The Relationship of Physical Activity and Peak Height Velocity in Children

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Abstract. The case of stunting in Indonesia is number one in ASEAN. The stunting indicator can be predicted by height and weight; the gene, nutrition, health, and physical activity also contributed to development and growth. The appropriate physical activity and engagement in sports can help to increase growth spurt in children. Each sport has a different characteristic and type and its effect on the growth of who engaged. The study investigates the relationship between physical activity (PA) and Peak Height Velocity (PHV) in children. The literature review was used in this study to explore the association between PA and PHV. The review study found that the level of PA strongly correlated with PHV. The substantial evidence also found that boys were higher in PA than girls on PHV time. However, when aligned no difference in biological age and sex three years before PFV. The children who get the intervention of PA regularly higher on PHV than no PA regularly. The study concludes that PA is essential to increase PHV in the development and growth stage of children.

Keywords: physical activity, biological maturity, PHV

INTRODUCTION

The prevalence of short (stunting) on Indonesian children is very high (Dewey, 2020; Sohn, 2015). The data of Riset Kesehatan Dasar (Riskesdas) 2018 showed the province level of stunting the highest on Nusa Tenggara Timur 41.1%, Sulawesi Barat 37,9 %, Aceh 32,3%, Papua 30,1%. In Jawa Tengah's province, the stunting reported on children age 5-12 years old about 20,8% (RI KemenKes, 2013; R KemenKes, 2018; RI, 2013). World Health Organization states that 30.5% prevalence of stunting 30.5% is a serious health problem (De Onis & Branca, 2016).

The indicator to know about stunting is to measure height and weight, while genetic, nutrition, health status, and physical activity (PA) affect physical growth and development (Handayani, Purwanti, & Fatmaningrum, 2017). The physical activity in children in age 10-14 years old is 64.4%, significantly less in Indonesia (R KemenKes, 2018). The genetic and level of physical activity associated with the physical growth of children (Bar-Or et al., 1998; Beunen & Thomis, 1999; Lightfoot, 2011; Lightfoot et al., 2018; Maia, Thomis, & Beunen, 2002; PÉRUSSE, TREMBLAY, LEBLANC, & BOUCHARD, 1989).

Therefore, the physical growth and development of athletes are needed to analyze the level of aged maturity not based on chronological age (Philippaerts et al., 2006). The peak height of velocity (PHV) is a basic to create an exercise program for children (ILHAM MAULUDDIN & HARTONO, 2019). The acceleration of height in girls is earlier, around the age of 11 than in boys around 13 years (Urlacher et al., 2016). Calculating the precise PHV can allow

trainers to design a more effective exercise program based on biological age rather than chronological age (A Van der Sluis, Elferink-Gemser, Brink, & Visscher, 2015).

This study aims to review the association between physical activity in children and peak height velocity (PHV). This study recommends to parents, teachers, coaches, and children how essential PA is to support growth in children.

METHODS

This study used a literature review to analyze the association of physical activity and peak height velocity in Google Scholar and PubMed from 2000 – 2021. Inclusion criteria were as follows: (a) subjects were in the age range of 3 – 18 years old or the mean age was in the range; (b) the dependent variable was measure physical activity (PA) and peak height velocity (PHV); (c) variable were tested for their association with physical activity, sports participation, and PHV. The article was excluded that had a focus on adult athletes, unpublished studies, and dissertations. The review consisted of children in the community, used various physical activity, intensity, and duration, how the association with the biological maturity measuring by PHV.

In the detailed table were created coding selected study characteristics and record results for children 6-15 years old in the detailed background table, the sample was described by sex, age, and ethnicity, and the design was coded as cross-sectional or prospective. The following categories were used to code the quality of the physical activity measure: 1) Self-report of poor or unknown reliability/validity, 2) Self-report with acceptable reliability/validity, 3) Acceptable objective measure.

Finally, the variables were classified as "related" or "not related" to physical activity based on statistical significance, and the direction of association for related variables was coded. The whole data tables are available upon request from the authors, and all studies that met review criteria are listed in the Bibliography. The detailed data tables were further analyzed to create tables that summarized the state of the literature for different variables. The following coding rules were used to create the summary tables.

Table 1. Rules for classifying variables regarding the strength of evidence of association with physical activity and peak height velocity

Summary Code	Meaning of Code
0	No Association
?	Indeterminate, inconsisten
+	Positive Association
-	Negative association

RESULTS AND DISCUSSION

The number of the study was related to the keywords of PA and PHV selecting used Google Scholar. The time per second appeared the results number of documents from the key words mentioned (Table 2).

Table 2. Children categories with physical activity and peak height velocity by Google Scholar

No	Publication	The resulting number of documents
1	Children Physical activity and PHV	60,900
2	Children exercise and PHV	
3	Type exercise in children and PHV	
	Total	

Tabel 3. The summary of the study about association between PA and PHV

Reference	Methods	Subject	Sample	Results	code
Weeks, B.K and Beck B.R., 2010(Weeks & Beck, 2010)	survey test, measures anthropometrics, assessment of maturity, and evaluation of muscle, bone, physical activity, and diet.	Caucasian adolescent 46 boys (13.8 ± 0.4 years) 53 girls (13.7 ± 0.4 years)	99 46 boys	Boys had greater age peak height velocity (APHV), weight, height, muscle power and dietary calcium than girls ($p < .05$). Boys greater femoral neck bone mineral content (BMC) and trochanteric BMC while girls had higher broadband ultrasound attenuation (BUA) and spine Bone Mineral apparent density (BMAD). PA predicted BMAD and BUA most strongly for boys from APHV.	++
Standing, R, and Mulder, P., 2019 (Standing & Maulder, 2019)	a semi-randomized test-retest design. Compare descriptive data maturation (pre, circa, and post PHV) and condition (traditional coaching progressive coaching and control)	youth male aged 13.2 – 15.7 years, maturity offset -1.0 to 2.6 years	111 youth males
Sherar, L.B. et al., 2007 (Sherar, Baxter-Jones, Faulkner, & Russell, 2007)	survey test, iced hockey athletes. Measures anthropometry, biological maturity assessment, and measurement of birth date distribution. Group, I = iced hockey athletes unselected on the first camp Group II = Iced hockey athletes unselected on the second camp Group III = iced hockey players who were selected as the team. Group control= the Saskatchewan Pediatric Bone Mineral Accrual Study (1991 – 1997) (PBMAS) (Bailey, 1997	Iced hockey athletes. aged 14-15 years old	281 players group I =208 group II = 51 group III = 22 and 93 controls	The ice hockey players selected for the final team were taller, heavier, and more mature ($p < .05$) than both the unselected players and the age-matched controls. Furthermore, age at peak height velocity predicted ($p < .05$) being selected at the first and second selection camps. The birth dates of those players selected for the team were positively skewed, with the majority of those selected being born in the months January to June, early maturing male ice hockey players who have birth dates early in the election year.	++
Lloyd, R.S. et al., 2016(Lloyd, Radnor, Croix, Cronin, & Oliver, 2016)	experimental, twice per week for 6 weeks training interventions	school children	n = 40 pre PHV n = 40 post PHV	all the training group is significant in maturity. plyometric training significantly the greatest (traditional strength, plyometric, and combine training) on sprinting and jumping performance pre and post PHV. training sessions were separated by at least 48 hours to enable full recovery. control group = completed their regular physical education and vertical jump lessons.	++

Thompson et al. 2003 (Thompson, Baxter-Jones, Mirwald, & Bailey, 2003)	The physical activity questionnaire for children (PAQ-C) was administered biannually or triennially to 138 (70 boys; 68 girls) Canadian children for seven consecutive years from 1991 to 1997.	children age 8-18 years old	138 70 bc 68 gi 228 child (113 and 1 girls)

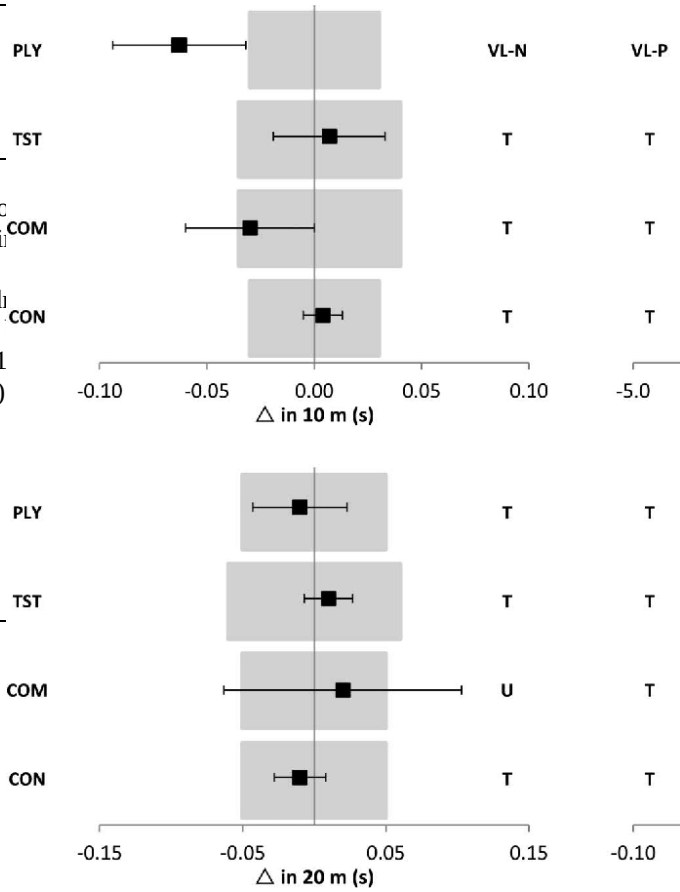

Figure 1. Mean difference (90% confidence interval) between pre-and post-peak height velocity groups in 10 m sprint time, 20 m sprint time, squat jump (SJ) height, and reactive strength index (RSI) across different training interventions. Training interventions are presented as PLY = plyometric training; TST = traditional strength training; COM = combined training; and CON = control group. The gray shaded area represents the smallest worthwhile effect. Magnitude-based inferences are represented by U = unclear; T = trivial; VL-N = very likely negative; and VL-P = very likely positive (Lloyd et al., 2016).

The maturation status can be estimated by age PHV (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002). The calculation of age PHV is based on chronological age and anthropometric ratios of weight, standing height, and sitting height (Mirwald et al., 2002). The age PHV is applicable to the determination of biological maturity in children both boys and girls (Thompson et al., 2003).

The PHV correlated with PA (Granados, Gebremariam, & Lee, 2015; Lloyd et al., 2016; Philippaerts et al., 2006; Rodríguez-Rosell et al., 2016; Sheehan & Lienhard, 2019; A Van der Sluis et al., 2015; Alien van der Sluis et al., 2014; Yagüe & De La Fuente, 1998). The PA level between boys and girls correlated with PHV; boys had significantly higher physical activity questioner for children (PAQ-C) scores than girls from 10 to 16 years of age.

However, no difference in biological age and sex on three years before PFV (Thompson et al., 2003).

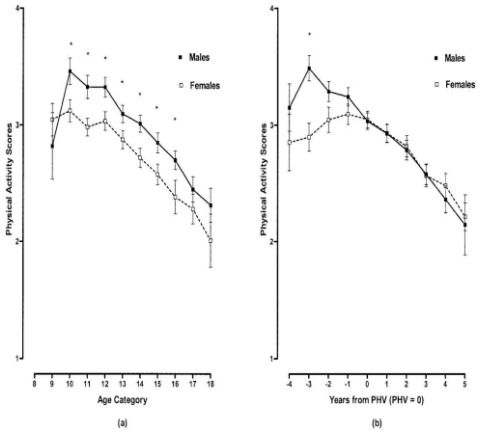

Figure 2. Physical activity (PA) (1 low; 5 high) development of boys and girls by chronological and biological age (years from age at peak height velocity [PHV]): a. Mean PA (SEM) by chronological age bands. b. Mean PA (SEM) by biological age bands; * $P < 0.05$ between age bands (Thompson et al., 2003).

The PA and muscle power were the strongest predictors of bone mass in boys, while biological maturity best-predicted bone mass in girls (Weeks & Beck, 2010). The injury problem during PA also associated with PHV, it found that traumatic and overuse injury increases from the year before PHV to the year of PHV (A Van der Sluis et al., 2015).

CONCLUSION

The level of physical activity (PA) in children affects maturity or biological ages, it was determined from PHV. The score of PA is associated with pre and post PHV.

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