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Investigation of maximal oxygen consumption capacity and body composition in children

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Abstract

The purpose of this study is to examine maximal oxygen consumption and body composition in children. The subjects of the study consisted 80 girls with mean age of 12.12±0.43 years old and 130 boys with mean age 12.10±0.40 years old. All of the 210 subjects joined the study volunterily. At the end of measurements, the mean values for girls found to be as follows: weight; 48.03±8.73 kg, height; 151.15±5.86 cm, body mass index (BMI); 20.93±04.20 kg/cm2, for boys weight; 43.23±7.10 kg, height; 147.90±8.26 cm, BMI; 19.53±03.43 kg/cm2. Age of children, who joined in study, was smilar characteristic. According to results statistical significant analysis performed; there is no significant differences between of the gender, in the datas, which are body weight, body size and maximal Oxygen consumption (maxVO2) ($p>0.05$). There is significant differences between of the gender, in the datas, which body weight (p 0.002), BMI (p 0.002) and body fat percent (p 0.002). According to results statistical significant analysis performed; there is significant differences between of gender in data of endomorphy ($p<0.05$), but there is no significant differences between of gender, in datas in mesomorphy and ectomorphy components ($p>0.05$). Endomorphy component of girls were higher than boys, because the girls' body fat percentage higher than boys. Although mesomorphy component of boys was higher than girls, there is no significant differences between of gender. Again, it is seen that the boys and girls have similar values of ectomorph components.

Keywords: Somatotype, maximal oxygen consumption, children

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1. Introduction

Aerobic capacity is maximum oxygen amount (VO^2max) that used by person in one minute. At a certain time how much oxygen is used, so many adenosine triphosphat (ATP) can produced (Crawford, 1996). Aerobic capacity usually determined by measuring the VO^2max. Increased oxygen use with maximal exercise, it is closely related to the training level, genetics, age and gender (Crawford, 1996, Armstrong & Welsman, 1994). VO^2max can increase with aerobic training in children (Falk & Bar-Or, 1993; Malina & Bouchard, 1991; Rowland, Vanderburgh & Cunningham, 1997). To evoluate the effects of exercise in children and metabolic and cordiorespiratory comment on the profile primarily it depends on the measurement of the VO^2max. VO^2max is important in this respect (Welsman & Armstrong, 2000).

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Children, maximal oxygen consumption increases with age in both sexes. Slight increase observed between 9-13 years, it accelerated puberty and reaches a peak about 14 years. Increase in the value of maximal oxygen consumption, similar increases in height and weight (Rowland, 1998; Lohman, Roche & Martorell, 1988; Heath & Carter, 1990; Leger & Lambert, 1982; Leger, 1996). Maximum oxygen consumption of a person's body weight and active skeletal muscle tissue is known to be largely dependent. Women's overall body size, body weight and maximal oxygen consumption values because they are smaller and lighter than males in lean body mass is lower in women. Maximal aerobic power in children, body size,sexual maturation level and is associated with sex that men are more likely than girls of all ages average maximal oxygen consumption values (Payne & Morrow, 1993; Rowland, 1990). The aim of this study was to examine somatotype profiles and maximal oxygen consumption in children.

2. Materials And Methods

2.1. Subjects

Total 210 students were participated to the study. The subjects of this study consisted of 130 healthy male students with mean age of 12.10±00.40 years old, height of 147.90±05.33 cm and weight of 43.22±07.10 kg and 80 female students with mean age of 12.12±00.43 years old, height of 151.15±05.33 cm and weight of 48.22±07.10 kg. All children included in the study, engine performance testing and anthropometric measurements were performed. All measurements are parents of students with approved permit from the local government posts and was carried out with the permission of the school management. In addition, all students must be volunteers were sought before starting the research.

2.2. Procedures

2.2.1. Anthropometric Measurements

Standard anthropometric methods were used to determine somatotypes, body mass, body height and all of skinfold and circumference measurements. All of the anthropometric measures were based on Anthropometric Standardization Reference Manuel (Lohman, Roche & Martorell, 1988). The holtain skinfold caliper (Holtain United, Dyfed, UK) was utilized in skinfold measurements.

Somatotype was determined from the following equations (Heath & Carter, 1990):

Endomorphy = $- 0.7182 + 0.1451(X) - 0.00068 (X)^2 + 0.0000014(X)^3$

Where; X = sum of supra-spinale, subscapular and triceps skin fold and corrected for stature by multiplying the sum of skin folds by 170.18/Body Height in cm

Mesomorphy = (0.858 x Humerus width) + (0.601 x Femur width) + (0.188 x Corrected arm girth) + (0.161 x Corrected Calf Girth) - (Body Height x 0.131) + 4.5

Where; Corrected Arm Girth = Arm girth-Biceps skinfold, Corrected Calf Girth = Calf Girth-Calf skinfold.

Ectomorphy = (HWR x 0.732)-28.58

Where HWR = (Body Height in cm)/ $(\text{weight in kg})^{0.33}$

2.2.2. The multistage 20 metre shuttle run test

Multistage Shuttle Run was used to determination aerobic fitness. This test is performed in 20-meter shuttle run test, the designated area. To determine an athlete's aerobic capacity and performance Leger and Lambert (Leger & Lambert, 1982), designed by a field test. For the 20 m shuttle run test, subjects are required to run back and forth on a 20 m courst and must touch the 20 m line at the same time that a sound signal is emitted from a prerecorded tape. The frequency of the sound signals increases in such a way that running speed is increased by 0.5 km h^{-1} each minute from a starting speed of 8.5 km h^{-1}. The test stops when the subject is no longer able to follow the set pace. The last announced stage number or the equivalent maximal aerobic speed is then used as the VO^2max index (Leger & Lambert, 1982; Leger, 1996).

Data obtained from tests are divided into two groups for anthropometric measurements and performance criteria. Anthropometric data obtained from measurement, Durning Womersley, using regression formulas developed for children up to the age of 17, is used to calculate body fat percentage indirectly. To find the body fat percentage, body fat formula was used in Siri percent density values obtained. Thus, percent body fat values were calculated.

2.2.3. Siri equation Body Fat Percentage

Body Fat Percentage = [(4.95 / Body Density) -4.5) x 100

2.2.4. Durn and Womersley body density equation

Girl children; Body Density = 1.1553-0.0643 x X

Boys; Body Density = 1.1369-0.0632 x X

X = log (biceps + triceps + subscapular + suprailiac)

2.2.5. Statistical Analysis

Statistical analyses were performed using IBM 22.0 SPSS Statistics for Windows. All values are expressed as mean ± standard deviation (SD). In order to detect differences between groups, Independent Sample t-test was used. Statistical significance was established a priori at $p<0.05$.

3. Results

According to the age group of male subjects participated in the study, height, weight and body mass index, average somatotype profile and aerobic value, standard deviation, minimum and maximum values are shown in table 1.

Table 1. Male Age, height, weight, body fat percentage and BMI, aerobic power and Somatotype values.

n=130	Mean + S.D.	Minimum	Maximum
Age(year)	12.10±01.46	09.59	14.56
Height (cm)	147.90±08.26	130.40	167.00
Weight (kg)	43.23±07.10	28.60	69.06
Fat Percentage (%)	15.96±08.50	12.61	38.00
BMI (kg/cm^2)	19.53±03.43	17.69	27.40
Aerobic Power (ml.kg^{-1}.dak^{-1})	23.50±04.23	15.98	33.51
Mesomorph	04.07±01.22	01.65	08.33
Endomorph	03.88±02.45	00.92	13.63
Ectomorph	02.55±01.47	02.45	05.70

According to the age group of female subjects participating in the study, height, weight and body mass index, average somatotype profile and aerobic value, standard deviation, minimum and maximum values are shown in table 2.

Table 2. Girls age of subjects, height, weight, body fat percentage, BMI, aerobic power and Somatotype values

n=80	Mean ± S.D.	minimum	maximum
Age (year)	12.12±01.43	09.69	14.56
Height (cm)	151.15±05.86	139.00	168.00
Weight (kg)	48.03±08.73	29.60	84.70
Body Fat (%)	26.33±03.72	19.33	34.90
BMI (kg/cm^2)	20.93±04.20	14.78	29.67
Aerobic Power (ml.kg^{-1}.dak^{-1})	22.88±04.16	14.69	32.47
Somatotypes			
Mesomorph	03.71±01.48	00.38	07.67
Endomorph	04.58±01.81	02.05	09.36
Ectomorph	02.12±01.81	01.70	05.40

The physical properties of the subjects participating in the study, comparison of maximal oxygen consumption and somatotype profile is shown in table-3.

Table 3: Physical Properties of subjects, Maximal Oxygen Consumption and Comparison of Somatotype

Independent Samples Test							
	Levene's Test for Equatity of Variances		t-test for Equatity of Means				
	F	Sig.	T	Df	p	Mean Diff.	Std. Error Dif.
Age (year)	0.048	0.826	-0.072	209	0.942	-0.020	0.208
			-0.073	175.065	0.942	-0.020	0.206
Height (cm)	14.328	0.000	-3.080	209	0.002	-3.243	1.053
			-3.328	205.490	0.001	-3.243	0.975
Weight (kg)	0.002	0.966	-3.126	209	0.002	-4.808	1.538
			-3.140	172.284	0.002	-4.808	1.531
Body Fat (%)	18.458	0.000	-9.942	209	0.000	-7.078	0.712
			-10.915	208.445	0.000	-7.078	0.648
BMI (kg/cm^2)	3.471	0.064	-2.698	209	0.008	-1.401	0.519
			-2.602	150.021	0.010	-1.401	0.538
Aerobic Power ($ml.kg^{-1}.dak^{-1}$)	2.012	0.158	0.603	209	0.547	0.611	1.014
			0.590	158.328	0.556	0.611	1.036
Mesomorph	2.348	0.127	1.899	209	0.059	0.357	0.188
			1.814	145.412	0.072	0.357	0.196
Endomorph	5.682	0.018	-2.229	209	0.027	-0.703	0.315
			-2.388	202.962	0.018	-0.703	0.294
Ectomorph	4.657	0.032	1.879	209	0.062	0.428	0.228
			1.792	144.513	0.075	0.428	0.239

Age of children participating in the study is similar. The statistics of the results of gender-specific physical characteristics compared to male and female subjects participated in the study of the difference in age and size parameters not significant (p> 0.005), weight (p 0.002), body mass index (p 0.002) and body fat percentage (P 0.000) were found to be significant difference between the values (p <0.005).

Although there is no significant difference between the sexes in the length parameter, girls appear to be longer. Weight parameters as also is heavier than the boys and girls is seen that the difference is significant. Body fat percentage terms, it is observed to have a higher body fat percentage of girls compared to boys.

Used to determine the maximal oxygen consumption "Multistage Shuttle Run" test for determining aerobic power value, it showed no significant difference between boys and girls (P> 0.05). When analyzed in terms of the components of somatotype profiles endomorphy significant difference was observed between boys and girls (p <0.05) in the mesomorph and ectomorph components showed no significant difference between genders (p> 0.05). Depending on the value of the girl child's body fat percentage, it seems to be more dominant than the endomorph component boys. However, despite the high value of boys than girls in this component When the mesomorph, showed no significant difference between them (P <0.05). Again, it is seen that the boys and girls have similar values of the components of the ectomorph.

4. Discussion

This study, was conducted to examine maximal oxygen consumption and somatotype profiles of participants who are mean age of 12.10+0.40 year old, mean height of 147.90+5.33 cm, mean body weight of 43.22+7.10 kg 130 boys and mean age of 12.12±0.43 years old, mean height of 151.15±5.33 cm, mean weight of 48.22+7.10 kg 80 girls total 210 childrens.

Although there is not outweighs the opinion that it is not a strong relationship between physical fitness and physical activity in children, a lot of coach and sports scientist continues to associate with each other physical fitness and physical activity (Payne & Morrow, 1993).

Conceptually it believed to be an inverse relationship between fat and activity levels in children. But it is also true that despite many research carries two significant. 50 studies were evaluated as satisfactory criteria. 50 studies were evaluated as satisfactory criteria. 78% of study 4% revealing a negative association was found a positive association. 18% off at if there was no significant relationship (Rowland, 1990).

Armstrong at all.Have done it on anaerobic performance of British children, have examined the relationship between physical activity and maximal oxygen consumption. In this study, girls in physical activities with a significant relationship between aerobic and anaerobic fitness was reported not observed (Armstrong, Welsman & Kirby, 1998). Boreham et al girl in his study on a total of 1015 children boys and girls 12-15 years of age, as determined by survey method have found a significant relationship between physical activity and fat levels (Boreham, Twisk, Savage, Cran & Strain, 1997).

In our study, male maximal oxygen consumption in children 23.50 $ml.kg^{-1}.dak^{-1}$, while the girls are 22.88 $ml.kg^{-1}.dak^{-1}$ olarak was measured. In girls, depending on gender and development properties VO^2max values, showed a different development than boys (Malina & Bouchard, 1991; Rowland, 2000; Payne & Morrow, 1993). Studies in girls the measured values of maximal oxygen consumption at any age, the boys are said to be lower (Rowland, 2000). Eight-year-old daughter of the maximal oxygen consumption measured value of a child, the measurements made 14 years back is reported to have decreased by 10%. This decline, due to the increased fat mass, body composition and sex are linked to participation in physical activity and less growth (Malina & Bouchard, 1991; Rowland, 2000; Payne & Morrow, 1993).

To the rapid growth phase, while there is parallelism in the development of boys and girls as functional and biomotor is broken this parallelism in the rapid growth phase. Girls entering the rapid growth phase of 1-2 years earlier than boys and are experienced at this stage shorter. In this case, depending on the different interactions of functional and female sexual maturation and sex hormones in male children by children create variations in biomotor properties (Rowland, 2000; Rowland, 1985).

Maximal oxygen consumption in children as in adults on a treadmill, bicycle ergometer or creates a standard workload is measured with the help of other ergometers (Bricker, 1993; Docherty, 1996). Parallel to the growth in children due to increased anatomical and functional characteristics, determining the maximal oxygen consumption, heart, lungs, blood and increases the capacity and size of skeletal muscle (Rowland, 2000). Six-year-old boys and girls on average 1.0 L.dk^{-1} with maximal oxygen consumption, 15-year-old girl in average 2.0 out of 2.8 L.dk^{-1} levels in males (Krahenbuhl, Skinner & Kohrt, 1985). Male and female children, although conflict in some years these values are generally higher than girls on average maximal oxygen consumption values in all phases of pre-pubertal boys (Bricker, 1993). Our results are in line with the literature.

Tolfrey et al (Tolfrey, Campbell & Batterham, 1998) in children before puberty, boys and girls, the 12-week training,The development of sexual characteristics, body fat when habits and regular physical activity is controlled not increase maximal oxygen consumption reported. McKeag, (McKeag, 1986) a significant increase in maximal oxygen consumption in children who stated that no training in pre-adolescent visit. With the start of the physiological changes related to puberty, untrained children in maximal oxygen consumption falls, it was observed that continued at the same level of trained. Therefore, it was concluded that there was no other contributions, other than learning skills training preadolescent (McKeag, 1986). Grund et al have demonstrated that aerobic performance in a negative relationship between fat mass and cross-sectional study (Grund, Krauser & Siewers, 2001).

Having an optimal body composition is essential for maximal oxygen consumption in children. Oiliness, indicating the percentage of body fat percentage, body fat weight and the high value of endomorphy children causes them to use more oxygen while doing a job. As a result, between physical activity and physical fitness level to determine whether there is any relationship, much more research needs to be done as a matter of physical activity as determined emerges. Therefore, the continuation of issues related research can provide some results become more clear and concise.

Body profile that is different than the engine performance testing can be done with larger groups in research involving body structure and physical fitness levels. Therefore, the continuation of issues related research can provide some results become more clear and concise.

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