ANTHROPOMETRIC, PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF INDIAN WOMEN BOXERS

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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. The performance during competition depends largely on the status of the different physiological mechanisms, apart from the technique, tactics and skill. The present work focused on the anthropometric, physiological and biochemical characteristics of Indian elite women boxers. Fifty (50) women boxers (age range: 17-23 yrs) of Indian National Camp volunteered for this study. Height, body mass, body fat, lean body mass (LBM), VO2max, anaerobic power, strength, haemoglobin (Hb), serum urea, uric acid, total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) were measured in the laboratory. Optimum levels of body fat, VO2max, Anaerobic capacity, back and grip strength, hemoglobin, total cholesterol, triglyceride, HDLC were noted. In addition, VO2max showed negative correlation with body fat and body mass. It can be suggested that with increase in body mass and fat content VO2max of the athletes decreased. The studies of women boxers are scanty in India. The data of the present study may be used as reference to develop training schedule for women boxers. Government and NGOs should take initiatives to ensure the participations of women in boxing.

Women athletes are getting success in all disciplines of sports. Boxing is one of the areas where Indian women athletes are gaining International achievements in recent years. Women's boxing first appeared in the Olympic Games as a demonstration in 1904. The British Amateur Boxing Association sanctioned its first boxing competition for women in 1997. The International Boxing Association (amateur) accepted new rules for Women's Boxing at the end of the 20th century and approved the first European Cup for Women in 1999 and the first World Championship for women in 2001. Women's boxing was included in London Olympic in 2012. 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 [Reilly et al., 1990]. Boxing is estimated to be 70-80% anaerobic and 20-30% aerobic [Khanna and Manna, 2006]. Boxing's work and rest ratio is approximately 3:1. The nature of boxing requires athletes to sustain power at a high percentage of maximal oxygen uptakes (VO2max). The primary aim of conditioning for boxing

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is to delay the onset of fatigue by increasing tolerance of lactic acid build-up, increasing the ATP and CP, to improve efficiency of oxygen use, and to improve recovery between intense bursts of activity [Guidetti et al., 2002]. Few studies have been reported in the literature about the cardiovascular and metabolic demands of male boxers [Khanna et al., 1995; Ghosh et al., 1995]. Studies on women boxing are scanty. Therefore, the present work focused on the anthropometric, physiological and biochemical characteristics of Indian National Women Boxers.

METHODS

Subjects

For the present study fifty (50) females (age range 17.00-21.99 yr; mean: 19.7 ± 2.2 yr), regularly playing competitive boxing for last 03-05 years, were selected after medical check up from the training camps at Sports Authority of India. The subjects were asked to maintain the normal diet. The subjects were informed about the possible complications of the study and gave their written informed consent. The study was approved by Sports Authority of India.

Measurement of Anthropometric Variables

Stature (height) and body mass were measured using standard procedure [Jonson and Nelson, 1996]. The skin fold thickness at the site of biceps, triceps, sub scapular and suprailiac were used to calculate the body density. Body density was calculated by the standard formulae [Durnin and Womersley, 1947]. Body fat was derived from the standard equation [Siri, 1956].

Measurement of Physiological Variables

Measurement of maximum oxygen capacity (VO2max) and heart rate during rest, maximal exercise and recovery was performed using Computerized Treadmill and Metabolic Analyzer [Astrand and Rodhal, 1970]. Measurement of anaerobic power/capacity was performed using Computerized Cycle Ergometer [Inbar et al., 1996]. Measurement of back and grip strength was performed using back and grip dynamometer [Jonson and Nelson, 1996].

Estimation of Biochemical Variables

A 15 ml of venous blood was drawn from the antecubital vein after a 12 hour fast and 24 hour after last bout of exercise. Measurement of Hemoglobin (Hb), Serum Urea, Serum Uric acid, Triglyceride (TG), Total cholesterol (TC) and High-density lipoprotein cholesterol (HDLC) were performed following standard procedure [Mukharjee, 1997]. Low density lipoprotein cholesterol (LDLC) was derived using standard equation [Friedewald et al., 1972].

Statistical Analysis

All the values of anthropometric, physiological and biochemical variables were expressed as mean and standard deviation (SD). Pearson's Correlation co-efficient was performed to find out if there is any significant relation between the selected anthropometric, physiological

and biochemical variables. In each case the significant level was chosen at 0.05 levels.

RESULTS AND DISCUSSION

Anthropometric Variables of Women Boxers

Body size (height and body mass) has a significant impact on elite boxers. The players are requited in different body mass categories. A standard body size is required for boxing. Tall players are getting advantage during bouts. Body mass is a considerable factor in boxing since body contact is essential in this game. A standard body mass is required for generation of force during the bouts. The percentage of body fat plays an important role for the assessment of physical fitness of boxers [Reilly *et al*., 1990]. The average body fat of present women boxers was observed to be 28.4 (%). Similar study on elite Indian male boxers showed VO_{2max} value of 12.2 (%) and 16.4 (%) respectively for junior and senior boxers [Khanna and Manna, 2006]. It can be said that the body fat of the women boxers are higher, which need to improve to get the optimum goal. A low-body fat may improve athletic performance by improving the strength-to-weight ratio [Reilly *et al.,* 1990; Katch *et al*., 2011]. Excess body fat adds to the load without contributing to the body's force-producing capacity [Reilly *et al*., 1990; Katch *et al*., 2011].

Physiological Variables of Women Boxers

The aerobic demand of boxing is also important since the game continues for 2 × 4

Table 1: Anthropometric variables of women boxers (n=50)

Parameters	Mean ± SD
Age (yrs)	19.7 ± 2.2
Stature (cm)	160.0 ± 4.8
Body mass (kg)	57.1 ± 9.1
Body fat (%)	28.4 ± 4.0

rounds of boxing [Ghosh *et al.,* 1995]. The average VO_{2max} of present women boxers was observed to be 47.9 (ml•kg-1•min-1). Similar study on elite Indian male boxers showed VO_{2max} value of 54.6 (ml•kg-1•min-1) 61.7 (ml•kg-1•min-1) respectively for junior and senior boxers [Khanna and Manna, 2006]. It has been seen that the VO_{2max} of the female boxers are quite lower that their male counterpart. Therefore, the female boxers need to improve the aerobic capacity in order to sustain their performance during the rounds. In the present study VO_{2max} showed negative correlation with body fat and body mass. Therefore it can be suggested that with increase in body mass and fat content VO_{2max} of the athletes decreased. This is supported by many researchers [Reilly *et al.,* 1990; Katch *et al*., 2011]. Heart rate increases with an increase in work intensity and shows linear relationship with work rate [Astrand and Rodhal, 1970]. It becomes the only factor to increase cardiac output after stroke volume reaches its maximum level at about 40% of maximal work [ACC, 1986; Katch *et al*., 2011].

As boxing is a combat sports, many activities are forceful and explosive (e. g. punches,

movements, changing pace etc.). The power output during such activities is related to the

Table 2: Heart rate and maximal aerobic capacity of women boxers (n=50)

Parameters	Mean ± SD
HRmax (bpm)	192.3 ± 8.2
RHR1 (bpm)	161.2 ± 10.5
RHR2 (bpm)	136.9 ± 9.7
RHR3 (bpm)	125.63 ± 9.6
VO2max (l/min)	2.7 ± 0.3
VO2max (ml/kg/min)	47.9 ± 7.4

strength of the muscles involved in the movements. Thus, it might also diminish the risk of injury [Reilly *et al.,* 1990]. Moreover, grip and back strength also have significant impact on the performance. Anaerobic power and strength are two most important variables in boxing. Training programme places great emphasis on the anaerobic pathways. The back and grip strength of Indian senior male boxers were found (156.5 kg, 62.7 kg, 50.1 kg) [Khanna and Manna, 2006] higher than the women boxers in the present study. The anaerobic power of the women boxer of the present study were found less than the senior male boxers (6.5 W•kg-1 BW) [Khanna and Manna, 2006]. The higher levels of anaerobic power and strength in the senior male boxers might be due to their higher body mass and high level strength training compared to the women boxers.

Table 3: Anaerobic capacity and strength women boxers (n=50)

Parameters	Mean ± SD
Anaerobic capacity (l)	4.3 ± 0.7
Back strength (kg)	91.1 ± 12.4
Grip strength right (kg)	32.8 ± 4.6
Grip strength left (kg)	30.9 ± 4.5

0bin is mainly used for the transport of oxygen from blood vessels to exercising muscles, and transport of carbon dioxide from working muscles to blood vessels. Moreover, hemoglobin represents the iron status of the body [Katch et al., 2011]. The present study showed normal level of hemoglobin in the women boxers. The serum level of urea and uric acid are considered as markers of overtraining as well as protein metabolism [Katch et al., 2011]. The present study normal level of urea and uric acid was observed among the women boxers. Lipids and lipoprotein profile are considered as the biochemical factors for assessment of risk of coronary heart disease [Katch et al., 2011]. The present study normal level of Lipids and lipoprotein profile was noted among the women boxers.

Table 4: Biochemical variables of women boxers (n=50)

Parameters	Mean ± SD
Hemoglobin (g/dl)	12.5 ± 1.1
Urea (mg/dl)	26.9 ± 5.7
Uric acid (mg/dl)	3.8 ± 0.9
Total cholesterol (mg/dl)	146.1 ± 25.7
Triglyceride (mg/dl)	59.2 ± 16.6
HDLC (mg/dl)	51.5 ± 8.4
TC/HDLC	2.9 ± 0.6

Table 5: Correlation studies of Anthropometric, Physiological and Biochemical variables of women boxers (n=50)

Correlations	r values
Body fat vs VO2max	- 0.76*
Weight vs VO2max	- 0.71*
Body fat vs Weight	+ 0.80*
Height vs grip strength	+ 0.52*
Height vs weight	+ 0.53*
VO2max vs Anaerobic capacity	+ 0.62*
TC vs TC/HDLC	+ 0.65*
TG vs TC/HDLC	+ 0.64*
HDLC vs TC/HDLC	- 0.54*

(*P<0.05)

CONCLUSION

Indian women boxers are getting success in International arena in recent years. Monitoring of anthropometric, physiological and biochemical variables are important for identification and selection of athletes. High intensity and long duration interval and strength training may develop the aerobic and anaerobic components of the boxers to meet the demand of the game. The study of women boxers are scanty in India therefore, the data of the present study may be used as reference to develop training schedule for women boxers. Government and NGOs should take initiatives to ensure the participations of women in sports.

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