

## Relationship between Body Mass Index, Age, and Muscular Endurance among Soccer Players in Medan, North Sumatra

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### ABSTRACT

**Background:** Maintaining body mass index is one of the social problems, especially for young athletes. This study aimed to determine the relationship of body mass index (BMI) and age to muscular endurance in soccer athletes in Medan.

**Subjects and Method:** This was a cross sectional study soccer clubs in Medan, North Sumatra, Indonesia, in April 2018. A sample of 96 soccer players was selected for this study. The dependent variable was muscular endurance. The independent variables were BMI and age. Body weight was measured by weight scale. Body height was measured by microtoise. The other data were collected by questionnaire. Muscle endurance was assessed by 1 minute push up test. The data were analyzed by Person product moment.

**Results:** BMI was positively correlated with muscle endurance but it was not statistically significant ( $r = 0.09$ ;  $p = 0.390$ ). Age was positively correlated with muscle endurance and it was statistically significant ( $r = 0.62$ ;  $p = 0.001$ ).

**Conclusion:** BMI and age are positively correlated with muscle endurance among soccer players.

**Keywords:** BMI, muscle endurance, soccer athlete

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### BACKGROUND

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The current branch of soccer is one of the sports that is loved by all levels of society and age. To achieve good performance, an athlete and soccer player must be supported by good physical condition. The indicator of good physical condition is to have a good picture of physical fitness (Kusmaedi, 2008 in Masudin 2018). Physical fitness is a condition for athletes to improve and develop sports achievements. Physical fitness is the ability of an athlete to be able to carry out daily activities without causing fatigue. Physical fitness consists of 10 components and must be owned by an athlete, among others; muscle strength, muscle endurance, speed, muscle explosive power, agility, flexibility, balance, accuracy, coor-

dination, and reaction time (Masudin, 2018). Physical conditions can also determine athlete's performance in athlete success and achievement (Ahmetov et al., 2015). Athlete performance is influenced by many factors, one of which is muscular endurance.

Muscular endurance represents the muscle to use the maximum force repeated over a period of time, or the duration of certain muscles that can maintain a percentage of 1-RM (One-Repetition Maximum) dynamically and methodologically (Katch et al, 2011). Muscular endurance is influenced by several factors, namely, the ability of mitochondrial oxidation, ATP synthesis, and types of muscle fibers (Yang et al, 2003). In athletes who are oriented to muscular

endurance, they usually have a greater number of type I muscle fibers (slow-twitch, fatigue-resistance) in their muscles so that this causes muscle contraction that can last longer on muscular endurance (Ahmetov et al, 2015). Football is one of the sports which is dominated by muscular endurance (Stolen et al, 2005)

In adolescence, excess body weight is a problem (Paramurthi, 2014). It was found that the prevalence of obesity throughout the world increased 2x over the years (WHO, 2015). The cause of increased BMI is a result of the imbalance of energy released with food consumed (WHO, 2015). BMI is one of the easy and simple ways to assess the high period of body fat (Pudjiadi, 2010).

Body mass index has an inverse relationship with fitness level, meaning that the higher the IMT value, the lower the fitness test score. This has been proven in the results of previous studies, namely that adolescent athletes who have BMI values in the overweight category will show lower fitness test results than the normal category (Utari, 2007)

Soccer game is one sport that is categorized into high activity that requires high muscle endurance, so it will consume a lot of energy. Because muscle endurance is very important for a soccer ball player, the researchers are interested in conducting further study on the relationship between body mass index, age and muscle endurance by using physical training methods to push up soccer athletes in several soccer clubs. in Medan City, North Sumatra.

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## **SUBJECTS AND METHOD**

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### **1. Study Design**

This study uses analytic observers with the application of specific cross sectional study designs. The research was conducted in April 2018 in several clubs (3 clubs) soccer

athletes located in Medan City, North Sumatra.

### **2. Population and Samples**

The target population in this study were 96 soccer athletes who were adjusted to the inclusion criteria and exclusion criteria in several football clubs in Medan (SSB Club, USU PS Club, part of the Patriot Club). The sampling technique in this study was to use consecutive sampling.

The inclusion criterion in this study was > 15-19 years old, underwent regular training in soccer clubs, was healthy and did not experience chronic diseases, and had no history of pulmonary and cardiovascular disease while the exclusion criteria were not experiencing muscle or muscle injury and bone, obesity, and smokers.

### **3. Study Variables**

The variables used in this study were BMI, age and muscle endurance. Meanwhile, the dependent variable is muscular endurance and the independent variables are body mass index and age of the athlete.

### **4. Variable Operational Definitions**

Muscle endurance is the ability of the muscles to be able to perform and maintain muscle contractions repeatedly in a certain time (Kenney et al, 2012). Muscle endurance will represent the muscle to use maximum repetitive force over a period of time, or muscle duration to be able to maintain one-repetition maximum (1-RM) dynamically and methodologically (Katch et al, 2011).

Body mass index is a measure of relative weight based on individual mass and height. Currently it is generally used to classify underweight, overweight and obesity. BMI is calculated by dividing the individual body weight in kilograms according to his height in meters, then dividing the answer with his height again (Kolimechkov, 2014).

Age is a unit of time that can measure the time of existence of an object or creature, both living and dead. For example, the age of a human being is said to be fifteen years measured since he was born until the age was calculated. By that, age is measured from the time of birth to the present (MOH, 2013). The age of the subject is adolescence (12 years-25 years) (WHO, 2009).

### 5. Study Instrument

Age was measured using a questionnaire. Body weight was measured by weight scales. Height was measured by microtoise. BMI was calculated using the formula weight (kg)/ height (m<sup>2</sup>). The BMI category was thin (<18.5), normal (18.5 to 24.9), overweight (25-29.9), and obese (>30) (Kolimechkov, 2014).

Muscle endurance is measured by a push up test. Start with a standard push-up position with the body weight resting on your hands and feet, with your body and back straight. Lower the subject's body until the subject's chest touches the second hand's fist. Calculate the number of push ups that are done in sequence correctly. Each time you lift and lower your body, head, back, and lower legs remain straight. Every time the body lifts are counted 1x. The implementation of push ups is done in 1 minute. The test is terminated if done with an improper technique for two repetitions in sequence. This test is a common test performed to test the general level of muscle resistance.

**Table 1. Normal Value of Push-up Test Based on Age and Gender**

Age (years old)	15-19		20-29		30-39		40-49		50-59		60-69	
	M	F	M	F	M	F	M	F	M	F	M	F
Very Good	≥39	≥33	≥36	≥30	≥30	≥27	≥25	≥24	≥21	≥21	≥18	≥17
Good	29-38	25-32	29-35	21-29	22-29	20-26	17-24	15-23	12-20	11-20	11-17	12-16
Moderate	23-28	18-24	22-28	15-20	17-21	13-19	13-16	11-14	10-12	7-10	8-10	5-11
Poor	18-22	12-17	17-21	10-14	12-16	8-12	10-12	5-10	7-9	2-6	5-7	2-4
Very Poor	≤17	≤11	≤16	≤9	≤11	≤7	≤9	≤4	≤6	≤1	≤4	≤1

The test officers were 2 people, the first to be in charge of measuring the subject's antropometry (weight and height) and demographic data; The second officer makes sure the position of the hand is perpendicular when the subject is doing push ups, whether the chest and back of the subject are straight and ascertain whether the subject's chest touches the fist when the chest drops towards the bottom while counting and noting the number of push ups performed by the subject the length of time that the subject does in doing push ups. After being done for 1 minute and counted, then adjusted to the push up value

table according to age. (Katch et al, 2011; Haff et al, 2012).

### 6. Data Analysis

Data were analyzed in univariate and bivariate. Bivariate analysis used the Spearman test to carve out the relationship of age and BMI on muscle endurance.

## RESULTS

### 1. Univariate Analysis

Table 1 showed the characteristics of research subjects based on age, BMI, and muscular endurance. Table 2 showed a description of the data in a continuous form. Table 2 showed that the average age of the study

subjects was 17 years old, had a normal BMI, and good muscle endurance.

**Table 1. Characteristic Samples**

Characteristic	Frequency (f)	Percentage (%)
<b>Age Group</b>		
15 years old	22	22.1
16 years old	10	10.41
17 years old	15	15.6
18 years old	20	20.8
19 years old	14	14.5
20 years old	12	12.5
21 years old	3	3.12
<b>BMI</b>		
Underweight	14	14.5
Normal	68	70.8
Overweight	12	12.5
Obesity	2	2.08
<b>Muscle Endurance</b>		
Very good	50	52.1
Good	9	9.4
Moderate	14	14.6
Poor	22	22.9
Very poor	1	1

**Table 2. Descriptive data on BMI and muscular endurance**

Variables	Mean	SD	Minimum	Maximum
<b>BMI (kg/m<sup>2</sup>)</b>	20.9	2.3	15.7	29.6
<b>Muscular endurance</b>	34.4	11.3	17	52
<b>Age</b>	17.4	1.8	15	21

**Table 3. The correlation of BMI and age with muscular endurance**

Variables	n	r	p
BMI	96	0.09	0.390
Age	96	0.62	0.001

## 2. Bivariate Analysis

Table 3 showed that BMI has a positive correlation with muscle endurance but it was not statistically significant ( $r = 0.09$ ;  $p = 0.390$ ). Age was positively correlated with muscle endurance and it was statistically significant ( $r = 0.62$ ;  $p = 0.001$ ).

## DISCUSSIONS

The results showed that the age of most research subjects was at the age of 15 years old (22.1%). The average test score for push up for soccer teen athletes was 34.5 x /

minute. The average BMI of a soccer athlete was 20.9 kg/m<sup>2</sup>.

### 1. The Relationship between BMI and Muscular Endurance

In adolescence, there would be a rapid growth period and changes in body composition which affected physical activity and response to exercise.

The results showed that BMI was positively correlated with muscle endurance but it was not statistically significant.

A study by Utari (2007) showed that there was a negative relationship between muscle resistance BMI. Muscle endurance

was measured by an endurance test for 30 seconds. The higher the BMI, the lower the value of muscle endurance.

Nichholaidis (2013) reported that the higher the BMI, the lower the body's performance. Body weight has a negative effect on the athlete's physical performance. Chen et al. (2006) also reported that children and adolescents with normal weight would have a superior performance in muscle endurance compared to children who were overweight.

Rhomadani (2015) in Yogyakarta reported that athletes with high BMI had low fitness (muscle endurance) values. This study was in line with Mak et al. (2010). Research on groups of adolescents aged 13-18 years old showed that overweight would give lower performance in most of the tests performed (Artero et al, 2010).

## **2. The relationship between age and muscular endurance**

The results of this study indicated that age was positively correlated with muscle endurance and it was statistically significant. Utomo (2010) showed that there was a significant relationship between muscular endurance and age.

A study by Hapsari (2011) using sit-up tests showed that there were significant differences between the tests performed. This was in line with Moeloek (1984) in Permaesih (2000) which showed that increasing age would affect a person's fitness status. As age increased, the mass of free fat would decrease by 15%. This change was related to the low level of physical activity, nutritional intake, and hormonal changes. The loss of muscle mass and minerals would be followed by loss of body fluids (Brown et al., 2005).

Physical fitness at the age of children and adolescents would increase and can reach maximum values at the age of 25-30 years old, and there would be a decrease in

the functional capacity of the whole body by approximately 0.8-1%/year. However, if people did a lot of exercise, the decline would be reduced completely (Wiarto, 2013 in Masudin, 2018).

The results of this study prove that the need for a personal approach in terms of understanding muscular endurance. Knowledge of the strengths and weaknesses of each athlete can help develop the optimal training program for the next athlete. BMI, age, and muscle endurance would be able to experience changes based on the program implemented. For example, with a basic training program that was carried out routinely for several months, it can reduce the body weight by 1.2% and a BMI of 1.3%, and can increase O<sub>2</sub> max up by 0.2% and push up values by 58.4% (Yanovich et al, 2005).

The cross sectional design in this study has limited time. Therefore, it was expected that in the further study, the researcher can monitor the athletes for a longer time to examine the effects of body fat on physical fitness, especially muscular endurance athletes (Pirainen et al, 2008). Another limitation was in the number of samples taken only at a number of athlete clubs and not for all soccer athlete clubs in Medan.

The variation would also be different between normal BW and BW over the value of push up (endurance) of 1 minute that was done by older soccer athletes (Maric et al, 2013).

Based on the measurement results of the push up test, the average score of push ups in 1 minute for soccer athletes in Medan was 52.1% (very good). However, the average value of push ups cannot be used as an indicator to determine whether an athlete has good overall muscular endurance. There were still many endurance tests that can be used as parameters for

muscular endurance, but this push up score can be assumed that the higher the push up score, the better the muscular endurance would be. This was in accordance with previous studies which stated that one of the factors that determine the success and performance of athletes, especially soccer athletes, was that they must have good muscular endurance (Ag et al, 2016).

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