The Relationship Between Physical Activity and Peak Height Velocity in Children Aged 9 – 11 Years

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Abstract. The purpose of this research was to determine the relationship between physical activity and the age of PHV in children aged 9-11 years. The method used in this research is a test survey with data collection techniques using questionnaires and measurement tests. The population in this research is SSB Tugumuda athletes and grade 4 students at SDN Karangjati 04. The samples were taken from as many as 29 boys from SSB Tugumuda and 23 boys from SDN Karangjati 04 aged 9-11 years. The sampling technique uses purposive sampling. The data analysis technique in this research used the Pearson bivariate correlation test. The results showed that 1) The level of physical activity of 1 child (1.9%) had a "low" level of activity, as many as 18 children (34.6%) had physical activity said to be "sufficient", 32 children (61.5%) with a "high" level of physical activity and 1 child (1.9%) had a "very high" level of activity, 3) The average age of PHV in 52 respondents was 14.02 years. It was concluded that there was a relationship between physical activity to the age of PHV in the 2 groups.

Key words: physical activity, peak, height velocity, children

INTRODUCTION

Many factors affect the growth of children at the age of 9-11 years, nutritional adequacy and physical activity are 2 factors that have a role in growth and development. The process of growth and development towards a more mature level or maturation refers to changes in qualitative systems, both structural and functional in the body's ability to reach maturity such as changes in cartilage in the framework (Olszewski, 2007). In maturation, there is a term called Age Of Peak Height Velocity which means the age of peak height growth during acceleration, to find out the age of the anthropometric measurements must be made to find out a person's PHV. PHV is a basis for determining exercise programs for children who are active in sports activities (Mauluddin 2019:2). At a higher age when entering adolescence, nutritional adequacy, lifestyle, and exercise patterns are some of the factors that can affect the physiological growth of an athlete. According to Handayani et al (2017:22), the speed of height growth will accelerate during puberty, last about two years, and will reach the peak of height speed at that time, then about three years will decrease and will continue to grow until the epiphyseal plate closes and height growth stops. Height growth is volatile, that is, height gain when the baby is fast then slows down and takes place quickly again at the age of 11-14 years. Therefore, the trainer needs to know the PHV in children who are active in sports to be able to adjust the training load for each child so that the child's growth and development process can be maximized.

Lloyd, Oliver (2012:62) explains that Peak height velocity (PHV) is the period in which a child experiences the fastest growth in height in status, that is when they grow the fastest during their growth spurt. The high peak velocity of PHV is one of the most widely used indicators in studies investigating the maturation process in adolescents (Aerenhouts et al, 2015). When individuals reach PHV can be estimated by monitoring the growth of body structures. Although height, weight, and skin folds, are the most widely used studies in maturation and growth is the age of PHV (Mirwald et al, 2002). The onset of the adolescent growth spurt coincides with the onset of puberty and occurs earlier in girls around 12

years of age and boys around 14 years (Olszewski, 2007). Although males have a later onset of PHV, the growth spurt in males is often greater than that in females. This indicates that boys experience a higher percentage of growth during the adolescent growth spurt than girls (R. Philippaerts et al., 2006). Batubara (2010:25) explains that in girls, height growth will end at the age of 16 years while in boys at the age of 18 years. After that age, in general, the increase in height is almost complete.

Rogol et al, (2000) explained that at the age of PHV, bones will need energy and nutrients to grow, and nutritional deficits caused by training loads and competition can slow down the linear growth of some adolescent athletes. At the age of PHV balance, leg movement speed, trunk strength, upper body muscle endurance, explosive power, running speed and agility, cardiorespiratory endurance and anaerobic capacity showed significant developments at the age of PHV (R. M. Philippaerts et al., 2006)). Adequate nutrition and physical activity that is done well during growth can be one of the successes of athletes in achieving achievements (Afriani et al., 2019). To maximize the age of growth, we can apply the measurement of the age of PHV in children who are active in sports so that they can determine the right exercise program and provide knowledge about nutritional adequacy so that it is balanced with their training load.

Several studies are relevant to the topic to be raised, research conducted by (Harahap et al, 2015) entitled "Bone Density, Physical Activity and Food Consumption Associated with Stunting Incidence in Children Age 6-12 Years" states that physical activity and adequate nutrition such as protein and calcium is significantly associated with stunting or impaired physical growth in children aged 6 - 12.9 years. (1) The incidence of stunting is significantly related to bone density, physical activity, and protein consumption in school-age children. (2) Children with low bone density are at risk of becoming stunted 5.3 times more compared to children with normal bone density (3) Children with high physical activity are more at risk of stunting. (4) In Children with protein consumption <80% of the recommended nutritional adequacy rate (RDA), the risk of becoming stunted as 6.4 times compared to children with 80% protein consumption.

Research by Mauluddin (2019) with the title "Identification of Physical Maturation Using the Mirwald Gender-Specific Regression Algorithms Method "In Male Athletes in Swimming Clubs in Surabaya", the research explains that (1) The research and discussion in this research includes age, height, height Sitting, weight, leg length influence the physical maturation or biological age of the child. (2) The Mirwald Gender-Specific Regression Algorithm method can be used as a method to predict the peak growth in height. (3) The coach can use this method as a reference in developing an exercise program according to the athlete's biological age in the sensitive period of training.

Furthermore, there is research from Van Der Sluis et al. (2015) with the title "Importance of Peak Height Velocity Timing in Terms of Injuries in Talented Soccer Players" explains that (1) the importance of PHV to determine the risk of injury to talented football athletes (2) Soccer athletes who have a slower maturation time of their peers, are significantly prone to overuse injuries. (3) Coaches and mentors who deal with talented soccer players should be careful with the training and match load they give to players especially those who are not physically able to handle that load. (4) The period between 13.5 - 14.5 years seems to be a difficult period to balance training and competition load. (5) Internal training and match load are monitored closely, especially for players who mature at an older age. (6) there is a large difference in internal training load, early to late maturation players may follow different training schedules selected with separate biological age groups in several segments of the training session.

From the studies, there were discussions about the identification of age of PHV, nutritional adequacy, or physical activity in children, but did not link the three. Therefore, researchers are interested in knowing more about the relationship between nutritional adequacy and the Age of PHV in children aged 9-11 years.

METHODS

This type of research includes test survey research to collect information and data with a cross-sectional design approach. The targets in this research were children of primary school age between 9-11 years and made into 2 groups, namely children who are members of the SSB and school children who are not members of the SSB. To determine the level of physical activity in this research using the Physical Activity Questionnaire for Older Children (PAQ-C) on all respondents, PAQ-C is suitable for elementary school-age children. To find out the age of PHV, the researcher used the Mirwald Gender-

Specific Regression Algorithms method by knowing chronological age, height, sitting height, weight, and leg length and analyzed using Microsoft Excel. The independent variables in this research are nutritional adequacy and physical activity, while the age of PHV is the dependent variable. By being divided into 2 groups, namely groups of school children and groups of SSB children. The inclusion criteria for the samples taken in this research are children aged 9 - 11 years who are members of football school and children aged 9 - 11 years attending elementary school.

The sampling technique in this research is using the purposive sampling technique. The samples in this research were children from SSB Tugumuda and students at SDN Karangjati 04, and it was conducted from April 8 - June 8, 2021, with a total of 52 respondents, conducted in 2 places, namely Sidodadi Field and at SDN Karangjati 04. The data analysis technique in this research used Pearson bivariate correlation test to see the relationship between the dependent variable and the independent variable.

RESEARCH RESULT

The sample research in this research is a sample that meets the inclusion criteria and is willing to be used as a research sample. The sample criteria in the research can be seen below;

Table 1. Research Data Characteristics

Variabel		Football School (n=29)	Elementary School (n=23)
PHV		13.91 ± 0.41	14.14 ± 0.522
Age		10.73 ± 0.80	10.83 ± 0.64
Height (cm)	**Mean ± SD**	140.1 ± 7.42	137 ± 8.11
Body Weight (kg)		30.3 ± 8.43	33.1 ± 9.72
Sitting Height (cm)		70.31 ± 4.89	68.17 ± 3.11
BMI		15.1 ± 3.63	17.20 ± 3.40
PAQ Score		3.38 ± 0.29	2.59 ± 0.43

Based on table 1, we can see that the average PHV in the soccer player group will enter the age of PHV earlier than school children with a difference of 0.23 years. With a lower average age than school children, the average height can be said to be higher than school children but with a lower weight and BMI. This means that there is an effect of higher physical activity on soccer players than school children which can affect some of the characteristics of the variables in this research.

Data Analysis

Table 2. Data Normality Test

	Kolmogorov-Smirnova		
Group	Statistic	df	Sig.
Football Player	0.1	29	.200*
Elementary Scholl	0.113	23	.200*

Table 2 shows the sig value of 0.200 in 2 groups, which means it has exceeded the significance value of 0.05 and it can be said that the data is normally distributed.

Table 3. Data Homogeneity Test

		Levene Statistic	Sig.
PHV	Based on Mean	1.18	0.282
Physical Activity	Based on Mean	1.561	0.217

Based on the results of the calculation of the homogeneity test, it is known that the significant value of all variables exceeds 0.05, then the data has the same variance value / not different (homogeneous). The data is homogeneous, so data analysis can be continued.

Table 4. Correlation Test

		Group	
		Football Player	Elementary Scholl
		PHV	
Physical Activity	Sig. (2 tailed)	0.003	0.003

Table 4 shows the results of the Pearson bivariate correlation test with a p value of 0.003 in all groups, which means that there is a relationship between physical activity and PHV in 2 groups of soccer players and school children with different levels of physical activity.

DISCUSSION

Physical Activity

The 2 groups had different levels of physical activity, with routine training in the soccer player group including the high level of physical activity with an average PAQ score of (3.83) while the group of schoolchildren was at a moderate level with an average score of (2.59). From the characteristics of the data, we can also see that physical activity also affects many things, such as higher height in soccer players with a lower average age. However, high activity can also affect body weight and BMI in soccer players which are lower than school children.

BMI

If we look at the results of the average BMI in the 2 groups, it can be seen that the average BMI in the group with high physical activity is lower, namely 15.1, and in the group of school children 17.2, this is a concern if there is a lack of nutritional intake in the group of players. football can cause growth problems in the future. Research conducted by (Harahap et al, 2015) entitled "Bone Density, Physical Activity and Food Consumption Associated with Stunting Incidence in Children aged 6-12 Years" stated that physical activity and nutritional adequacies such as protein and calcium were significantly associated with stunting. or impaired physical growth in children aged 6 - 12.9 years. (1) The incidence of stunting is significantly related to bone density, physical activity, and protein consumption in school-age children. (2) Children with low bone density are at risk of becoming stunted 5.3 times more compared to children with normal bone density (3) Children with high physical activity are more at risk of stunting. (4) In Children with protein consumption <80% of the recommended nutritional adequacy rate (RDA), the risk of becoming stunted as 6.4 times compared to children with 80% protein consumption.

Peak Height Velocity

Based on the results of the study it is known that the average age of PHV in 52 respondents was 14.2, this is similar to the research conducted (Sciences & Leuven, 2005) that for boys, the average age of PHV is about 14.0 years. Comparison of the average age of PHV in both groups of 0.23 years with the group of football players early into the age of PHV. Research from Van Der Sluis et al. (2015) explains that, the importance of PHV to determine the risk of injury-prone in talented football athletes. Football athletes who have a slower maturation time than their friends are significantly prone to overuse injuries. Coaches and mentors should be careful with the training and match loads they give to players. The period between 13.5-14.5 years seems to be a difficult period to balance training and match weights. It can also be a concern for football coaches to measure the PHV age of their players to draw up a suitable training program.

CONCLUSION

The study concludes that physical activity is effective on peak height velocity (PHV) in children. Children with a higher rate of physical activity (PA) are faster to get PHV between 13.5-14 years than a lower rate of physical activity.

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