Medica Hospitalia

Journal of Clinical Medicine

Med Hosp 2021; vol 8 (2) : 166–171

Original Article

The difference of physical fitness of short stature children with and without Channa striata extract (CSE) supplementation

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p-ISSN: 2301-4369 e-ISSN: 2685-7898
https://doi.org/10.36408/mhjcm.v8i2.544

Accepted: December 23th, 2020
Approved: April 15th, 2021

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Abstract

Background : Physical fitness is affected by aortic elasticity which is increased appropriately with insulin like growth factor-1 (IGF-1). Channa striata extract (CSE) supplementation increases arginine serum level and further increases IGF-1 level, endothelial dysfunction remodeling, and physical fitness. The current study aimed to explore the difference in physical fitness of short stature children with and without CSE supplementation.

Methods : This cross sectional study was conducted on 100 short stature children (male 58; female 42; CSE 50; placebo 50) aged 8–12 years in Brebes, Central Java Indonesia. Short stature was defined as the height/age Z score between -2 and -3 based on WHO 2007 growth chart standard. Physical fitness was measured by modified Harvard step test as stated as VO_2max, physical activity by physical activity record and stated as physical activity level (PAL). Data were analyzed by independent t-test and Pearson correlation.

Results : VO_2max level was higher in CSE 41.67 ± 6.967 ml/kg/minutes and placebo 41.16 ± 5.238 mL/kg/minutes, p=0.682. Hemoglobin level was higher in CSE than placebo (13.12 ± 0.932; 12.99 ± 0.878) g/dL; p=0.5020. All children revealed an active category on PAL. The results showed a significant relationship between PAL and physical fitness, hemoglobin and PAL on CSE (p<0.05), however there was no correlation between hemoglobin level and physical fitness.

Conclusion : In general, physical fitness in short stature children were categorized in the good category. There was no differences between hemoglobin level and PAL in both of groups. There was no difference between physical fitness in short stature children with CSE supplementation or placebo.

Keywords : physical fitness, short stature, physical activity, hemoglobin level

INTRODUCTION

Prevalence of short stature children is high around the world[1] and associated with inadequate nutrition, lack of micronutrients,[2] sociodemographic condition,[3] limited access of healthcare services,[4] parents with low formal education[5] and exposure to pesticides.[6] Global prevalence decreased from an estimated 40% in 1990 to 25% in 2013 except for Africa and Indonesia.[7] Riset kesehatan dasar (Riskesdas) data in 2013 showed increasing prevalence of 36.8% in 2007 to 37.2%, while the prevalence of children aged 5 to 12 year was 30,7%.[8] Children with short stature suffer from both short-term and long term consequences. Short-term consequences are associated with high mortality, morbidity and disability. Whilst long-term consequences are decreased adult height, low intellectual ability, economical hardships, low reproductivity, risk of metabolic and cardiovascular diseases.[9]

Short stature is a condition in which the height-for-age z-scores (HAZ) of a child is below-2 SD according to Word Health Organization (WHO) 2007 criteria regardless of the causes.[10] Short stature is associated with insuline growth factor-1 (IGF-1) level.[11] IGF-1 plays an important role in child growth and vascular functions.[12] IGF-1 blood level is affected by food intake,[13] particularly by proteins and minerals intake.[14] The preceding study by Soetadji A *et al* to 50 children aged 9–12 year at elementary school around Brebes region found 28% (14/50) children were having short stature with lower IGF-1 serum level compared to normal children (normal children 112.08 ng/mL vs short stature 82.42 ng/mL).[15] One of best amino acid, fatty acid and micronutrients sources is snakehead fish *(Channa striata)*. Channa Striata Extract (CSE) is known to contain high proteins, albumin, fats, amino acid, vitamins and minerals.[16] Dried CSE incapsules contain 500 mg of CSE/capsule, consists of proteins, fats, amino acid (mainly glutamate which is around 15 g/100g), vitamins and minerals.[17,18] CSE supplementation is expected to increase IGF-1 and arginin blood level which plays critical role in vascular functions by inducing aortic elasticity. Physical fitness is associated with aortic elasticity and aortic intima-media thickness in adolescents.[19] There are some tests to assess physical fitness including Harvard Step Test (HST). Harvard step test is a test to assess Physical fitness by taking steps up and down on a platform in particular rate.[20] According to WHO, in assessing cardiorespiratory endurance, VO_{2max} or maximum oxygen consumption is one of good indicators which can be estimated by direct or indirect methods.[21]

This study is part of Anindita Soetadji research entitled "The Role of Channa Striata Extracts Supplementation on Arterial Functions of Short Stature Children: A Study of Insuline Growth Factor-1 (IGF-1), Arginin/Arginin Dimetil Asimetris Ratio (ADMA) Blood Level." At the end of the study, an assessment was conducted to analyze cardiovascular fitness using HST methods on children who had short stature with and without CSE supplementation by considering confounding factors including Hemoglobin level (Hb) and child physical activity level.

METHODS

This study is an observational-analytical study with cross sectional design in children who have short stature aged 8 to 12 year after CSE supplementation or placebo for 6 months in Brebes region, Central Java. We excluded children who were obese (BMI for age >3 SD), underweight (BMI for age < -3 SD) and children with congenital disease. Minimum sample of 80 subjects was calculated by using formula for sample size calculation for comparison between two groups. Subjects were selected using consecutive sampling technique. Short stature refers to condition in which the height-for-age z-scores (HAZ) of a child is below -2 SD according to Word Health Organization (WHO) 2007 growth chart standard. We assessed physical fitness by using modified version of Harvard step test(HST) methods to evaluate VO_{2max} (mL/kg/minute) as one of the indicator. The platform used when conducting HSTwas at a height of about 25 cm. Steps rate were divided into 3 steps. On the first step the subjects stepped up and down at a rate of 15 steps per minute, followed by 3 minutes rest on completion of the test. During the second stepthe subjects stepped up and down at a rate of 22.5 steps per minute for 3 minutes followed by 3 minutes rest. At the end of the steps the subjects stepped up and down at a rate of 30 steps per minute for 3 minutes followed by rest on the end of the test. The test is terminated after the subject was exhausted and could not maintain the stepping rate. Heartbeat was measured for 15 seconds using pulse oxymeter FOX-1 Elitech after 5 seconds at the end of each steps. The VO_{2max} was calculated using following equation:

$VO2 = (0.2 \times \text{total steps}) + (2.4 \times \text{height of the platform} \times \text{total steps}) + 3.5$

$HR\ max = 220 - age$

$VO_{2max} = (VO2 \times HRmax) / HR\ \text{excercised measured}$

Physical activity by 7 days physical activity record and stated as physical activity level. Data was analyzed using independent t-test and Pearson correlation.Written consentwere obtained from the parents. This study was approved by Ethics Committee Faculty of Medicine of DiponegoroUniversity / Dr. Kariadi Hospital, Semarang No. 557/EC/FK-RSDK/2016.

RESULTS

Observational-analytical study with cross sectional design was conducted in Brebes region on May 2016 to children with short stature aged 8 to 12 year who were

TABLE 1
Characteristics of the subjects

Variable		CSE (n=50)	Placebo (n=50)
Gender	Male	28	30
	Female	22	20
Age (year)	Mean (SD)	10.08 (0.877)	9.92 (0.829)
	Min – Max	8 – 12	8 – 11
HAZ (SD)	Mean (SD)	-2.44 (0.313)	-2.45 (0.260)
	Min – Max	-2.99 – -2.01	-2.98 – -2.01
BMI for age (SD)	Mean (SD)	-1.27 (0.962)	-1.29 (0.821)
	Min – Max	-2.97 – 1.57	-2.96 – 0.42

TABLE 2
Comparison tests of VO_{2max}, hemoglobin and physical activity level on SG and PG

Variable		CSE (n=50)	Placebo (n=50)	*p*
VO_{2max} (mL/kg/minute)	Male	41.67 (6,.67)	41.16 (5.238)	0.682
	Median (min – max)	41.30 (31.6 – 62.8)	40.65 (31.2 – 54.5)	
Hb (g/dL)	Mean (SD)	13.12 (0.932)	12.99 (0.878)	0.502
	Median (min – max)	13.40 (10.90 – 14.60)	13.00 (11.10 – 15.10)	
Physical activity level	Mean (SD)	1.76 (0.140)	1.78 (0.097)	0.245
	Median (min – max)	1.77 (1.32–2.11)	1.79 (1.54 – 2.02)	

TABLE 3
Correlations among VO_{2max}, Hb and physical activity level

Parameter	CSE (n=50)		Placebo (n=50)		Total n=100	
	r	*p*	r	*p*	r	*p*
Hb level and VO_{2max}	-0.149	0.303	-0.051	0.724	-0.104	0.301
Physical activity level and VO_{2max}	**0.316***	**0.025**	0.091	0.528	0.171	0.089
Hb and Physical activity level	**-0.28***	**0.049**	0.058	0.688	-0.152	0.132

*Pearson correlation

treated with CSE supplementation or placebo for 6 months period at fourelementary school in Bulakamba, Brebes region, Central Java. This study was conducted to 100 children with short stature who were already treated with CSE supplementation or placebo every day for 6 months using randomized double blind technique. Characteristics of the subjects is presented in Table 1.

VO_{2max}, hemoglobin and physical activity level were assessed. Independent t-test was used to compare both groups, the result is presented in Table 2.

This study analyzed correlation among variables of VO_{2max}, hemoglobin and physical activity level using Pearson correlation. The analysis revealed weak positive correlation between physical activity level and VO_{2max};

and weak negative correlation between Hb level and physical activity level on Supplementation group, which is presented in Table 3.

DISCUSSION

The findings of this study revealed no significant difference was found on both groups (p = 0,682). VO_{2max} of both groups were classified as good physical fitness.[22] Short stature is known to be associated with low IGF-1 level.[11] IGF-1 level in bloodis affected by food intake particularly proteins and minerals.[14] IGF-1 level can be raised by increasing protein consumption.[23] In this study, we expected increased level of IGF-1 in children who received CSE supplementation every day for 6 months period. CSE is one of the best source of amino acid, fatty acid and micronutrient. This study did not assess IGF-1 level. CSE supplementation was expected to raise IGF-1 level that will furthermore increase aortic elasticity and improve vascular function. Reports of a randomized control trial (RCT) study by Pahkala *et al* to 916 adolescent aged 17 year revealed physical fitness was associated with aortic elasticity and thickness of intima-media layer.[19] Physical fitness is affected by aortic elasticity as well as nutritional status, hemoglobin level and child physical activity.

We used modified version of Harvard step test to assess physical fitness in this study by using a platform at a height of 25 cm we expected would dfit the subjects with short stature aged 8 to 12 year. The height of the platform is in the range of staircase height/bench height which is around 6–20 inches.[20] This modification is different from Harvard step test conducted by Mexitalia M *et al* that assessed body composition correlation with physical fitness by using Harvard step test and 20m shuttle run test in obese children. The subjects of the study were children of elementary school age with normal stature and the platform used is at the height of 30 cm.[24] The subjects of this study were children at elementary school aged 8–12 year who can perform Harvard step test cooperatively.

This study revealed higher hemoglobin level on CSE supplementation group compared to placebo group (13.12 ± 0.932 vs 12.99 ± 0.878 g/dL) but no significant difference was found (p=0.502). Whereas physical activity level on both groups showed no significant difference (1.76 ± 0.140 vs 1.78 ± 0.097; p = 0.245). A cross-sectional study conducted to 69 elementary school children in Bulang, in South-west China resported by Yap P *et al* found that children with short stature who were infected with *T. trichiura* had low level of Hb as well as low level of VO_{2max} compared to normal children.[25] The study used 20 m shuttle run test instead of step test to assess VO_{2max}. A cross sectional study by Malina RM *et al* conducted to 688 children aged 6 to 13 year, revealed physical fitness of normal children and short children showed no difference in run distant range.[26] Whereas Amstrong MEG *et al* investigated the association of anthropometric status of 10285 children aged 6 to 13 year in South Africa with verifying socioeconomic status, revealed that children with short stature had poorer physical fitness compared to normal children (p< 0.001).[27] Physical fitness was assessed using standing jump, sit-ups, shuttle run, and ball throw. Prista A *et al* investigation in Mozambique to 2316 children aged 6 to 18 year found physical fitness was poorer in boys with short stature compared to normal children, they used curl up and standing long jump methods.[28] Nhantumbo L *et al* investigation to 797 children aged 6 to 17 year in Calanga, a countryside community in Mozambique, revealed physical fitness in children with short stature assessed using standing long jump, handgrip and 1-mile run were lower compared to normal children. Whereas in malnourished group, physical fitness was poorer compared to normal children which was assessed using handgrip method (in boys), standing long jump, handgrip and 1-mile run, and 10 x 5 m run (in girls).[29] Compared with this study, we didn't find the differences physical fitness because only involved short stature children.

This study analyzed correlations among variables: hemoglobin level, VO_{2max}, and physical activity level. There was positive correlation between physical activity level and physical fitness in supplementation group with r = 0.316 (p<0.05); and negative correlation between hemoglobin level and physical activity level on supplementation group with r = -0.280 (p<0.05). No significant correlation between hemoglobin level and VO_{2max} on both groups, physical activity level and VO_{2max} on placebo group, and between hemoglobin level and physical activity level on placebo group. This finding revealed CSE supplementation did not affect hemoglobin level, physical activity level and VO_{2max}. The findings on supplementation group in this study was consistent with the findings of Moselakgomo VK *et al* investigation to 1361 children aged 9 to 12 year in South Africa, showing that children with low physical fitness was associated with low physical activity.[30] Denker M *et al* reported positive correlation between daily physical acivity of children aged 7.9 to 11.1 year assessed using accelerometer with r=0.23 p< 0.05.31 The correlations of the variables on placebo groups was consistent with the findings of Cruz C *et al* investigation in 131 healthy children aged 14 to 18 year in Portugal, which revealed no correlation between physical fitness, physical activity level and BMI. The study presented physical activity level and physical fitness in categorical scale data.[32] The correlation between hemoglobin level and physical activity level in this study was consistent with the findings of Hida A *et al* investigation conducted to 169 high school students in Japan that found positive correlation between hemoglobin and body weight, BMI, obesity level, body fat index, and lean body mass; they also found negative correlation to physical activity level. The study showed weak positive correlation between hemoglobin and BMI; and weak negative correlation to physical activity level. High physical activity level and low BMI might decrease hemoglobin level. Hida A *et al* revealed hemoglobin level measurement using non-invasive vascular monitor and physical activity level by assessing 24-hour activity.[33] Berntsen S *et al* conducted a cross sectional study to 2537 children age 9 to 10 year to figure out correlation between physical activity level and lung functional capacity. The study revealed higher lung functional capacity in children aged 9 to 10 year with high physical activity level.[34] The study did not explore the causality between lung functional capacity and physical activity level. Rowland T *et al* investigated 39 healthy boys aged 12 year and revealed VO_{2max} was found higher in children with high physical activity level compared to children with low activity level 166 ± 9 mL/kg/minute; 127 ± 11 mL/kg/minute) and maximal stroke index assessed using echocardiography was associated with VO2max ($r = 0.52$, $p < 0.05$).[35] The study used cycling test method to assess$VO_{2max.}$

This study has several limitations. Our data lacked on information of classification short stature and dietary intake of the subjects. We did not conduct echocardiography to assess aortic elasticity and maximal stroke index associated with $VO_{2max.}$

CONCLUSION

Physical fitness of children who have short stature administered by CSE supplementation as well as placebo are categorized as good. No differerence found on physical fitness assessed by using Harvard step test, hemoglobin level and physical activitiy level in short stature children with and without CSE supplementation.

DECLARATION OF CONFLICT OF INTEREST

The authors have no conflict of interest to declare in relation to the study.

ACKNOWLEDGEMENT

We thank to the Indonesian Pediatric Society for IDAI Research Grants 2016, for the teachers, parents and their children who participated in this study.

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