex.

Neurogenesis is affected also by IGF-1 through a mechanism similar to angiogenesis. Neurogenesis occurs most predominantly in the hippocampus. Increased neuroprotective factors through an increase in gene expression through mRNA triggered by physical activity that is repetitive and regular. BDNF is a growth factor that is influenced by physical activity and to have neuroprotective properties through improved resistance to damage neurons, induces the growth of axons, and increased synaptic plasticity. Through angiogenesis, neurogenesis, and neurotrophic factors, physical activity is believed to be involved in protecting neurons from damage and improve cognitive abilities and memory. The memory capacity is strongly influenced by the structure and function of the brain.

Similarly, the learning motor skills, this will not happen without higher-level thinking processes. All forms of motion (physical activity) shown in need of stages of cognition. The more complex motion tasks should be shown, increasingly requires cognitive processes. When the learned motor skills, cognitive patterns are formed, and cognitive patterns are stored in memory, and ready to be called when needed [9]. Additional assumptions about the relationship between physical activity and cognitive function is that the effect of physical activity on cognitive function depends on the intensity and duration (volume) workouts do. Intensity workouts that are low to medium tends to support the notion that a physical arousal facilitate cognitive function [2].

In the meantime Clancy (2006) Physical education is a terrific laboratory not only for improving student’s fitness but also for building their brain power. As we learn more about the connection between movement and learning, we discover more teaching opportunities that exploit this connection... physical education classroom help your students be better movers and better learners [4]. The influence was marked due to the several changes related to the brain, among other things:

4.1. The flow of blood and oxygen to the brain becomes more smoothly
Moderate intensity physical exercise improves the ability to pump blood throughout the body and help blood flow to the brain, thereby increasing oxygen to the brain and glycated. The physical activity will increase nitric oxide which helps maintain blood vessel walls open wide and strengthen the blood vessels in the arterial pulsation, the pulse of the blood vessels supplying blood strong smoothly throughout the body including the brain stricken area. Oxygen carried blood to the brain becomes more and will help in the growth of new brain cells and keep it from damage or death of the cell. With
blood and oxygen supply is good then the brain will not get tired and survival of the cells became more looked after. The degree of concentration and absorption capacity of the brain to stimuli or information that came to be better and able to accept and store that information more durable and easier to remove if asked to disclose it back. This is in line with [8] in the Proceedings of the National Academy of sciences, and Dr. Scott Small (quoted in Reuters Health, Monday 12/2003) [33].

4.2. Physical activity stimulates the Neurogenesis and synaptogenesis
Regular physical activity and intensity were able to stimulate the growth of new cells or neurons of new areas of the brain. With the growth of new neurons will result in cells or neurons of the brain become more, especially the hippocampus region, Physical activity affect the neurosystem, neurotrophin growth, the growth of neurons, neuronal connectivity, and improve oxygen delivery to the brain.

4.3. Physical activity stimulates the hormone production increases
Physical activity in addition to an effect on brain cells, also can affect the increased production of hormones, proteins and other chemical compounds that are useful and related to the performance of the brain. As Tomporowki [28]. Several other hormones including proteins and chemicals that increase production and nothing to do with the brain include: norepinephrine is also called Noradrenaline, Endorphin, serotonin, Gamma Aminobutyric Acid (GABA), acetylcholine, Brain derived neurotrophic factor (BDNF), Insulin Growth Factors (IGF-1), Vascular Endothelial Growth Factor (VEGF), Fibroblase Growth Factors (FGF-2), glutathione. [13]; [20].

However, not all physical activity will be beneficial to health [11]. To be beneficial for health, physical activity should be moderate or vigorous intensity [3]. While it Zervas & Stambulova [2]. Provides Additional assumptions about the relationship between physical activity and cognitive function is that the effect of physical activity on cognitive function depends on the intensity and duration (volume) workouts do. Intensity workouts that are low to medium tends to support the notion that a physical arousal facilitate cognitive function, [13]; [22]; [15].

5. Conclusion
Physical activity performed varied it can provide a better effect of physical activity similar, especially in the process of synaptogenesis which showed better developments in addition to the occurrence of angiogenesis and neurogenesis. Physical activity at low intensity to medium proved to be of considerable benefit both the growth and development of individuals, especially for the development of cognitive functions of individuals, this gives evidence that physical activity is not synonymous only with strong intensity course that impact is good for the body but of low intensity until're also able to provide a good benefit too.

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