TO DETERMINE THE ASSOCIATION OF CARDIORESPIRATORY FITNESS WITH ANTHROPOMETRIC CHARACTERISTICS IN COLLEGIATE ATHLETES

Neeraj Kumar¹, Archana¹, Singh Priyanka¹

¹Department of Physiotherapy, Saii College of Medical Science & Technology, Kanpur, INDIA

Abstract The purpose of this present study was to determine the relationship of cardiorespiratory fitness (VO₂ max) with anthropometric characteristics such as BMI, hip-waist ratio and body fat percent in collegiate athletes. A total of 100 healthy collegiate athletes with mean age of 19.51 years voluntarily participated in this study. The mean weight (kg), height (m), BMI, hip-waist ratio and body fat percent of all the subjects were 52.29, 1.62, 19.81, 1.16 and 14.07 respectively. The VO₂max was measured by Bruce treadmill test and the mean VO₂max was 56.65 ml/kg/min. The Pearson’s correlation test was applied between these variables and statistically significant relations were found between BMI and VO₂ max, as well as between body fat percent and VO₂ max, but statistically insignificant relation was found between hip-waist ratio and VO₂ max. Therefore, the finding of the present research suggests that VO₂ max is directly associated with BMI and body fat percent.

Keywords: Cardiorespiratory fitness (VO₂max), BMI, hip-waist ratio, body fat percent, body stature

INTRODUCTION

Cardiorespiratory fitness can be used as a health measurement and it also helps in prescribing physical exercises [4]. VO₂ max is an important determinant and primary criterion for measuring cardiorespiratory fitness [1]. VO₂ max is the capacity of an individual to consume maximal oxygen. It is considered as the most important determinant of athletes’ fitness [14]. VO₂ max is the ability of an individual to perform moderate to high intensity exercise for the prolonged period of time [7]. There are various methods of measuring VO₂ max, both direct or indirect [8]. There are various field tests also to measure VO₂ max which are convenient, reliable and cost effective [9]. The gold standard indirect method of measuring VO₂ max is Treadmill test. There are various treadmill tests, and Bruce Treadmill testing is one of them and very much reliable [7]. VO₂ max is found to be increased with aerobic exercise [7], high altitude [15], consumption of pre-exercise sports drink [8]. It decreases with consumption of alcohol [10], smoking [6] and tobacco [9]. BMI, body fat percent and hip-waist ratio are important determinants of body composition and physical fitness [7]. All these determinants are considered as anthropometric characteristic measures of an individual and considered as the measurement of fat mass of the body.

The associations of VO₂ max with the stature and body composition has been done by several researchers in different countries [2, 13] but there is an insufficiency of work in collegiate athletes in Indian context. Therefore, the purpose of present research was to determine the relationship of VO₂ max with some anthropometric characteristics (height, weight, BMI, body fat percent and hip-waist ratio) of collegiate athletes.

MATERIAL AND METHODS

A total of 100 male collegiate athletes, aged between 18-25, were randomly selected from the total of 275 volunteers for this correlation study. The age of subjects was recorded from their birth certificates which were submitted to their college. The data were collected in an evening session at room temperature.
Subjects were asked to fill and return the consent form for their voluntary participation. The study was approved by institutional ethics committee of Saaii College of Medical Science & Technology, Kanpur, India.

**PROCEDURE**  
**Anthropometric Measurements:**  
Height, weight, BMI, Hip-Waist Ratio and body fat percent of each subject was measured using standard technique and were measured in triplicate with the mean value used as criterion. The height was measured using a stadiometer to the nearest 0.1 cm during inspiration. Weight was measured by digital standing scales to the nearest 0.1 kg. Hip and waist measurement was done by standard measuring tape to the nearest 0.1 cm and body fat percent was measured after determining the BMI using the formula [16].

For males= 1.34 X BMI - 12.47  

**VO2 Max:**  
VO2 max was measured by the standard treadmill test using Bruce protocol. The subjects were asked to report 30 minutes before the test. They consumed nothing, but were well hydrated, from 2 hours prior to the test. VO2 max was recorded in ml/kg/min.

**STATISTICAL ANALYSIS**  
Mean, standard deviation, standard error and percentile were used to prepare summary statistics. Karl Pearson’s correlation coefficient (r) was used to determine the association between different variables. The statistical analysis was done on SPSS v16.00. A 5% confidence level was used to determine statistical significance.

**RESULTS**  
A total of 100 male individuals participated in present study with the mean age of 19.51 (±1.69) years, mean height 1.62 (±0.06) mts, mean weight 52.29 (±6.57) kg, mean hip measurement 85.42 (±5.33) cm and mean waist measurement 73.96 (±6.57) cm, as shown in table 1.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean age, height, weight, hip measurement, waist measurement, BMI, hip-waist ratio, % body fat and VO2 max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD (±)</td>
<td>S.E.</td>
</tr>
<tr>
<td>2.06</td>
<td>0.21</td>
</tr>
<tr>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>6.35</td>
<td>0.63</td>
</tr>
<tr>
<td>5.33</td>
<td>0.53</td>
</tr>
<tr>
<td>6.57</td>
<td>0.66</td>
</tr>
<tr>
<td>2.06</td>
<td>0.21</td>
</tr>
<tr>
<td>0.07</td>
<td>0.01</td>
</tr>
<tr>
<td>2.95</td>
<td>0.29</td>
</tr>
<tr>
<td>3.74</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Mean BMI of all individuals were 19.81 (±2.20), mean hip-waist ratio were 1.16 (±0.07), mean body fat percent were 14.07 (±2.95) and mean VO2 max (ml/kg/min) were 56.65 (±3.74), as shown in Table 1. Pearson’s Correlation was applied between VO2 max, BMI, H/W ratio and body fat percent, which is shown in Table 2.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Correlation between VO2 max, BMI, H/W ratio and body fat percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2 Max</td>
<td>% Body Fat</td>
</tr>
<tr>
<td>-0.22*</td>
<td>0.97**</td>
</tr>
<tr>
<td>0.12</td>
<td>-0.17</td>
</tr>
<tr>
<td>-0.26*</td>
<td>1</td>
</tr>
</tbody>
</table>

**DISCUSSION**  
The purpose of the present study was to determine the association of VO2 max with the anthropometric
characteristics or body stature such as BMI, HW ratio and body fat percent. Statistically significant correlation (-0.22) was found between BMI and VO₂ max, which suggests that BMI is indirectly proportional to VO₂ max. A person who is having lower BMI is expected to have a greater VO₂ max. The finding of this study is supported by the finding of Pribis et al, 2010 [11] & Dagan et al, 2013 [3], which worked on the association of BMI with VO₂ max and suggested that an appropriate lower, but within the range BMI, is always essential for having a good VO₂ max.

Statistical significant correlation (-0.26) was found between body fat percent and VO₂ max, which again suggest that body fat percent is also indirectly proportional to VO₂ max. It means a person having lower body fat percent will be having a better VO₂ max and this finding is consistent with the findings of Pribis et al, 2010 [11] & Dagan et al, 2013 [3], which emphasized the correlation of body fat percent with maximum oxygen consumption (VO₂ max) and concluded that body fat percent plays an important role in altering VO₂ max, as higher the body fat percentis, the lesser is the VO₂ max and vice versa.

There is statistically insignificant correlation (0.12) found between H/W ratio and VO₂ max, which suggests that H/W ratio has no influence on the VO₂ max, which is quite inconsistent with the findings of Dagan et al., 2013 [3]. This suggests that H/W ratio has negative correlation with the VO₂ max, which means lower the H/W ratio, better the VO₂ max.

In spite of the relation between VO₂ max and body stature, we have also found the interrelation between anthropometric components. There was statistically significant correlation (0.97) found between BMI and body fat percent, which suggests that BMI is directly proportional with the body fat percentage and it can also be suggested that if a person is having more BMI, his/her body fat percent will be greater. This finding is also supported by the findings of Flegal et al, 2009 [5] & Ranasinghe et al, 2013 [12] who also suggested that BMI has direct relation with body fat percent and if a person’s BMI is above the normal, than that person can be considered obese.

Inter-correlation between other parameters of anthropometric characteristics was found statistically insignificant, like between BMI and H/W ratio (-0.16), between H/W ratio and body fat percent (-0.17). This suggests that BMI has no relation with hip-waist ratio, which is inconsistent with the findings of Ranasinghe et al, 2013 [12], who found that BMI has correlation with hip-waist ratio. Furthermore, it is also found in the present study that hip-waist ratio is not related with body fat percent, which is inconsistent with the findings of Ranasinghe et al, 2013 [12] who suggested that hip-waist ratio is directly related with the percent body fat.

CONCLUSION

The finding of the present study reveals that a person’s maximum oxygen consumption or VO₂ max is very much dependent upon his/her BMI. An adequate and minimum BMI is essential for having higher VO₂ max. Therefore, in order to increase VO₂ max, one should have to decrease their weight to minimize BMI and hence improve VO₂ max.

This finding can help athletes, coaches, physiotherapists and team managers to become acquainted with the need of maintaining athlete’s body weight, and to thereby maintain BMI, and ultimately to improve VO₂ max.

Moreover, the findings of the present study also reveal that VO₂ max is dependent on a person’s body fat percent. Increased body fat is always detrimental for person fitness, and for VO₂ max. It actually causes a decreased cardiorespiratory fitness or VO₂ max, which is an essential component of overall fitness. Therefore this finding is also helpful for the athletes, coaches, physiotherapists, team managers etc. to give emphasis on athletes’ body fat and always keep trying not to increase body fat. A proper exercise program and healthy diet is needed to maintain and decrease body fat and weight.

Therefore, we can conclude that, for having a better VO₂ max one should control his/her body weight and body fat percent, because increase in any of the both can lead to decrease in VO₂ max.

REFERENCES

N. Kumar, A. Agrahari: To Determine the Association of CRF with AC in collegiate athletes


Address for correspondence:

Neeraj Kumar
Asstt. Professor
Department of Physiotherapy
Galgotias University, Greater Noida, INDIA
Phone: +91-9005411557
Email: physioner@gmail.com