



Correlation between Physical Fitness and Concentration of Gymnastics Athletes

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Abstract

The purpose of the study was to examine the correlation between physical fitness and the concentration of West Java gymnastics athletes. The method used in this research was descriptive quantitative method with correlational design. The sampling technique used in this study was purposive sampling, involving seventeen young athletes (9 women and 8 men; age 19.71 ± 4.22 years, height 1.57 ± 0.07 m, body mass 52.4 ± 7.58 kg) who were members of PPLP (Student Sport Education and Training Center) and Pelatda (Regional Training Center). The instruments used in this study were a physical condition test (sit and reach test, trunk lift test, standing stork test, whole body reaction, hurdle jump test, 12 core stability test, and beep test) for physical fitness and a concentration grid test for measuring concentration ability. The data processing and analysis results found a correlation of ($r = 0.50$ with a p-value of $0.041 < 0.05$) and a coefficient of determination of 25%. It concludes that there is a correlation between physical fitness and the concentration of West Java gymnastic athletes. Physical fitness is a crucial aspect for an athlete to meet the needs of movement and to perform optimal gymnastic movements without feeling excessive tired, so that they can maintain concentration when practicing or competing. Therefore, activities that can improve physical fitness are considered beneficial in increasing concentration abilities.

INTRODUCTION

Mental Gymnastics is a type of sport characterised by unique movement skills (Gifari et al., 2020). There are seven dominant patterns of gymnastic movements, namely: (1) landing, (2) static position, (3) locomotor, (4) swing, (5) rotation, (6) repulsion, and (7) height and kite (Budiarti et al., 2020). Gymnastics athletes should have an appropriate body physique, maintain low body fat, and have specific physical abilities (such as, flexibility, explosive strength, accuracy, coordination, balance, and agility) to achieve a successful performance (Douda et al., 2008; Di Cagno et al., 2009; Ana-Maria & Ionuț, 2014; Firmansyah, 2016; Dallas et al., 2021). The successful performance of any gymnastic movement skill requires regular physical activity and practice.

Regular physical activity and exercise can improve physical fitness, which is associated with higher health-related quality of life (HRQOL), as key indicators of health (Ortega et al., 2008; Sigvartsen et al., 2016; Zhang et al., 2016; Knaeps et al., 2017; Chen et al., 2018; Higuera-Fresnillo et al., 2018; Nowak et al., 2019), including cardiovascular endurance, muscle strength and endurance, flexibility, and body composition (Hurtig-Wennlöf et al., 2007; Ramanian, 2020).

Physical fitness refers to physical activity that can be achieved through the exercise process (Simon & Docherty, 2017; Loviani, 2022). Therefore, the physical activity carried out must be in accordance with a certain level of urgency to have a significant impact on athletes. The improvement in physical fitness is a sign of the impact of physical activity on the body and is associated with a better effect on the brain (Alosco et al., 2013; Best et al., 2020; Ruotsalainen et al., 2020; Dunås et al., 2021; Hernández et al., 2021). In general, good physical fitness allows physical activity without fatigue. The American Academy of Physical Education adopted the following definition: 'Physical fitness is the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to engage in leisure time pursuits and to meet the above-average physical stresses encountered in emergency situations' (in Vanhees et al., 2005). Optimal health and physical fitness are important for gymnastics athletes to be able to perform various elements and routines effectively and accurately (Kiuchukov et al., 2019).

Nowadays, many gymnastics athletes experience a

decrease in concentration when performing movement performances. One of the factors causing it is the athlete physical fitness condition. Athletes are only concerned with movement exercises that refer to gymnastic performance without paying attention to physical activity related to their physical fitness level. Physical fitness possessed by gymnastics athletes is still low so that, when doing movements in gymnastics, they easily experience fatigue. Fatigue conditions have an impact on decreased concentration and reactions resulting in failure to perform maximal movement performance and even injury. Yoon & Song explained that fatigue is related to physical activity level and cognitive function (Yoon & Song, 2018).

The study of cognitive function and neuroscience is increasing in sports (Chuang et al., 2013; Ermutlu et al., 2015; García-Monge et al., 2020; Hendrayana et al., 2020; Negara et al., 2021). Advances in neuroscience have led to substantial advances in linking physical fitness to cognitive function and brain structure and function (S. Colcombe & Kramer, 2003; Donnelly et al., 2016; Raichlen & Alexander, 2017). In the range of cognitive functions, two important measures of cognition in athletes are attention and concentration because both are indispensable elements in the process of understanding and learning. (Hillman et al., 2003; Pesce et al., 2009; Rueda et al., 2015; He, 2017; Ludyga et al., 2018; Devenney et al., 2019). The results showed a positive relationship between physical activity and attention and concentration. Regular physical activity can increase attention and concentration, while minimal physical activity levels can reduce attention and concentration (Mahar, 2011; Vanhelst et al., 2016; de Greeff et al., 2017; Harris et al., 2018).

Luque-Casado et al. explained that the group that had less regular physical activity, in other words low fitness, showed poor results in the psychomotor alert task, namely the continuous attention task (Luque-Casado, Zabala, Morales, Mateo-March, & Sanabria, 2013). In addition, the pressure during sports activities can disrupt the athlete's concentration, such as ridicule from the audience, music, hurtful words from the coach, and unsportsmanlike behavior from opponents. (Goldman & Rao, 2012; Weinberg & Gould, 2018). The results of a study explained that there was a significant contribution of physical fitness on the level of concentration at $p=0.000$, the magnitude of the contribution

was 24.6% (Negara et al., 2017; Nuryadi et al., 2018). Other research showed that adolescents who practiced more hours of physical exercise per week and were in better physical fitness achieved higher scores in selective attention, concentration, processing speed, general self-efficacy, self-health assessment, and life satisfaction (Vanhelst et al., 2016; Reigal et al., 2020b).

Attention and concentration play an important role in an athlete performance and are mutually sustainable. This is because the focus and attention significantly affect performance (Negara et al., 2021). Athletes' ability to concentrate has a relationship with the performance of gymnastic movements, such as postural sway, rhythmic gymnasts, and pommel horse. (Vuillermé & Nougier, 2004; Corlaci, 2013; Nassib et al., 2014). Athletes who can concentrate well will be able to perform at their best (Mommert, Simons, & Grimme, 2009). This is related to the athlete's ability to make the right decisions about the received stimulus to respond to or ignore it (Abdollahipour et al., 2015). Athletes will also save more energy with concentration because athletes only focus their attention on the right instructions and do not feel disturbed by distractions (Janssen et al., 2014).

The findings of studies further demonstrated that there was evidence to suggest a relationship between physical fitness and concentration but only examined it in general terms. Based on this explanation, researchers aimed to examine more in gymnastics, specifically to determine the relationship between physical fitness and the concentration of West Java gymnastics athletes.

METHODS

This study used the correlational research method.

Participants

The participants were West Java youth gymnastics athletes (age 19.71 ± 4.22 years) who regularly participated in or were preparing for competitions. The technique used was purposive sampling, in which seventeen teenage athletes (9 women and 8 men) who were members of PPLP and Pelatda participated in this study. Prior to data collection, sample consent was given without coercion. Samples were in good health and could participate in the given activities. The physical characteristics of the samples are presented in Table 1.

Table 1. Physical characteristics of the subjects

Data	Mean \pm Sd	Min	Max	N
Age	19.71 ± 4.22	13	25	17
Height (cm)	157.4 ± 7.45	142	171	
Weight (kg)	52.4 ± 7.58	41	67	
Body Mass Index	21 ± 1.97	18	25	

Instrument and Procedure

Physical Fitness

Physical fitness measurements carried out consisted of sit and reach test, trunk lift test, standing stork test, whole body reaction test, hurdle jump test, 12 core stability test, and multi stage fitness/beep test.

Concentration

Concentration data were collected using a validated Concentration Grid Test. The Concentration Grid Test was adopted from the research of Hendrayana et al. (2020), entitled "The Impact of Beta Brain Waves in Improving Cognitive Function through Brain Jogging Applications", to measure one of the cognitive functions, namely concentration. Concentration Grid Test is a concentration measuring tool in the form of a table containing numbers 00 to 99 randomly.

Data Analysis

Data were reported descriptively as mean \pm standard deviation. Data were checked for normal distribution using the Shapiro-Wilk test. Product Moment Pearson correlation analysis found out the relationship between the variable dideoebdeb (physical fitness) and the dependent variable (concentration). All analysis were administered in SPSS for Windows version 25. The statistical significance was set at $p < 0.05$

RESULT

The data obtained after the implementation of this research included the physical fitness score and the concentration of the West Java gymnastics athletes as the sample of the study. The data regarding the summary of physical fitness and concentration can be seen in Table 2.

Table 2 explains that the standard deviation of physical fitness was 4.39 and the mean was 41.9. Meanwhile, the standard deviation of the concentration was 3.47 and the mean was 7.8. The summary of the results

of physical fitness and concentration tests can be seen in Figure 1.

Table 2. Summary of physical fitness and concentration results

Variable	Mean	Std. Dev	Min	Max	N
Physical Fitness	41.9	4.39	32	50	17
Concentration	7.8	3.47	3	14	

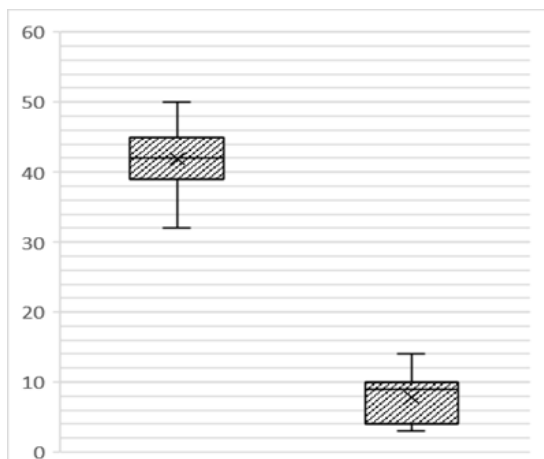


Figure 1. Bar chart summary of data on physical fitness and concentration of gymnastics athletes

Hypothesis testing in this study employed an analytical test on SPSS 25 using a correlation test, namely the Pearson Product Moment correlation test. The results of the test can be seen in Table 3.

Based on the results of the Pearson Product Moment correlation test, there was a positive functional correlation between physical fitness and concentration. The test found a correlation of $r = 0.50$ with a p -value of 0.041. By interpreting the level table of the correlation coefficient according to the Negara et al. (2019), the strength of the relationship between physical fitness and concentration was quite strong. In addition, the coefficient of determination of 0.25 means that the physical fitness variable contributed 25% to the concentration of gymnastics athletes and the remaining 75% was influenced by other variables not examined. Therefore, the hypothesis was tested and correlated.

DISCUSSION

Physical fitness and concentration performance are important factors in improving the gymnastic athlete performance. After conducting the analysis, we found a

Table 3. Pearson Product Moment Correlation Test

Variable	Correlation		Coefficient of Determination	F	p-value	Description
	r	R				
Physical Fitness - Concentration	0.5	0.25	25%	4.995	0.041	Significant

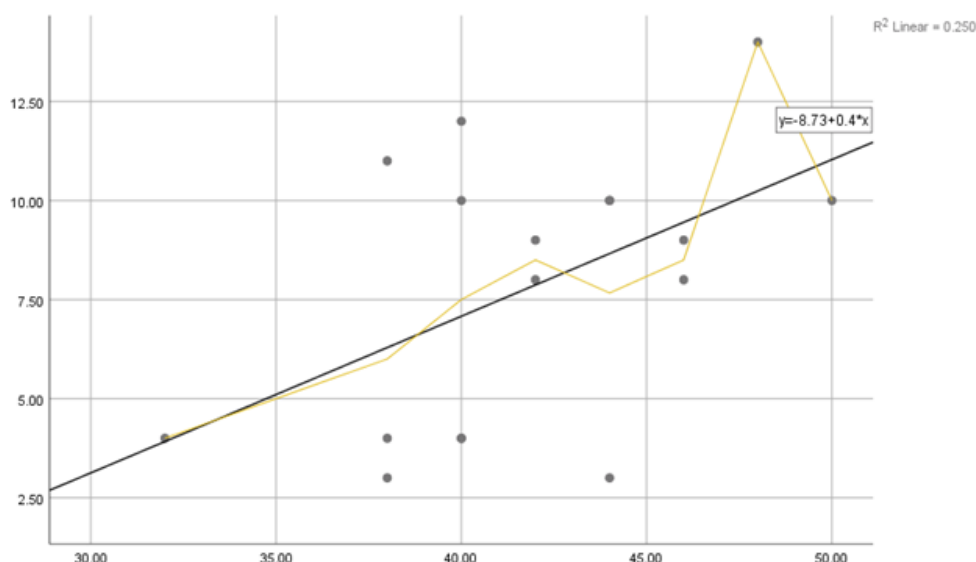


Figure 2. Bar chart summary of data on physical fitness and concentration of gymnastics athletes

significant positive correlation between physical fitness and the concentration ability of gymnastic athletes. This is in accordance with the researchers' predictions supported by the results of previous research conducted by Vanhels et al. and Reigal et al. The results of the study showed that individuals who were active in sports and had a high level of physical fitness tended to have the ability to concentrate longer than individuals who had low physical fitness (Vanhelst et al., 2016; Reigal et al., 2020b). Our findings are also supported by previous studies conducted by Negara et al., and Nuryadi et al., which showed a positive correlation between physical fitness and ability to concentrate at a significance level of $p < 0.000$, with a contribution of 24.6%. This confirms that physical fitness is important in improving the ability to concentrate in gymnastic athletes (Negara et al., 2017; Nuryadi et al., 2018).

Good physical fitness can provide many benefits to cognitive function, including the athlete concentration performance. This is caused by increased blood flow to the brain and oxygenation of brain cells which function to improve cognitive function (Antunes et al., 2020; Hsu et al., 2021; Pani et al., 2021). In addition, physical fitness can increase the production of endorphins, which can help increase concentration and improve mood (Sławińska et al., 2019; Murawska-Ciałowicz et al., 2021). Gymnastic exercises in particular can help improve the ability to concentrate on gymnastic athletes because gymnastic movements require high concentration. Thus, physical fitness and gymnastic exercises can contribute to improve concentration abilities and overall cognitive function.

A person with a high level of physical fitness does not easily experience fatigue so that it is possible to quickly respond to stimuli and increase concentration which has an impact on movement performance (Negara, 2021). Meanwhile, someone with a low level of physical fitness will easily experience fatigue which has an impact on decreased concentration and reaction (Hernández et al., 2021). Fatigue is interconnected with the level of physical activity and cognitive function. The results of research by Gregory et al. explained that regular physical activity will improve cognitive function and increase brain responses substantially which are responsible for maintaining healthy neurons (Gregory et al., 2012). As stated by Colcombe et al., increased physical activity, in terms of cardiovascular

fitness, resulted in improved functioning of key aspects of the brain's attentional network during cognitively challenging tasks (Colcombe et al., 2004).

Although the relationship between physical fitness and concentration has been better established in previous studies, the complexity of this phenomenon is so extensive that more data are available on the underlying processes that accompany other increases in physical capacity and the possible mechanisms to link them. For example, Esteban-Cornejo et al. (2017) deems it is necessary to assess how the interaction of different physical qualities can modulate brain development.

Increasing physical fitness can cause changes in the structure and function of the brain. Previous studies have shown that physical fitness factors are related to gray matter volume in several brain regions (Esteban-Cornejo et al., 2017). Increasing physical fitness can cause changes in the structure and function of the brain. In other words, an increase in physical fitness can affect the structural development of the brain which will ultimately affect its function including the performance of attention and concentration (Reigal et al., 2020a; Reigal et al., 2020b; Niederer et al., 2011).

This study has several limitations that need to be considered. This study only focuses on the relationship between physical fitness and concentration performance. Future studies should explore other factors that may influence this relationship, such as demographic characteristics and exercise performance, and involve a more representative sample. In addition, because the research design is correlational, it cannot be concluded that physical fitness can causally improve concentration performance. Nonetheless, the results of this study may provide useful information for future health interventions. To improve the ability to maintain concentration over a long period of time, health interventions should focus on improving physical fitness and physical activity among gymnastic athletes.

CONCLUSION

Physical fitness is an important factor for athletes to be able to meet movement needs and display optimal gymnastic performance without significant fatigue, so they can maintain concentration when practicing or competing. Therefore, activities that can improve physical fitness are useful in improving concentration abili-

ties. The results of our study conclude that physical fitness plays an important role in improving the concentration abilities of gymnastic athletes. Athletes with higher physical fitness levels show higher concentration abilities, while athletes with lower physical fitness levels have lower concentration abilities.

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CONFLICT OF INTEREST

The authors declared no conflict of interest.

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