VO_2max & Haemodynamic Profile of Woman Boxers

Kumar[1], Ashok, Manisha[2] & Kumar[3], Rajesh.

[1]Asst. Prof., Dept. of Sports Science, Punjabi University Patiala (Punjab) India, Email: akashokin@gmail.com
[2]M.Sc. Sports Science Student, Department of Sports Science, Punjabi University Patiala (Punjab) India
[3]Associate Professor, Department of Physical Education, Osmania University, Hyderabad (Andhra Pradesh) India

Abstract

Woman boxers of national and interuniversity level participation of Punjabi University Patiala volunteered to participate in this study and their age ranged 18 to 23 years. The standard procedure was used to observe VO_2max and haemodynamic variables. The mean age, height, weight and BMI of woman boxers were 20.18±1.66 years, 162.04±5.45 cms. 60.18±10.21 Kg and 23.25±3.31 respectively. The resting VO_2 max, Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume and Cardiac Output was 44.45±3.26 $ml.kg^{-1}.min^{-1}$, 67.00±5.15 beats/minute, 114.91±5.24 mmHg, 77.27±5.53 mmHg, 37.64±1.96 mmHg, 89.55±5.39 mmHg, 76.85±9.15 $beats.min^{-1}$.mmHg, 54.93±4.34 ml/beat and 3.60±0.23 L/minute respectively. It was concluded from the results that women boxers of this study have less mean value of VO_2max (aerobic fitness) and haemodynamic variables than reported of elite national and international boxers.

Key words: PP, MAP, RPP, SV, CO

Introduction

In the field of combat sports several works on taekwondo, karate kumite, nunchaku exercise, and judo have been reported *(Beneke et al, 2004; Toskovic et al, 2002).* Boxing is an intermittent sport characterized by short duration, high intensity bursts of activity. It requires significant anaerobic fitness, and operates within a well-developed aerobic system. Boxing is estimated to be 70-80% anaerobic and 20-30% aerobic *(Ghosh et al, 1995).* The study of VO_2max and haemodynamic variables can be informative in regard to the physiological status of the athletes and can also help in preparing a well defined training schedule on a physiological basis. Despite the sport's popularity, little is known about the VO_2max and haemodynamic variables like heart rate, blood pressure, pulse pressure, mean arterial pressure, rate product pressure, cardiac output, stroke volume, and maximal oxygen consumption. Moreover, very few studies were conducted on VO_2max and haemodynamic profile of Punjabi woman boxers in India *(Chatterjee et al, 2005).* Hence, the present study was undertaken with the aim of studying the VO_2max and haemodynamic profiles of Punjabi women boxers.

Materials & Methods

Eleven woman boxers of national and interuniversity level participation of Punjabi University Patiala volunteered to participate in this study and their age ranged 18 to 23 years. The VO_2max (aerobic fitness) of each subject was estimated by taking subject's resting heart rate for 20 seconds and enter the number of beats that counted, along with subject's

age, into the equation VO_2max = 15.3 x (MHR/RHR); where, MHR = Maximum heart rate (beats/minute) = 208 - (0.7 x Age); RHR = Resting heart rate (beats/minute) = 20 second heart rate x 3 (Uth et al., 2004). Blood pressure was recorded using a standardized protocol, according to the World Health Organization recommendations, pulse pressure- difference between the Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP), Mean arterial pressure = Diastolic pressure + 1/3 (Systolic - Diastolic pressure) (Andy et al.,1985),Rate-Pressure Product (beats.min^{-1}.mmHg) = HR x SBP /100 (Nagpal et al., 2007), Stroke Volume (ml/beat) = 91.0 + 0.54 PP - 0.57 DP - 0.61 age (Starr et al.,1954) and Cardiac Output (ml/min) = Heart Rate (beats/min) X Stroke Volume (ml/beat) (Jackson et al., 1995).

Statistical Analysis

Statistical analysis was performed with SPSS version 16.0 (free trial, SPSS Inc, Chicago). Results were expressed as Mean ± Standard Deviation. The level of significance for the data analysis was $p< 0.05$.

Results & Discussion

The mean age, height, weight and BMI of woman boxers were 20.18±1.66 years, 162.04±5.45 cms., 60.18±10.21 Kg and 23.25±3.31 respectively. The mean VO_2 max, Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume and Cardiac Output of women boxers at resting was 44.45±3.26 ml.kg^{-1}.min^{-1}, 67.00±5.15 beats/minute, 114.91±5.24 mmHg, 77.27±5.53 mmHg, 37.64±1.96 mmHg, 89.55±5.39 mmHg, 76.85±9.15 beats.min^{-1}.mmHg, 54.93±4.34 ml/beat and 3.60±0.23 L/minute respectively (Table 1).

Table 1: Mean ±SD of VO_2max & Haemodynamic Variables of Woman Boxers

Variables	Resting
Age (years)	20.18±1.66
Height (cms)	162.04±5.45
Weight (Kg)	60.18±10.21
BMI	23.25±3.31
VO_2 max (ml.kg^{-1}.min^{-1})	44.45±3.26
Heart Rate (beats/minute)	67.00±5.15
Systolic Blood Pressure (mmHg)	114.91±5.24
Diastolic Blood Pressure (mmHg)	77.27±5.53
Pulse Pressure (mmHg)	37.64±1.96
Mean Arterial Pressure (mmHg)	89.55±5.39
Rate Pressure Product (beats.min^{-1}.mmHg)	76.85±9.15
Stroke Volume (ml/beat)	54.93±4.34
Cardiac Output (L/minute)	3.60±0.23

Discussion

One of the challenges confronting coaches and combat fighters is to understand the physiological factors contributing to the success or failure of an athlete. Testing of these aerobic fitness components can provide an insight to the combat fighter's current physical capability. Also, assessment of the combat fighter's current level of aerobic fitness reveals strengths and relative weaknesses that can become the basis for the development of an optimal training program *(Mirzaei et al, 2009).* The results of the measurements in this study were relatively similar to the values reported in the literature for other combative sports. It is important to note that the results of aerobic fitness components will differ depending upon the relationship of the athletes training schedule and competitive schedule *(Roemmich et al, 1997).* Maximum oxygen uptake is considered to be a valid indicator of the function of respiratory, cardiovascular and muscular systems working together *(Impellizzeri &*

Marcora, 2007). Aerobic capacity is necessary to prevent fatigue during training/or competition in martial arts *(Imamuraet al, 1998).* There are no VO_2max *measurements* found for university level women boxers. Studies performed on untrained subjects have shown that a good VO_2max is above 40 ml/kg/min; a measure reported above 50 ml/kg/min is considered excellent *(Impellizzeri & Marcora, 2007).* In relationship to sport, endurance specific athletes such as cyclists have been shown to have a VO_2max values on the order of 75 ml/kg/min *(Saltin & Astrand, 1967).* Martial art athletes generally exhibit greater cardiorespiratory endurance than untrained individuals, but not as great as athletes who focus on cardiorespiratory endurance as their primary fitness component for success in their sport, such as cyclists. In regard to martial art disciplines, a study of highly trained competitive black belt karate practitioners were found to have a VO_2max of 57.5 ml/kg/min while the lesser skilled competitive white belt karate practitioners were found to have a VO_2max of 57.2 ml/kg/min *(Imamura et al, 1998).* By contrast, VO_2max values of 63.8 ml/kg/min were found in 60 England International boxers *(Smith, 2006). Crisafulli et al (2009)* reported that maximum oxygen uptake for martial art athletes may be as low as 48.5 ml/kg/min and as high as 63.2 ml/kg/min depending upon the specific type of training discipline. *Adams et al (1997)* reported that average VO2max of boxers was 57.6 ml/kg/min for running on treadmill and 54.9 ml/kg/min for pedaling on cycle ergometer and 49 ml/kg/min on step test method. These results correspond to a 4.7% difference, which is practically equivalent to the 5-15% previously mentioned *(Hermansen & Saltin, 1969; Chase et al, 1966; Astrand & Saltin, 1961).* Indian women boxers have an average VO_2max of 48.6 ml/kg/min as obtained in the pre-test. VO_2max (ml/kg/min) of international elite athletes of a few sports reported in the literature *(Astrand & Rodhal, 1986)* are as follows - in boxing male 65 ml/kg/min, fencing male and female 59 ml/kg/min and 43 ml/kg/min , wrestling male 57 ml/kg/min. In a recent study, VO_2max of elite Italian male boxers was 57.5 ± 4.7 ml/kg/min *(Guidetti et al, 2002).* Indian male boxers of the pooled weight category showed a VO_2max value of 58.32 ml/kg/min *(Majumdar, 1989)* which was 16.6% higher than the Indian female boxers. It can be said that the obtained value of relative resting VO_2max (44.45±3.26 $ml.kg^{-1}.min^{-1}$**)** in our study is highly comparable with that of the male boxers.It should be noted here that, in a recent study *(Guidetti et al, 2002)* high positive correlation was found between VO_2max and boxing performance ranking. Resting heart rate averages 60 to 80 beats/min in healthy adults *(Wilmore & Costill, 2005).* In the present study the mean resting heart rate was 67.00±5.15 beats/minute**.** Thus, the resting heart rate of woman boxers of this study was in the normal range. Earlier reports support the reduction in resting heart rate as aerobic training brings about both functional and dimensional changes in the cardio-vascular system *(Fox et al., 1973).* In untrained individuals stroke volume at rest stroke volume averages 50-70ml/beat. In elite athletes resting stroke volume averages 90-110ml/beat increasing *(Wilmore & Costill, 2005).* Thus, the resting stroke volume of woman boxers of this study was in the normal range. At rest the cardiac output is about 5L/min *(McArdle et al, 2000)* but in this

study resting cardiac output was 3.60±0.23 L/min which is not in the normal range. At rest, a typical systolic blood pressure in a healthy individual ranges from 110-140mmHg and 60-90mmHg for diastolic blood pressure *(Wilmore & Costill, 2005)* and the mean systolic and diastolic blood pressure of the woman wrestlers of this study also falls in the normal range.

Conclusion

It was concluded from the results of this study that university level Punjabi women boxers have less mean value of VO_2max and haemodynamic variables than national/international level women boxers. As in other sports, where skills play a decisive role, the physiological data cannot be the sole predictor of competitive success. On the other hand, we must note that these physiological variables are necessary conditions for success in high levels of boxing competition. The norms play a decisive role in talent selection. A norm of desired level for physiological status of the women boxers may be formulated after sufficient data.

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