

Intervention of Modified Physical Activity Model on Symbol Test Abilities of Elementary School Students

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Abstract: Regular physical activity, especially moderate to vigorous physical activity (MVPA), has been proven to have positive effects on memory function. This is due to the significant influence of physical activity on brain function. Several studies indicate that physical activity optimizes brain development, especially in school-aged children who are still growing. The method used in this research is a two-step research design. Firstly, a Research and Development approach will be utilized to prepare and develop a moderate physical activity program suitable for elementary school children. Secondly, an Experimental Group Design will be employed to investigate the effects of physical activity on brain function. Researchers administered a "Digit Symbol Test" to experimental groups before and after the physical activity. The "Digit Symbol Test" is completed within 90 seconds, and students are required to complete as many as possible within their ability. The results indicate that the scores after the physical activity intervention tend to increase compared to the scores before the physical activity. The highest score increase is 27 points, with an average score increase of 9 points. These results are also consistent with previous studies and will challenge the perspective of parents who believe that physical activity before lessons begin has a negative impact on the learning process. This research proves that physical activity conducted before the start of lessons has a beneficial effect on students' brain function.

Keywords: Physical Activity, MVPA, Brain Function, Elementary School, Cognitive

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INTRODUCTION

The development process of elementary school students is something that requires careful attention. Development in children occurs in several aspects, namely physical aspects, including gross and fine motor skills, cognitive aspects,

and social aspects (Burhaein, 2017). Optimal child development can occur when all these aspects are well fulfilled, such as fitness and health. From the elementary school age, children need to be introduced to physical activities that can support their physical fitness. Besides supporting physical fitness, physical activity also plays a role in the cognitive development of students (Lemes et al., 2021).

Regular physical activity, especially moderate to vigorous physical activity (MVPA), has been proven to have positive effects on memory function. This is due to the significant influence of physical activity on brain function. Physical activity enhances attention and concentration, improves focus, reduces the likelihood of distractions, and triggers the release of chemicals such as endorphins (Sran et al., 2021), which can induce positive feelings and reduce levels of stress and anxiety.

Physical activity stimulates the body to produce more dopamine hormones. The proper production of dopamine hormones enhances mood, making individuals happier and more content. (Marques et al., 2021) also state that dopamine hormones play a strong role in motor and cognitive functions because dopamine is a primary neurotransmitter in the nervous system that supports cognitive control. Physical activity is known to have a positive relationship with cognitive function (Sneck et al., 2019; Garcíá-Hermoso et al., 2021) and contributes to increasing happiness. Moderate to vigorous physical activity also increases the production of chemicals that stimulate the growth of new neurons in the hippocampus, a crucial area in the brain that controls memory and learning processes.

Several studies indicate that physical activity optimizes brain development, especially in school-aged children who are still growing. According to research conducted by (Berrigan et al., 2014) with forty elementary school students aged six to eight years, physical activity conducted before classes started increased average MVPA by 7% each day. Moreover, there is a significant correlation between the program and variations in attention levels throughout the day. The study concludes that adding physical activity programs to school schedules is an excellent way to help achieve daily MVPA recommendations and develop components that impact students' academic learning.

Exercise can improve brain function, and enjoyable exercise can make a significant difference. Hogervorst's study observed the impact of physical activity on behavior and learning outcomes in classrooms, with 77% of participating schools noting improved brain function and student learning after exercise. Exercise improved the mood of all children in this study, especially boys. Brain speed increased by up to 19% after exercise. This study tested the impact of physical activity and its effects on learning with over 1,000 students from 17 elementary schools in England.

According to Scott McGinnis (2023), a neurology instructor at Harvard Medical School, "There is a lot of science behind this, where exercise causes the body to change many things, such as the production of growth factors—chemicals

that affect the growth of new blood vessels in the brain, and even the number, survival, and overall health of new brain cells." Research shows that the part of the brain that controls thinking and memory is larger in people who exercise compared to those who do not. Meanwhile, Legey et al. (2017) researched the Relationship Between Physical Activity Levels, Mood, Anxiety, and Quality of Life of Physical Education Students, proving that increased leisure-time physical activity correlates with quality of life related to health and mood state.

Based on assumptions compiled from previous research results, researchers conducted preliminary research to determine the opinions or views of parents in Indonesia if their children were provided with physical activities before classes. A total of 894 parents with children in elementary school from 10 provinces in Indonesia agreed to participate voluntarily (76.7% mothers; 17.2% fathers; 6% guardians). Several questions were asked, and the responses obtained were as follows.

When asked if their children were physically active, 92.6% answered 'active', and only 3.8% answered 'not active'. Among those who answered 'active' a follow-up question was asked, "Is your child active in sports clubs or participating in extracurricular sports at school?" 52.6% answered 'Yes' and 47.4% answered 'No.'

Furthermore, for children who do not participate in sports activities outside of school hours (407 respondents), reasons were asked. There were five causes: 1) children ran out of time for academic lessons after school hours (25.6%), 2) ran out of time to do homework (10.8%), 3) the home is far from sports clubs (28%), 4) no one can pick up and drop off the child (48%), and 5) parents are concerned that their children will get injured (7.6%).

Parents were also asked further questions, "Do you agree if physical activities are provided before school lessons start?" 87.2% agreed and 12.8% disagreed. Those who disagreed cited reasons such as: 1) children will quickly get tired when starting to learn, 2) sweating will disturb learning comfort, 3) children will lose concentration in learning, and 4) physical activity will make children sleepy. Interestingly, of the 87.2% of parents initially agreeing, 11.6% or 91 individuals changed their minds to disagree when asked, "What if physical activities were provided before Mathematics, Science, and English lessons?" The reasons were: 1) the child's concentration would be disrupted, 2) these subjects are crucial for the child's future, and 3) the child should be fresh and not tired during these lessons.

Based on the results of several previous studies proving that physical activity can enhance brain capacity, it appears inconsistent with the results of the preliminary research conducted by researchers to understand the perceptions of parents in Indonesia when their children are provided with physical activities. Therefore, further research is needed to prove that providing physical activities

before children start learning activities will have a positive impact on brain function.

METHOD

The method used in this research is a two-step research design. Firstly, a Research and Development approach will be utilized to prepare and develop a moderate physical activity program suitable for elementary school children. Secondly, an Experimental Group Design will be employed to investigate the effects of physical activity on brain function.

1. Research and Development Phase

The first phase of this research involves the Research and Development approach to create and develop a model of physical activity tailored to the characteristics of elementary school students. This physical activity model includes basic movements, energetic movements, can be performed in the classroom, and is accompanied by music to make it more engaging. The physical activity lasts approximately 11 minutes and includes enjoyable movements for elementary school students.

A trial of this physical activity model was conducted at SD Lab School UNNES Kota Semarang on January 15, 2024. The population consisted of 19 students from class 3-C. The trial aimed to determine whether the developed physical activity model qualifies as MVPA (Moderate to Vigorous Physical Activity) and whether it can increase heart rate. Researchers used 4 smartwatches with heart rate detection features to monitor changes in heart rate before (baseline) and after the physical activity was administered. The smartwatches were worn by 4 students selected using Simple Random Sampling.

2. Experimental Phase

The next phase of the research is the Experimental Group Design. This phase took place at SDN Pujokusuman 1 Yogyakarta on May 8, 2024, with experimental group is class of 3-B consisting of 28 students. Researchers administered a "Digit Symbol Test" to experimental groups before and after the physical activity. The "Digit Symbol Test" is completed within 90 seconds, and students are required to complete as many as possible within their ability.

The obtained data will show the difference in scores between before and after the physical activity intervention. Subsequently, the data will be compared before and after the physical activity intervention.

RESULTS

The results of the physical activity trial can be seen in Table 1. which shows the changes in heart rate before and after performing physical activity observed in 4 samples from the population of 19 students in class 3-C, SD Lab School UNNES. Researchers assigned names to the samples using the code "T".

Table 1. Physical Activity Trial Results

Name	Gender	Initial HR	Final HR	Diff
T01	Male	86	112	+26
T02	Female	88	144	+56
T03	Male	126	138	+12
T04	Female	122	156	+34

Table 2 shows the “Digit Symbol Test” scores before and after the physical activity intervention. Researchers assigned names to the subjects in the experimental group using the code "EG."

Table 2. Score Digit Symbol Test

Name	Gender	Breakfast	Feeling	Symbol Test		Diff
				Pre	Post	
EG01	Male	Not yet	Good	52	61	9
EG02	Female	Not yet	Really good	30	47	17
EG03	Male	Not yet	Good	32	36	4
EG04	Female	Not yet	Brilliant	29	35	6
EG05	Male	Already	Good	30	43	13
EG06	Female	Already	Not very good	34	48	14
EG07	Female	Already	Good	35	54	19
EG08	Male	Not yet	Not very good	38	46	8
EG09	Male	Not yet	Brilliant	44	54	10
EG10	Female	Already	Brilliant	39	45	6
EG11	Male	Already	Very good	35	46	11
EG12	Female	Already	Brilliant	36	44	8
EG13	Male	Already	Good	33	40	7
EG14	Female	Already	Good	38	47	9
EG15	Male	Already	Not very good	28	34	6
EG16	Male	Already	Good	26	37	11
EG17	Female	Already	Good	25	33	8
EG18	Male	Already	Good	38	53	15
EG19	Male	Already	Very good	34	40	6
EG20	Male	Not yet	Brilliant	28	33	5
EG21	Female	Not yet	Good	34	41	7
EG22	Male	Not yet	Brilliant	31	42	11
EG23	Female	Not yet	Good	43	49	6
EG24	Male	Not yet	Good	41	51	10
EG25	Female	Not yet	Good	48	44	-4
EG26	Male	Not yet	Good	51	61	10
EG27	Female	Not yet	Good	39	52	13
EG28	Male	Not yet	Not very good	46	73	27

DISCUSSION

Table 1 shows the differences in heart rates experienced by the samples before and after the physical activity intervention. The changes in heart rate show an increase from the initial heart rate to the final heart rate. Sample T01 experienced an increase of 26 bpm, sample T02 experienced an increase of 56 bpm, sample T03 experienced an increase of 12 bpm, and sample T04 experienced an increase of 34 bpm. This proves that the developed physical activity model qualifies as MVPA.

Meanwhile, the results from Table 2 display the scores for the “Symbol Digit Test.” These results indicate that the scores after the physical activity intervention tend to increase compared to the scores before the physical activity. The highest score increase is 27 points, with an average score increase of 9 points. Out of 28 students, only 1 student experienced a decrease in score after the physical activity intervention.

CONCLUSION

Based on the results of this research, the author found that the physical activity intervention can have a positive impact on students' brain function and focus. This is evidenced by the increase in “Digit Symbol Test” scores, where this test is commonly used to assess brain sharpness and focus. These results are also consistent with previous studies and will challenge the perspective of parents who believe that physical activity before lessons begin has a negative impact on the learning process. Once again, this research proves that physical activity conducted before the start of lessons has a beneficial effect on students' brain function.

Conflict of Interest

The author has no interests that would compromise the neutrality or objectivity of this research. This study purely aims to demonstrate the impact of physical activity intervention on brain function. The author also presents the findings of this research using actual data from the field.

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