Evaluation of basal heart rate and cardio respiratory endurance among wrestlers-a cross-sectional study

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ABSTRACT

Background: Cardiorespiratory endurance is the most important component of health fitness concerned with the aerobic efficiency of the body. The VO\textsubscript{2} max (maximum oxygen uptake) is the criterion measure of cardiorespiratory fitness that determines amount of oxygen consumed per kilogram of body weight per minute of exercise. Aim and Objectives: The aim and objective of the study is (1). To assess the heart rate and VO\textsubscript{2} max among Indian wrestlers and age and sex-matched healthy controls and (2). To find the correlation between resting heart rate and VO\textsubscript{2} max (if any). Materials and Methods: About 35 wrestlers aged between 18 and 25 years practicing in district stadium Belgaum and 35 age and sex-matched students of KLE University, Belgaum were enrolled as controls. Resting heart rate was measured, and cardiorespiratory endurance test was done on treadmill to calculate the VO\textsubscript{2} max using Bruce protocol. Results: The data were analyzed using Student unpaired “t-test” (P < 0.05 was considered as significant). Karl Pearson’s correlation coefficient was used to evaluate strength of association between heart rate and VO\textsubscript{2} max. The mean resting heart rate of players was significantly less than that of the controls (P < 0.001). Mean VO\textsubscript{2} max was significantly higher in wrestlers than in the controls (P < 0.001). Negative correlation was found between the resting heart rate and VO\textsubscript{2} max among the wrestler’s and controls. Conclusion: The higher VO\textsubscript{2} max in the wrestlers can be attributed to the duration of training which causes greater increase in cardiac output and arteriovenous O\textsubscript{2} difference. Resting heart rate of the wrestlers was found to be lower than that of the sedentary people. High VO\textsubscript{2} max and low resting heart rate are both associated with cardiovascular fitness and common among endurance players. These could be beneficial tools for trained wrestlers looking to improve their performance.

KEY WORDS: Wrestlers; Cardiorespiratory Endurance; VO\textsubscript{2} max

INTRODUCTION

Wrestling consists of high intensity efforts combined with brief periods of mild- to moderate-intensity work or resting indicated by effort of the wrestler to sustain physical control over opponent.\textsuperscript{[1,2]} Wrestling is type of conflict sport that requires more effort and a high degree of compatibility between the efficiency of the internal organs in the body and the physical effort exerted in order so that the wrestler is able to achieve the physiological requirements of performance. It is an alternating physical exercise of flexible intensity.\textsuperscript{[3]} Wrestling is characterized by speedy, fiery attacks and counterattacks which are executed repetitively.\textsuperscript{[4]} Both anaerobic and aerobic energy systems, like many other sports are employed to a various degree in wrestling.\textsuperscript{[4-6]} The short and quick bursts of maximal power during the match are provided by anaerobic system, whereas the aerobic system contributes to the wrestler’s ability to sustain effort for...
the entire duration of the match. A success in wrestling requires highly advanced capabilities of maximal strength, power, muscular endurance, anaerobic capabilities, speed, lactate tolerance, and maximal aerobic power. Thus, the cardiorespiratory system is an energetic system in body of athletes who play combat sports commonly and wrestling especially because it involves many portents on the preparedness to bear the load of training.

**Aim and Objectives**

1. To assess the heart rate and VO\(_2\) max among wrestlers and healthy controls.
2. To find the correlation between resting heart rate and VO\(_2\) max (if any).

**MATERIALS AND METHODS**

About 35 wrestlers aged between 18 and 25 years practicing regularly at district stadium, Belgaum were recruited. 35 age and sex-matched students of other constituent units, Belgaum were enrolled as controls. It was a cross-sectional study conducted in Department of Physiology, J N Medical College, Belgaum. Ethical clearance was sanctioned by JNMC Institutional Ethics Committee on human subject’s research. The subjects were divided into two groups depending on number of years of training. Group A consisted of wrestlers with >4 years of training and Group B consisted of wrestlers with <4 years of training. They were briefed about the type of study and written informed consent was taken. Basal heart rate was measured and cardiorespiratory endurance test was done on treadmill to calculate the VO\(_2\) max using Bruce protocol selection criteria.

**Inclusion Criteria**

1. All the wrestlers in the age group of 18–25 years who were trained and practicing regularly for a minimum period of 2 years
2. In the comparative group, age and sex (18–25 years) matched subjects coming from same region who were not trained or carrying out any regular exercise were selected randomly.

**Exclusion Criteria**

1. Subjects with neuromuscular, respiratory, endocrine, cardiac, disorders among players and comparative group
2. From comparative group subjects who were regularly doing physical exercise, meditation or undergoing any sports training.

**Procedure**

Basal heart rate was calculated by checking pulse for 1 min and blood pressure (BP) was measured by Omron digital BP apparatus. A motor driven treadmill (Model-Fitness world 3000, manufacturers-Square cut, Belgaum) was used to perform cardiorespiratory endurance test using Bruce protocol which is regularly used treadmill exercise stress test to estimate cardiovascular fitness and calculate the VO\(_2\) max (maximum oxygen uptake). The test starts at 2.74 km/h (1.7 mph) and at a gradient (or incline) of 10%. The inclination of the treadmill was increased by 2%, at 3 min intervals and the speed increased as shown in the Table below. Subjects were asked to perform with maximum effort and notify on tiredness.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Speed (km/h)</th>
<th>Speed (mph)</th>
<th>Gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.74</td>
<td>1.7</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>4.02</td>
<td>2.5</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>5.47</td>
<td>3.4</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>6.76</td>
<td>4.2</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>8.05</td>
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<td>18</td>
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<tr>
<td>6</td>
<td>8.85</td>
<td>5.5</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>9.65</td>
<td>6.0</td>
<td>22</td>
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<tr>
<td>8</td>
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</tr>
<tr>
<td>9</td>
<td>11.26</td>
<td>7.0</td>
<td>26</td>
</tr>
<tr>
<td>10</td>
<td>12.07</td>
<td>7.5</td>
<td>28</td>
</tr>
</tbody>
</table>

The scoring was observed by the time taken for the test, in minutes. Which was then converted using following formula, VO\(_2\) max (ml/kg/min) = 14.76 − (1.379 × T) ± (0.451 × T\(^2\)) − (0.012 × T\(^3\)) where the value “T” is the total time completed (expressed in minutes and fractions of a minute, e.g. (9 min 15 s = 9.15 min). to an estimated VO\(_2\) max score.

**Data and Statistical Analysis**

Data were statistically analyzed, which convoluted quantitative variables summarized through mean and standard deviation. Students unpaired “t” was used to test difference between the mean of the two groups, where the \((P < 0.05)\) was statistically significant. The strength of association between heart rate and VO\(_2\) max was evaluated by Karl Pearson’s correlation coefficient.

**RESULTS**

Table 1 shows the mean of the parameters which was found using Student unpaired’ test. The resting heart rate of wrestlers was significantly less compared than that of
the controls (P < 0.05 was considered as significant). Mean VO₂ max was significantly higher in players than in the controls. Table 2 shows the assessment of basal heart rate and VO₂ max among the two wrestler groups. The HR of the group A was lesser than group B, similarly group A had higher Mean Maximum Oxygen uptake (VO₂ max) than group B both were statistically significant (P < 0.05). Figure 1 illustrates the assessment of cardiorespiratory fitness among the wrestlers and the controls. VO₂ max-maximum oxygen uptake mean was higher for wrestlers and was statistically significant. Figure 2 illustrates the assessment of cardiorespiratory fitness (VO₂ max) among the two wrestler groups it was statistically significant and higher for group A than group B.

DISCUSSION

Heart rate being easy to measure, even though the HR changes during and after cessation of exercise have been used as marker of cardiovascular health; it is only in recent past few years that resting HR has gained importance as a powerful marker of cardiovascular health.[9] In healthy adults resting heart rate ranges from 60 to 80 beats/min. It may be as high as 100 beats/min in sedentary and middle-aged individuals. In elite endurance athletes heart rates as low as 28–40 beats/min have been recorded.[8]

In the present study, the resting heart rate was significantly lower in players as compared controls, which can be attributed to their longer training duration. Results of cardiorespiratory fitness tested by Bruce protocol using Treadmill was considerably higher in wrestlers than in the sedentary controls. It is in constant with preceding studies were elite junior wrestlers had 51.2 ml/kg/min, elite Canadian wrestler showed 50.25 ml/kg/min, elite Japanese wrestlers had 55.6 ml/kg/min and Turkish wrestlers had 55.6 ml/kg/min and Turkish wrestlers had 43.25 ml/kg/min. senior Korean wrestlers showed 60.24 ml/kg/min.[6,8,12] The results are comparable to some of the reviewing studies relating peak VO₂ max between elite and non-elite wrestlers which also did not discover significant differences in VO₂ max.[13,14]

Limitations and Future Scope

With the above findings present study proposes that future studies be undertaken:

- To increase the sample size
- To compare physical fitness with the sports specific skills between the two types of wrestling
- Plus may include additional parameters like Electromyography, whole body reaction time
- Further, physical fitness and psychological factors which might affect the performance of wrestlers need to be correlated. Since yoga and meditation are known to improve flexibility, concentration and quickness it is advisable to incorporate yoga and meditation as a part of their training.

CONCLUSION

The data analyzed suggests that the higher VO₂ max in the players can be credited to the duration of training which improves the cardiac output. Aerobic training increases muscle blood flow, capillarization of muscle tissue, levels of aerobic enzymes, mitochondrial number, size, surface area and myoglobin content. These contribute to improved oxygen extraction by muscle.[14,15] Resting heart rate of the athletes was found to be lower than that of the sedentary people. Negative correlation was found between the resting heart rate and VO₂ max among the wrestlers and controls.
Low resting heart rate and High VO₂ max are both related with cardiovascular fitness and mutual among endurance players. These findings could be used as valuable tools for trained wrestlers considering to improve their performance.

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REFERENCES