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Physical Fitness in Normal and Overweight Elementary School Children

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Abstract: Sedentary lifestyle in children caused low physical activity and increase incident of overweight and obesity. Low physical activity leads to physical fitness decline. The objective of this study was to analyze differences of physical fitness in normal and overweight elementary school children. This study was conducted on 108 children as subjects. They were on the fifth grade of elementary school, consisted of normal and overweight student. Physical fitness was measured by some physical tests, i.e., 40 meters sprint, pull up, sit up, jump up and 600 meters run. The result showed that physical fitness of normal and overweight children were significantly different ($p<0.05$). The average physical fitness score of normal children (13.4±2.1) was higher than overweight children (10.9±1.7). The speed, muscle endurance, explosive muscle power and cardiovascular endurance of normal children were significantly different from overweight children ($p<0.05$). Nutritional status significantly influenced physical fitness of elementary school children ($p<0.05$).

Key words: Elementary school children, overweight, physical fitness

INTRODUCTION

Inactive lifestyle could impact school children's health condition, adversely. Sedentary lifestyle in children led to increased incidence of overweight and obesity. Globally, in 2008 there were more than 40 million overweight preschoolers. Obesity in children is a problem that become a challenge in the 21st century. Obesity in children will continue to adulthood and may endangers children's health. Studies in overweight children and adolescents indicated increased risk of cardiovascular disease in adult life (Must *et al*., 1992; Oren *et al*., 2003; Wright *et al*., 2001).

Prevalence of obesity in Indonesia increases continuously. The results of Basic Health Research (Ministry of Health Indonesia, 2010) showed that the prevalence of overnutrition in Indonesia increased from 12.2% in 2007 to 14.0% in 2010. Prevalence of overnutrition among school age children (6-12 years old) was higher than other age group. Nationally, prevalence of overnutrition among children aged 6-12 years was 9.2%, while in the age range 13-15 years and 16-18 years were 2.5 and 1.4%, respectively. Incidence of overnutrition in children aged 6-12 years belonged to high category of public health problem, as it was above 5%.

Incidence of overnutrition is related to physical activity decline (Pramudita, 2011; Suryaalamsyah, 2009). Studies in United States showed that decrease of physical activity in young people was simultaneously with increasing prevalence of obesity. Similarly, incidence of physical activity decline happened on Australian children aged 10-11 years from 1985 to 1997 (Dollman *et al*., 1999; Yeung and Hills, 2007).

Physical activity is an integral part of children's growth and development. Physical activity is important for physical, psychosocial and mental development in children. Low physical activity may cause physical fitness decline. Physical fitness is an ability to perform a specific task that requires muscle strength. Several studies have shown that active people have higher physical fitness than inactive people. Women aged 7-17 years were obese had lower physical fitness than normal women (Malina *et al*., 1995). Physical fitness on obese boys was lower than non obese boys (Kim *et al*., 1993).

Based on previous explanation, we were interested to assess differences of physical fitness on normal and overweight children. This research is important because physical fitness in children essential for maintaining health, environment stress and support daily activities, particularly learning and playing (Suryanto, 2006). Moreover, physical fitness is one biomarker for health (Cvejic *et al*., 2013). Prevalence of overnutrition in children aged 6-12 years in Bogor City was highest in West Java, i.e., 15.4% in boys and 8.6% in girls (Ministry of Health West Java, 2007). Considering these data this research was conducted in Bogor City.

MATERIALS AND METHODS

Study design and setting: This research utilized cross sectional design. This research was conducted in Bogor City from August to October 2013.

Sample: The population in this study was 5th grade elementary school students in two favorite private elementary schools in Bogor City, which was Bina Insani

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and Insan Kamil elementary schools. These two elementary schools were selected purposively with consideration they have the same characteristics. Inclusion criteria of school was predominantly upper middle class families. The sample in this research were 108 children, consisted of 52 boys and 56 girls aged 10-11 years old.

Data collection: The data collected in this research were children characteristics, nutritional status, physical activity level and physical fitness. Children characteristics consisted of age and gender. Children' activity level was expressed by physical activity level (PAL). PAL was obtained by interviewing students about the activities done on school days and holidays. Data on physical activity including the duration and type of the activities. PAL values were obtained by multiplying the time allocation of certain types of activity with PAR value (physical activity ratio). Physical activity values were categorized into three level, those are light activity lifestlyle (1.40-1.69), moderately activity lifestlyle (1.70-1.99) and vigorous activity lifestlyle (2:00 to 2:40) (FAO/WHO/UNU, 2001).

Nutritional status was determined by anthropometric measurement. Data on nutritional status were obtained by measuring body weight and body height of children. The body weight measurement was done by using a digital scale with capacity of 200 kg and accuracy of 0.1 kg. Body height was measured by using a microtoise with capacity of 200 cm and accuracy of 0.1 cm. Children were asked to take off their footwear, belts as well as hair accessories worn at the time of the measurement. Nutritional status of children was categorized based on body mass index/age standard (Ministry of Health Indonesia, 2011). Definition of overweight in this research included overweight and obese.

Physical fitness was measured by observation with physical fitness test of Indonesia Elementary School Children. Reliability and validity of the test were 0.911 (boy) and 0.942 (girl) and 0.884 (boy) and 0.897 (girl) (Nurhassan and Cholil, 2007). Those physical tests were 40 meters sprint, pull up, sit up, jump up and 600 meters run. Each test was given score 1-5. Physical fitness was determined by the sum of score of each test. The categories were excellent (22-25 point), good (18-21 point), moderate (14-17 point), less (10-13 point) and poor (5-9). Furthermore, physical fitness was grouped into fit and non fit. The consideration of this classification was physical fitness of children in this research only range from moderate to poor, there were no excellent or good score. Fit physical fitness score was 14-17 point and non fit score was 5-13 point. In this research, measurement of physical test was helped by sport teacher with consideration they have skill to measure those test.

Data analysis: Statistical analysis used in this research were univariate analysis and bivariate analysis. Univariate analysis was used to assess subjects characteristics. Bivariate analysis used were, independent t-test, pearson and Spearman correlation and regression analysis. Spearman correlation was used to examine the relationship between nutritional status with physical fitness. Pearson correlation was used to examine the relationship of nutritional status to physical activity level. The t-test tests was done to distinguish physical activity level and physical fitness between normal and overweight children. Regression analysis was used to assess the factors that influence children's physical fitness. The regression model is:

$$\text{Model: } y_1 = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\varepsilon$$

where:

y_1 = Physical fitness
β_0 = Intercept
β_1X_1 = Age
β_2X_2 = Gender
β_3X_3 = Physical activity
β_4X_4 = Nutritional status (normal, overweight)
ε = Error

RESULTS

Children's characteristic: Children's characteristic of this research is presented in Table 1. Children's age ranged from 10-11 years old. Children's age 10 years were more than children aged 11 years, 72.2% and 27.8%, respectively. There was 39 normal children (36.1%) while overweight children was 69 (63.9%). This research showed that overweight children was higher in boys than girls. Percentage of overweight children in boys and girls were 59.4 and 40.6%, respectively.

The result in this research similar with Basic Heath Research result (Ministry of Health Indonesia, 2010), that showed overweight among children aged 6-12 years was higher in boys than girls, which were 10.7 and 7.7%, respectively. It might be related with children's growth and development. In this age, girl is in puberty period. Puberty in girls occurred early than boys. In this stage girls began to be aware of their appearance, while boys were less aware. Thus, they tend to manage their diet.

Physical activity level (PAL): Most children had light physical activity level, both in normal and overweight. Percentage of light physical activity was higher in overweight than normal children. Moderate physical activity was higher in overweight than normal children, while percentage of vigorous physical activity was same among normal and overweight children (Table 2).

Table 1: Children's characteristic in elementary school in Bogor

Children's characteristics	Normal		Overweight		Total	
	n	(%)	n	(%)	n	(%)
Gender						
Boys	11	28.2	41	59.4	52	48.1
Girls	28	71.8	28	40.6	56	51.9
Total	39	100	69	100	108	100
Age (years)						
10	32	82.1	46	66.7	78	72.2
11	7	17.9	23	33.3	30	27.8
Total	39	100	69	100	108	100

Table 2: Physical activity level among elementary school children in Bogor

Nutritional status	Physical activity level								
	Light		Moderate		Vigorous		Total		
	n	(%)	n	(%)	n	(%)	n	(%)	p-value
Normal	33	35.5	4	36.4	2	50.0	39	36.1	0.813
Overweight	60	64.5	7	63.6	2	50.0	69	63.9	
Total	93	100	11	100	4	100	108	100	
Average±SD	1.38±0.12		1.85±0.1		2.25±0.18		1.46±0.24		

Table 3: Physical fitness among elementary school children in Bogor

Nutritional status	Physical fitness						
	Fit		Not fit		Total		
	n	(%)	n	(%)	n	(%)	p-value
Normal	17	81.0	22	25.3	39	36.1	0.000**
Overweight	4	19.0	65	74.7	69	63.9	
Total	21	100	87	100	108	100	
Average±SD	15.1±1.2		11.0±1.6		11.8±2.2		

This research showed that physical activity level between normal and overweight children was not different ($p>0.05$). Pearson's correlation showed that physical activity was not related to nutritional status ($p>0.05$). The result of this research was similar with other research, that showed correlation between physical activity and obesity or body mass index were not clear (Kaluski *et al*., 2008; Aires *et al*., 2010).

Physical fitness: The result in this research showed that normal children had better physical fitness than overweight children. Percentage of fit was higher in normal children than overweight, which were 81.0 and 19.0%, respectively. Percentage of non fit was higher in overweight than normal children, which were 74.7 and 25.3%, respectively. Independent t-test showed that physical fitness between normal and overweight children was different ($p<0.05$). Average physical fitness score in normal children was higher than overweight, which were 13.4±2.1 point and 10.9±1.7 point respectively (data not shown).

The result in this research was in accordance with He *et al*. (2011) that showed cardiorespiratory fitness was higher in normal children than overweight.

Physical fitness component: Result showed that in average physical ability of overweight children was lower than normal children.

Speed: Speed in this research was examined by of 40 m sprint. Independent t-test showed that ability of sprint was different between normal and overweight ($p<0.05$). Average of leng of time in normal children was lower than overweight, which were 7.6"±1.1 and 8.2"±1.2 seconds, respectively. The result in this study shows that speed ability on normal weight better than overweight children.

Muscle endurance: Muscle endurance of normal children was better than overweight. Arm muscle endurance was measured by pull up. Average number of pull up that can be done by normal children was higher than overweight children, which were 8.7±4.2 and 6.2±3.2 times, respectively. Shoulder muscle endurance was examined by sit up. Average number of sit up within 30 minutes was higher in normal weight children than overweight children, which were 17.3±6.0 and 14.2±5.9 times, respectively. Independent t-test showed that muscle endurance among normal and overweight children are different ($p<0.05$). The result in this research showed that muscle endurance in normal children better than overweight.

Endurance is the body's ability to supply oxygen that is needed to do daily activities. Low muscle endurance in overweight children indicated that work capacity in long term is lower and not efficient. Nevertheless, endurance could be improved by regular exercise.

Explosive muscle power: Jump up in this research portrayed explosive leg muscle power. Average of jumping reach in normal children was higher than overweight, which were 27.3±4.7 and 23.7±5.6 cm respectively. Independent t-test showed that explosive muscle power in normal and overweight children was different ($p<0.05$).

Cardiovascular endurance: Cardiovascular endurance in this research was measured by run 600 m. Independent t-test showed that the ability to run 600 meters between normal and overweight children was different ($p<0.05$). Average leng of time in overweight was higher than normal children, which were 6.03±0.94 and 5.22±0.80 min, respectively. The result in this research showed that overweight children had lower cardiovascular endurance. Children who have lower total adiposity or abdominal adiposity have higher cardiorespiratory endurance (Ortega *et al*., 2008). Someone who has better cardiorespiratory endurance, will have lower risk cardiovascular disease. Children and adolescent who have higher cardiorespiratory endurance related with healthy profile cardiovascular.

Cardiorespiratory endurance capabilities indicated that heart, lungs and blood vessels were functioning optimally when doing daily activities in a long time without fatigue. Cardiorespiratory endurance is related to stamina which is an important component in supporting the day-to-day activities. Students who have good cardiorespiratory endurance is suspected to have good stamina to support learning capability. If someone has good cardiorespiratory endurance then the oxygen flow to the organ cells becomes effective and the organs will work optimally (Ohara, 2009).

Factors affecting physical fitness: Regression analysis showed that nutritional status had significant impact on physical fitness ($p<0.05$). Apparently, 29.7% variety of physical fitness can be explained by nutritional status variable (BMI/age). Each additional one point of body mass index/age can lower physical fitness 0.60% (Table 4). Age, gender and physical activity level does not influence physical fitness ($p>0.05$).

The result in this research was similar with Botelho *et al*. (2013), overweight and obesity had significant impact to physical fitness in adolescent aged 10-17 years. Other research showed the same result, that overweight or obese were related with low physical fitness (Brunet *et al*., 2007; Utari, 2007; Aires *et al*., 2010; He *et al*., 2011).

Table 4: Factors affecting physical fitness

Variable	B	Sig.
Constant	13.018	0.000**
Body mass index/age	-0.595	0.000**
R^2	0.297	
F (Sig)	44.826 (0.000)	

**Significant in α = 1%

DISCUSSION

The result in this research showed that physical fitness in overweight children was lower than normal children. Nutritional status is a significant factor that influence physical fitness among elementary school children. The result in this research same with other research (Brunet *et al*. 2007; Utari, 2007; Aires *et al*., 2010; He *et al*., 2011; Botelho *et al*., 2013). Thus, maintenance of body weight is necessary to avoid physical fitness decline. Furthermore, overweight or obesity are related with children health. Physical fitness in school children is important to attention. Physical fitness could support academic achievement. Ortega *et al*. (2008), shows that cardiorespiratory endurance has positive impact on depression, anxiety, mood and improved confidence that related with improved achievement in children.

Nonetheless, most elementary school children in this research had less physical fitness both in normal and overweight children. There are no children who had good physical fitness (data not shown). Physical fitness is condition that is integrated between the various system in the body. Some of that system are musculoskeletal, cardiorespiratory, hematocirculatory, psychoneurological and endocrine-metabolic system. Furthermore, physical fitness is one of the biomarker of health conditions Ortega *et al*. (2008). Consequently, if children have low physical fitness, they are potentially have bad body conditions.

Some research showed there are association among physical fitness and biomarker of health conditions. Ruiz *et al*. (2006) showed that cardiovascular profile in children and adolescent who have good physical fitness was better. Ortega *et al*. (2008) showed that bone mineral in male and female adolescent in AVENA were better in adolescent who had good cardiorespiratory endurance, muscle endurance and speed or agility. Good cardiovascular endurance could improve bone formation and bone mineral absorption (Schneider *et al*., 2007). This is related with skeletal muscle. Skeletal muscle is one of major component of the lean body mass. Improvement of muscle endurance could improve bone attachment, which indirectly stimulate optimal bone growth (Rauch *et al*., 2004).

In this research physical activity not associated with children's physical fitness. This research is different with some researches. The research in England showed that there were positive correlation between physical activity and physical fitness in children aged 8-10 years (Rowland *et al*., 1999). The research in Oman concluded that aerobic fitness had negative correlation with sedentary activity, such as watching television, computer and video games (Barwani *et al*., 2001). Active adolescent in Taiwan had good physical fitness compared with inactive adolescent (Huang and Malina, 2002).

The different result of this research was assumed because of the different instrument. Moreover it could be caused by bias during interviews. One of obstacle in this research was children were' interviewed using a questionnaire. At the time of the recall of children' physical activity, they often forgot their activity, moreover many of the students answered lazily. Subjective measurements could cause overestimation or underestimation thus it is not appropriate to describe the real physical activity of children. Furthermore, physical activity instrument is needed to assess the duration, intensity, frequency, so it can accurately assess children's physical activity (Rauner *et al*., 2013).

Low physical fitness could be improved by regular physical activity. The result in this research showed that most children's physical activity level were light. It is important to be addressed because it could cause negative impact for their health. Physical activity is related with physical or mental health. Good physical activity is important for optimal children's growth and development. Weight bearing activity is important for skeleton development during childhood and adolescent and could help optimal peak bone mass on young adults (Gibney *et al*., 2008).

Based on the result in this research, children's physical activity could be improved to prevent the increase prevalence of overweight or obesity. Overweight in children could keep on into adulthood. Overweight in young age have higher risk for obesity later than normal (Rimbawan and Siagian, 2004). Dr Winick showed that children who had obesity around 4 years of age were 80% likely to be obese in adulthood (Soenardi, 2011). Obesity in children can lead to degenerative diseases such as diabetes mellitus, dyslipidemia and hypertension which can lead to an increase in coronary heart disease (Ruiz *et al*., 2006).

WHO recommends that physical activity for the age group 5-17 years at least 60 minutes, ranging from moderate to vigorous activities. The recommended daily physical activity is aerobic activity. The types of physical activity that can be done such as brisk walking, running, biking, jumping rope and swimming. Physical activity can improve cardiorespiratory fitness and muscle strength, bone health and cardiovascular health. Physical activity can strengthen bones and muscles if performed at least 3 times a week. Physical activity is recommended for students who are less active and should be done in stages ranging from the duration, frequency and intensity so it would not endanger health (WHO, 2010).

Conclusion: Physical fitness in overweight children were lower than normal children. Nutritional status was influenced physical fitness among elementary school children.

Suggestion: The results of this study indicated the level of physical activity and physical fitness among elementary school children were low. Therefore, improvement is necessary through a program inserted in school curriculum to increase physical activity or physical fitness in children. It is expected that students will have better physical fitness.

There need to be more research that examines the relationship between physical fitness of children to health biomarkers, such as bone system or the cardiovascular system, because this information is important to predict future health of school children who are the future generation.

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