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ORIGINAL ARTICLE

Correlation between body fat percentage and aerobic capacity in various athletes: An open assessment

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ABSTRACT

Introduction: The Body Fat Percentage is an indicator of the Body's fitness level and its effects on VO_{2max} and thus the cardiovascular status of the athletes. Physical exercise can help to improve a healthy life interestingly. Aims: This study aims to understand the relationship between Body Fat Percentage and Aerobic Capacity of different athletes. Methods: A total of 150 athletes were randomly selected as the subjects for the present study. In the present study VO_{2max} was measured by Step test in millimeters of oxygen per kilogram of body weight per minute ($ml.kg^{-1}.min^{-1}$) and Fat percentage was measured by Skinfold Calliper in Millimeters (mm). The collected data were inferential statistics and an independent t-test was applied to check the level of significance. The significance level was set at $p < .05$. Descriptive and for the relationship appropriate multiple relation statistical tools will be used for the analysis of gathering data. Results: In between fat percentage and Step Test Pulse rate (b/min) coefficient of correlation (r = .441) and level of significance (p = .00) indicated statistical significance with a small positive correlation. At the time relationship between fat percentage and VO_{2max} (ml/kg/min) (r = -.450) and level of significance (p = .00) indicated a statistically significant and medium negative correlation. Conclusion: The relationship between body fat percentage variables and VO_{2max} was statistically significant and indicated a negative correlation but step pulse rate and fat percentage were statistically significant with a small positive correlation.

Keywords: Sport medicine, Cardiovascular fitness, Body fat, VO_{2max}, Step test, Skinfold calliper.

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INTRODUCTION

Living in the modern era, particularly in the years following World War II, has allowed people to use technology to make daily tasks easier, which in turn has decreased people's levels of physical activity. Athletes' aerobic capacity is a crucial component of their performance in sports (Shete, A. N. et al.2014). The components of body composition and aerobic and cardiovascular fitness are closely related. Aerobic fitness increases as body fat percentage decreases (Shete, A. N. et al.2014 & Brooks, L. L. 2002). Body composition and physical fitness are also related. The capacity to live a healthy, fulfilling, practical, and more productive life is known as fitness (Arafat.Y. et al. 2020; Rickta J.F. et al. 2021 & Arafat, M. Y., 2022). Another definition of fitness is the capacity for work and a full, balanced life [3-6]. Physical fitness, which is necessary for performing any movement activity, is thought to include motor fitness (Arafat.Y. et al. 2020; Rickta J.F. et al. 2021 & Arafat, M. Y., 2022). The current concept of motor fitness encompasses a few coordinative elements, including orientation ability, balance, strength, speed, endurance, and agility, as well as the ability to couple rhythm and differentiation (Arafat.Y. et al. 2020; Rickta J.F. et al. 2021 & Arafat, M. Y., 2022).

Aerobic capacity (VO_{2max}) is reflected as one of the important indicators of physical fitness level regardless of gender (Nebahat E. 2018). Aerobic capacity of an individual, as measured with a VO_{2max} test. Maximum oxygen uptake, or VO_{2max}, is a phrase used to describe the intensity of aerobic processes and, in actuality, the organism's ability to use the maximum amount of oxygen available at a given time (Ranković, G., et al. 2010). The maximum quantity of oxygen that an organism can absorb in a given amount of time while engaging in increasing-intensity exercise is known as maximal oxygen uptake, or VO_{2max} (Ranković, G., et al. 2010). This amount cannot be increased further with increased exercise intensity. The international standard of physical capacity has been established as maximal oxygen uptake (VO_{2max}) as a measure of aerobic capacity (Fleg, J. L., et al. 2000 & Fletcher, G. F. 1995).

Since they are the only body indicators in prior research that can determine a person's relative body composition without taking into account their height or weight, the body mass index and body fat percentage both serve as indicators of fitness level (Rani, N. G. S. 2015). Body composition variables like body fat percentage, body mass index, and body muscle mass are impacted by the decrease in physical activity. Since the increase in body weight derived from fat is not accompanied by an increase in the ability to produce higher strength, it is important to take into consideration that excess adipose tissue has a negative influence on sports performance (Villaseca-Vicuña, R., et al. 2021 & Joel, B. et al. 2022).

One key component of sports success is an athlete's aerobic capacity. When an exercise is performed at a higher intensity, the terms Vital Capacity (VC) and VO_{2max} refer to the intensity of the aerobic process and, respectively, indicate the maximum capacity to transport and utilize oxygen and exhale carbon dioxide. The components of body composition and aerobic and cardiovascular fitness are closely related. Aerobic fitness increases as body fat percentage decreases (Bute, S. S. et al. 2014). This study aims to collect data on the aerobic capacity and body fat percentage of various athletes. The primary goal of this study is to comprehend how various athletes' body fat percentage and aerobic capacity relate to one another.

METHODOLOGY

A total of one hundred and fifty (150) male athletes (ages 18-25) were selected for the present study district-level players from different games. Some personal information such as age, height, sex, living area, and types of Sports of all subjects is collected. VO_{2max} and Body Fat Percentage were the measuring criteria for the present study. The VO_{2max} was measured by Step test in millimeters of oxygen per kilogram of body weight per minute ($ml.kg^{-1}.min^{-1}$) and the Fat percentage was measured by Skinfold Calliper in Millimeters (mm). Before collecting data researcher describes the purpose of the present study. Finally, discuss the procedure, demonstrate the test, allow practicing, liberty to quit the test at any time, take normal breathing, and concise of the test of all subjects to collect accurate data by skin fold Calliper.

Step test procedure

Equipment required

20-inch Platform or step, stopwatch, metronome or cadence tape, Sound box.

Pre-test

At first inform the subject of the test procedures. Assess potential health risks and acquire informed consent. Forms should be prepared, and basic data like age, height, gender, and test conditions should be noted. Establish the metronome and check the step height.

Data collection

Show the subject the alternating stepping cadence to start. Step one foot up on the bench in time with the beat, then step up with the second foot in beat two, step down with one foot in beat three, and step down with the other foot in beat four. Permit the participant to practice stepping at a pace of 24 steps per minute using the metronome cadence, which is set at 96 beats per minute (4 clicks = one-step cycle). For three minutes, the athlete moves at the specified pace up and down the platform. The athlete immediately stops on completion of the test sits down and remains still. Starting within 5 seconds, the tester is to count the participant's heart rate (ideally with a stethoscope) for one complete minute.

Scoring system

The total one-minute post-exercise heart rate is the participant's score for the test.

The following equations can be used to determine the athlete's VO_{2max} (McArdle, 2000).

$$\text{Men} = 111.33 - (0.42 \times \text{pulse rate beats/min})$$

$$\text{Women} = 65.81 - (0.1847 \times \text{pulse rate beats/min})$$

Data analysis

The collected data was analyzed using descriptive statistics, mean, and standard deviation (SD). An inferential statistics-paired and independent t-test was applied to check the level of significance. The significance level was set at $p < .05$. Descriptive and for the relationship appropriate multiple relation statistical tools SPSS has been used for the analysis of gathering data.

RESULTS

In Table 1 it is clearly shown that the number of all subjects is 150; mean age 21.85 and standard deviation 1.91; mean BMI 22.072 and standard deviation 1.55; mean supra-iliac muscle 17.09 and standard deviation 3.82; mean Abdomen muscle 17.41 and standard deviation 4.30; mean Triceps muscle 14.80 and standard deviation 3.05; mean Thigh muscle 14.82 and standard deviation 3.48; mean Body Fat % 14.32 and standard deviation 2.83; mean Step Test Pulse rate (b/min) 145.89 and standard deviation 14.37; mean VO_{2max} (ml/kg/min) 50.04 and standard deviation 6.10.

Table 1. Mean and standard deviation of all variables.

	Mean	Std. Deviation	Number of Samples
Age	21.85	1.91	150
BMI	22.07	1.59	150
Supra-iliac fat	17.09	3.82	150
Abdomen fat	17.41	4.30	150
Triceps	14.80	3.05	150
Thigh	14.82	3.48	150
Body Fat %	14.32	2.83	150
Step Test Pulse rate (b/min)	145.89	14.37	150
VO_{2max} (ml/kg/min)	50.04	6.10	150

Table 2. Persona correlation sig. (2-tailed) in between all variables.

		Age	BMI	Supra-iliac	Abdomen	Triceps	Thigh	Fat	Step Test Pulse Rate (b/min)
BMI	Persona Correlation	.194*							
	Sig. (2-tailed)	.018							
Supra-iliac subcutaneous fat	Persona Correlation	.191*	.540**						
	Sig. (2-tailed)	.019	.000						
Abdomen subcutaneous fat	Persona Correlation	.148	.502**	.793**					
	Sig. (2-tailed)	.070	.000	.000					
Triceps subcutaneous fat	Persona Correlation	.063	.387**	.502**	.414**				
	Sig. (2-tailed)	.446	.000	.000	.000				
Thigh subcutaneous fat	Persona Correlation	.201*	.256**	.598**	.540**	.461**			
	Sig. (2-tailed)	.014	.002	.000	.000	.000			
Body Fat %	Persona Correlation	.296**	.540**	.894**	.868**	.677**	.782**		
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		
Step Test Pulse Rate (b/min)	Persona Correlation	.148	.417**	.414**	.452**	.207*	.300**	.441**	
	Sig. (2-tailed)	.071	.000	.000	.000	.011	.000	.000	
VO_{2max} (ml/kg/min)	Persona Correlation	-.146	-.419**	-.426**	-.460**	-.219**	-.302**	-.450**	-.998**
	Sig. (2-tailed)	.074	.000	.000	.000	.007	.000	.000	.000

Note. Correlation is significant at the .05 level (2-tailed). Correlation is significant at the .01 level (2-tailed).

It is clearly shown from the Table 2, the correlation and significant level among each parameter of athletes.

DISCUSSION

The present study shows a statistically significant relationship between most of the variables of athletes. It also showed a significant difference in the body fat percentage and aerobic capacity of the athlete. The difference in VO_{2max} and body fat percentage was statistically significant and negative correlation with the Pearson test (Shete, A. N. et al. 2014). Another research found a high negative correlation between body fat percentage and of VO_{2max} or aerobic capacity of athletes (Demirkan, E. et al. 2016). In the present study, the result of this case complies with the previous study's result.

Here all positive relationships moving together such as age increases, BMI, Supra-iliac muscle, and other positive correlations various also tend to increase. Previous researches indicate co-linearity between age and body mass index, total adipose tissue, body weight, and body muscle (Sarvottam, K. et al. 2020). Other research results indicate co-linearity between age, body mass index, and total adipose tissue (Feliciano Pereira, P.et al 2015). This result fully supports another previous research.

The relationship between body fat percentage variables and VO_{2max} indicates a negative correlation. An investigation shows that there is a negative correlation between maximum oxygen uptake and body fat percent and VO_{2max} has been shown to decrease and improve body composition (Amani, A. R.et al. 2010). Although not statistically significant, a different study found a negative correlation between VO_{2max} and body fat percentage (Shete, A. N. et al. 2014). Here we see pulse rate of athletes has a strongly negative correlation with VO_{2max} it's defined as if the pulse rate increases VO_{2max} decreases at the same time. The correlation between VO_{2max} and pulse amongst athletes showed a negative correlation with Pearson's correlation coefficient (Gupta, R. et al. 2015). A lower resting pulse rate is indicative of adaptive changes brought about by aerobic exercise in the cardiovascular system (Gupta, R. et al. 2015). The present study results highly supported the previous study in this field.

In all of them, the coefficient value of the abdomen is probably mostly correlated with VO_{2max}, if the abdomen fat increases, VO_{2max} capacity decreases so the fat percentage of the abdomen muscle mostly effects on aerobic capacity of the athlete. Factors that determine VO_{2max} include age, gender, heart-lung function, aerobic muscle metabolism, exercise, genetics, multivitamins, and nutritional statuses such as BMI, abdominal circumference, and percent body fat (Depkes, R. I. 2005 & Aulia, N. S., & Widodo, A. 2021). Abdominal circumference and body fat percentage are significantly correlated with VO_{2max} (Auliadina, D. et al. 2019). A study saw the relationship between subcutaneous and total abdominal adipose tissue, and visceral adipose tissue with VO_{2max} (Ebaditabar, M.et al. 2021). This result is also supported by the previous research report. Coaches and physical educators may take the help of the explored knowledge to understand the aerobic capacity of the athletes from body fat percentage. The present study suggests that athletes are more conscious about physical fitness-related body fat and cardiovascular endurance. The instruments used for collecting data were not of a very high standard, and time and finances were limiting conditions for the study. In future research, more subjects and standard instruments will be used.

CONCLUSION

Athletes gain a little more weight in the progression of their age. In the progression of age among the athletes' supra iliac fat also slightly increases. Further, augmentation in body mass index (BMI) contributes to an increase in Supra ileac subcutaneous fat. The elevated level of subcutaneous fat in the abdomen results in the rise of body mass index (BMI) and is seriously responsible for the increased level of fat in the supra-iliac region of athletes. Triceps subcutaneous fat level increase works as an indicator of body mass index (BMI) deterioration and elevated levels of supra-iliac fat as well as abdominal fat. In progression of age and body mass index (BMI) ratio of the athletes results in a slight increase in subcutaneous fat at the thigh region. Besides increased levels of subcutaneous fat at the Supra iliac, abdomen, and Triceps are a direct indicator of thigh subcutaneous fat. Although the age of the athletes is somehow responsible for increasing Body fat percentage and body mass index, Supra-iliac, Abdomen, Triceps, and Thigh subcutaneous fat levels are direct contributing factors. Higher levels of Body mass index ratio, body fat percentage, and subcutaneous fat level of the Supra-iliac, abdomen, Triceps, and Thigh hurt athletes' pulse rate. An increase in Body mass index ratio, body fat percentage, and Pulse rate as well as the increase in Subcutaneous fat at the supra-iliac, abdomen, Triceps, and Thigh region have a straight contrary effect on the VO_{2max} of the athletes.

AUTHOR CONTRIBUTIONS

JFR conceived the design research, collected the data and critically review the article. FTJM help to collect the data. MYA calculation and write the article. RI collect the data.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ETHICAL STATEMENT

The study complied with every essential guideline for doing ethical review committee Faculty of Biological Science and Technology, Jashore University of Science and Technology, Bangladesh.

DATA AVAILABILITY STATEMENT

The article contains every one of the unique contributions that are featured in this manuscript.

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