

The Effect of Physical Activity on Body Composition in 9 and 10 Years Old Children

Nawan Primasoni¹, Sugiyanto², Furqon Hidayatullah³, Muchsin Doewes⁴
{nawanprimasoni@student.uns.ac.id¹, sugiyantoprobo@gmail.com², furqon@fkip.uns.ac.id³}

Universitas Sebelas Maret, Surakarta, Indonesia^{1,2,3,4}

Abstract. This study examined the effect of football on body composition in children. It was designed with one group pre and post-test involving 9-year-old (n=22) and 10-year-old (n=18) children at the Football School of Universitas Negeri Yogyakarta. This study was conducted three times a week for six months by measuring height and weight. The pretest results showed, most of children in the 9-year-old group were healthy weight (91%). While the posttest indicated a change. The number healthy weight children was 19, while the underweight and overweight children remained the same. In the 10-year-old group, the most children were also healthy weight (10 children), while the post-test results showed that the number of underweight, healthy, overweight, and obese children were 2, 10, 2, and 4 respectively. Football is a sport with an anaerobic predominant energy system in which to produce energy comes from carbohydrates more than 90% and fat less than 10%.

Keywords: Physical activity, body composition, children

1 Introduction

Physical activity is a basic function of human life. WHO, 2010 physical activity is a movement of the body produced by skeletal muscles that requires energy. Children and adolescents obtain physical health from the physical activity undertaken, including the benefits of bone health [1]. Although there are many benefits of physical activity, not all children can do it well [2]. Physical activity is any bodily movement with the help of muscles, producing energy expenditure, energy in the form (kilocalories) continued from the least, positively correlated with physical fitness [3]. Physical activity that is planned and programmed regularly and aims to improve and to maintain fitness is usually defined as exercise.

Pate (1993) defined exercise as a systematic effort aimed at increasing physical functional capacity and endurance to improve sports performance. Bompa (1990) stated that exercise is a systematic sports activity in a relatively long time to form physiological and psychological functions for achieving certain needs. Exercise provides benefits to the human body, including 1) prevent diseases by expediting body's metabolism and blood circulation, 2) build ideal body growth since the calories

in the body will be used perfectly, and will not lead to fat gain, 3) build a more robust body because it helps all parts of the body to be more flexible [4].

Four main purposes of human to do football as sports include (a). recreation, (b). educational goals, (c). to reach a certain level of physical fitness, (d). to achieve certain goals or achievements. More than 150 articles in 35 international journals that have been reviewed state that football is a sport that is fun, popular, and effective for health. It can be used to establish social relationships and its' positive effects are applicable for all genders and age levels [5-7]. Forty percent of children aged 10 to 18 are fond of football [8].

Body composition is the proportion of fat and fat-free tissue in the body. It means the percentage of fat from the total body weight and Body Mass Index, which is translated into fat and non-fat mass in the body. Muscles, bones, and organs are non-fat mass in the body, while the elements are muscles (40-50%), bones (16-18%), and body organs (29-39%). Fat mass is expressed in percentage of total body weight. In general, it can be concluded that the smaller the percentage of fat, the better the performance of a person.

Assessing body composition can be used to determine the optimal weight for health and physical performance abilities. Some terms that are often used and should not be separated are as follows:

1. Overweight is a deviation from the ideal body weight to height.
2. Overfat is the percentage of excess body fat. In men ideally, it is 2 to 3 percent and in women is 8 to 12 percent.
3. Obesity is the excess of adipose tissue produced by excessive energy intake than the energy expenditure

The growth and development of children are influenced by the environment. Physical activities carried out by children will affect their growth. Physical activity needs to be developed and carried out to prevent adverse effects on other aspects of development [9]. Bone and muscle growth in children is affected by the stimulus of physical activity. Growth norms in children are very closely related to the child's health, body, and mental status [7]. Realizing the importance of growth, in Indonesia, monitoring and measurement of children's body height and weight is performed to observe the child's growth compared to the normal curve

2 Method

The experimental group consisted of 22 children aged 9 years and 18 children aged 10 years who practice football at the Football School of Universitas Negeri Yogyakarta. The sample used the entire population in the range of 9 to 10 years. The physical activity program was implemented through football training and exercise for 90 minutes per session by dividing 15 minutes of warm-up sessions, 60 minutes of core sessions (technical training and games), and 15 minutes of cooling sessions. This study was conducted three times a week for six months at 15.00-16.30 WIB. The training session was led by 4 trainers who supervised and implemented the program. The children's weight was measured with a digital scale and the height was measured

with a calibrated stadiometer. Body mass index was measured using the Excel program. This study was approved by the Faculty of Sport Science, Universitas Negeri Yogyakarta, Health Sports Center, and related parties. After explaining the method to the parents, an agreement was reached between the two parties. Participation in this study was voluntary, children were free to participate and stop at any time. The sample received preliminary tests in May 2019 and treatment for six months. In November 2019, a post-test was carried out in the form of height and weight measurements. Post-tests were carried out in the same place to minimize other variables. The method used in this study was the Quasi Experiment, with one group pretest-posttest design. Data were analyzed with a T-test using SPSS 16.

3 Results and Discussions

The differences in BMI Percentile of the children aged 9 years before and after the treatment were analyzed with a BMI percentile test using the Child Body Mass Index Calculator. The pretest results showed 1 underweight child, 20 healthy weight children (91%), 1 overweight child. While the results of the posttest indicated a change, where there was 1 overweight child, and healthy weight children became 19 children, while the underweight and overweight children remained the same. Based on these results, the differences before and after the treatment is at an average of 18.0 (BMI in kg / m^2).

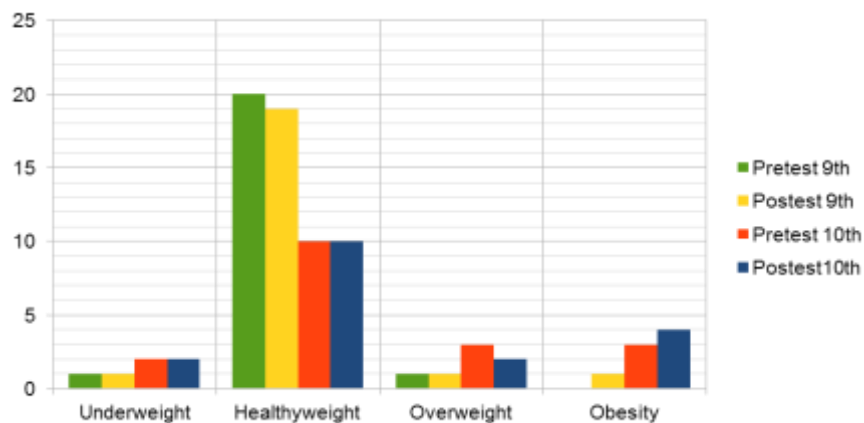
The differences in BMI Percentile in children aged 10 years before and after the treatment was assessed by performing a BMI percentile test using the Child Body Mass Index Calculator. Based on these results, there were 2 underweight children, 10 healthy weight children, 3 overweight children, and 3 obese children. While the posttest results indicated changes, there were 2 underweight children, 10 healthy weight children, 2 overweight children, and 4 obese children. Based on these results, the differences before and after the treatment is at an average of 6.7 (BMI in kg / m^2).

BMI-for-age weight status categories and the corresponding percentiles: Underweight (Less than the 5th percentile), Normal or Healthy Weight (5th percentile to less than the 85th), Overweight (85th to less than the 95th percentile), Obese (Equal to or greater than the 95th percentile).

BMI percentile measurement aims to determine the range of a healthy body and can be one of the predictive indicators of health problems. BMI measurements use a measuring tool in the form of a weight scale to measure weight and a stadiometer to measure height. Measurement results can be seen in tables and diagrams. These results can be used to provide an overview and treatment plans for children who are in the underweight category to gain weight to be healthy/ideal, children in the healthy category to maintain the Body Mass Index and most importantly, for children in the overweight and obesity category to lose weight to be healthy/ideal. Children in the healthy weight category will naturally have a small risk of mental and health problems.

Table 1. BMI Frequency Distribution

Category BMI	Terminology	9 years				10 years			
		n = 22				n = 18			
		Pretest		Posttest		Pretest		Posttest	
		n	%	n	%	n	%	n	%
<5th percentile	Underweight	1	4.5	1	4.5	2	11.1	2	11.1
5th–84th percentile	Normal	20	91	19	86.5	10	55.5	10	55.5
85th–94th percentile	Overweight	1	4.5	1	4.5	3	16.6	2	11.1
≥95th percentile	Obesity	0	0	1	4.5	3	16.6	4	22.2
Mean BMI		38.2		56.2		57.8		64.5	
Difference		18				6.7			

**Fig. 1.** Pretest and posttest BMI percentile

Height and weight ratios, body mass index (BMI), provide another way of categorizing levels of overweight and physical status early. Physical activity has an important role in physical development, psychosocial, and child mentality especially in childhood and early childhood (Dubuy, 2014). The often-quoted health benefits of physical activity for young people include the prevention of obesity; improvement in the framework of health; improved heart and lung function; and better psychological health.

Underweight children can be caused by the consumption of large amounts of food and large amounts of fluid which only fills the stomach but does not supply much energy for children. Active children need additional energy with food. One must also consider genetic predispositions in some cases of underweight children. Genetics, age, sex, nutrition, physical activity, hormonal status, health, and environmental conditions are important for normal weight in children. Some children

may gain weight slowly, others gain weight quickly. Thus, normal weight in children may also be different from this point of view. BMI is a good indicator to determine normal weight, underweight, overweight, and obesity levels in children.

Some documents state that overweight and obesity in children can be a trigger for health problems such as asthma, psychological disorders, and respiratory disorders [10,11]. One of the factors causing overweight and obesity is the lack of physical activity that is both structured daily and monthly. Physical activity routinely carried out from childhood to the old age is very influential in the process and health for life. The causes of obesity in children are numerous and include genetic predispositions, biological factors, behaviors, and cultural specificities. If one parent is obese, the chance of obesity in a child is 50%. When both parents are obese, the chance of being overweight in children is 80%. Obesity in children presupposes reducing the number of calories consumed and increasing the level of exercise.

The treatment includes setting reasonable and achievable weight loss goals, effective diet and physical activity management, changes in behavior patterns, and family participation. Obesity in childhood is a pandemic problem in various countries in the world today. Overweight and obesity are multidimensional problems because almost all groups can be affected, not only the upper-middle socioeconomic group but the middle and lower-middle classes. Determination of nutritional risk is an early detection effort to identify the target group to prevent the incidence of overnutrition and obesity in children and to avoid or reduce the impact of Non-Communicable Diseases. WHO recommends a physical activity program as one of the methods to achieve a healthy body size for children [12].

Experts even emphasize the risk of a new generation becoming less healthy than the previous generation due to the increasing number of overweight children, unhealthy eating, and inadequate physical activity. Prevention of overweight in children is the best approach to avoid problems related to excessive weight gain. Healthy eating and adequate physical activity are the determining factors in cases of being overweight in children. Adequate physical activity is an important approach to weight loss.

Various scientific studies show that overweight can occur due to three factors, namely: a) genes (heredity), b) patterns of physical activity, c) patterns of food consumption. Genetic factors become one of the factors that cause overweight related to the body's metabolic rate. Individuals with slow metabolic rates are more at risk of overweight and obesity. Some health experts reveal that genetic factors are not the main factor in overweight in children, this can be seen by the increasing magnitude of overweight prevalence from year to year, while genetic changes in the last three decades did not occur. Therefore parents do not have to blame heredity but respond to how the pattern of activity and food patterns in children. Eating factors need to be considered. Calories in which is greater than calories out in the body are the determining factors for overweight. Factors of physical activity patterns are factors that can be improved in overweight children. Children with minimal physical activity will be usually overweight. Physical activity with the concept of playing will be very suitable for children. Physical activities such as football are healthier than physical activities of playing video games that require less movement and less energy [13].

A form of endurance physical activity which does not require a fast movement, so the formation of ATP occurs with aerobic metabolism. Adequate oxygen (aerobic

conditions) will occur where the body uses more oxidative energy systems that choose fat as the source of energy used. Glycogen which is the raw material will be broken down completely into CO₂ and H₂O and produce a number of ATP. Aerobic systems produce energy in a relatively long time, but the amount of energy produced is more. So it can be used for longer movements. People who are overweight/obese are advised to do a lot of physical activity or exercise using the aerobic predominate energy system because overweight / obese people have fat reserves that can be used as the body's fuel sources.

Physical activity such as football is one sport with a high level of intensity. Football is a sport with an anaerobic predominant energy system where the energy released to produce energy comes from carbohydrates more than 90% and fat less than 10%. This sport is not suitable for weight loss but it should be considered and investigated, how to implement football with moderate intensity where fat is the main source of energy with changes in the rules and the field.

Table 2. Energy Sources for Various Types of Activities. Source: Giam and Tea (1993).

Aerobic Activity	Intensity		Energy sources (%)	
	VO ₂ Max (%)	Max BPM (%)	Carbohydrates	Fats
Low Mediu, Aerobic	< 50	< 70	25-50	50-70
Medium High Aerobic	50-60	70-80	< 25	> 75
Very Heavy Maximum Aerobic	60-90	80-95	> 90	< 10
Anaerobic	> 90	> 95	> 90	< 10

Physical activity that uses fat as the largest source of energy is moderate to severe aerobic, with a maximum pulse rate of 70-80 percent. Football will be an effective sport in losing weight if the rules and systems are modified so that the maximum heart rate is between 70-80 percent of the maximum heart rate. The role of training or sports teacher is very influential, especially in planning training programs and measuring the intensity of training.

4 Conclusion

Actions to reduce overweight and obesity can be done in various ways, one of which is to exercise. Not all exercise is effective for weight loss. Jogging and walking are forms of exercise that can lose weight, but both types of exercise are relatively boring because of monotonous movements. Children who are fond of football need to be treated specifically with certain rules in pating football to lose weight. It should not reduce the element of fun playing which is an integral part of the lives of children. Football is a sport that emphasizes the concept of play. This can be used as a medium to improve certain skills and abilities in children. Playing helps children to channel more energy to prevent them from negative activities. Besides, playing will function as a process of sublimation to escape from excessive stress toward positive things. The process of sublimation will assist children to be more creative, better, and more

organized in their lives. Aside from the psychological aspect, it also contributes to health and weight loss.

References

- [1]. Barlow, S. E, & et al. (2007). Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. American Academy of Pediatrics..
- [2]. Carl J. Caspersen, Kenneth E. Powell and Gregory M. Christenson (1985). Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for HealthRelated. Published Vol. 100, No. 2 (Mar. - Apr., 1985), pp. 126-131 by: Sage Publications, Inc.
- [3]. Erick Burhaein (2017). Aktivitas Fisik Olahraga untuk Pertumbuhan dan Perkembangan Siswa SD. Vol 1 No 1 (2017) 51-58 Indonesian Journal of Primary Education. Indonesian Journal of Primary Education -Vol 1 No 1 (2017) 51-58-<http://ejournal.upi.edu/index.php/IJPE/index>.
- [4]. Giam, C.K dan Teh, K.C. 1993. *Sport Medicine Exercise and Fitness*. Singapore: PG Publishing Pte Ltd.
- [5]. Howie, E. K., & Pate, R. R. (2012). Physical activity and academic achievement in children: A historical perspective. *Journal of Sport and Health Science*, 1(3), 160–169. <https://doi.org/10.1016/j.jshs.2012.09.003>.
- [6]. Khan KM, Thompson AM, Blair SN, et al. Sport and exercise as contributors to the health of nations. *Lancet* 2012;380:59–64.
- [7]. Matthew Pearce, Sarah Webb-Phillips, Isabelle Bray. (2015). Changes in objectively measured BMI in children aged 4–11 years: data from the National Child Measurement Programme. *Journal of Public Health* | Vol. 38, No. 3, pp. 459–466 | [doi:10.1093/pubmed/fdv058](https://doi.org/10.1093/pubmed/fdv058) | Advance Access Publication May 6, 2015
- [8]. Tanner, J.M., Whitehouse, R.H., Marubini, E., & Resele, L.F. (1976) The adolescent growth spurt of boys and girls of the Harpenden growth study. *Ann Hum Biol*3:109-26.
- [9]. Oja P, Titze S, Kokko S, et al. Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with metaanalysis. *Br J Sports Med* 2015;49:434–40.
- [10]. Pedersen BK, Saltin B. Evidence for prescribing exercise as therapy in chronic disease. *Scand J Med Sci Sports* 2006;16(Suppl 1):3–63.
- [11]. Sallis RE. Exercise is medicine and physicians need to prescribe it!. *Br J Sports Med* 2009;43:3–4.
- [12]. U.S. Department of Health and Human Services. (2008). Physical activity guidelines advisory committee report. Washington, DC: USDHHS.
- [13]. Veerle Dubuy, Katrien De Cocker, Ilse De Bourdeaudhuij. (2014). Diet And Physical Activity In Children And Adolescents From A Lower Socio-Economic Background: A Controlled Pretest-Posttest Design. Dubuy et al. *BMC Public Health* 2014, 14:457