MANGAL RESEARCH JOURNAL **Received:** 20-07-2022 **ISSN:** 2631-2441
Volume 3, December 2022, **pp:** 33-42 **Accepted:** 25-12-2022 **DOI:** https://doi.org/10.3126/mrj.v3i1.51637

Heart Rate and Anthropometrical Study of Nepalese International Boxing Players

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Abstract

The present study aimed to measure the HR response of boxing players during the four rounds of a punching before and after training to determine effectiveness of the training. Five international male Boxers who were participating in Asian Boxing Championship were selected with purposive sampling method. The data were collected during preparation camps for the championship. Each athlete was tested for various Anthropometric measurements necessary for the exact decimal ratings of Endomorphy, Mesomorphy and Ectomorphy equations developed by Carter and Heath (1990). Lafayette Skinfolds caliper has been used to measure the skin folds and for bone width measurement. For the Body Composition calculation, Drinkwater and Ross fractionation procedure (1980) was followed using Phantom model. Cardio-sport Heart Rate monitor was used to measure heart rate. Maximum heart rate and recovery heart rate were measured before and after training in 7 weeks interval on the same samples.

Nepalese Boxers were observed with average somatotype of 1.97 – 4.49 – 2.23 falling in Ectomorphic – Mesomorph category. Nepalese International Boxer's average age, height, body weight is 23.83 (S.D. 2.23), 168.1 cm (SD 8.5 cm) and 60.0 kg (SD 9.35) respectively. Nepalese Boxers are having 9.06 % body fat percentage and muscle mass 46.9 %. This study found the participants had good endurance capacity and improved their fitness level after 7-week training. This study suggested that they should give more emphasis in weight training. Future studies should conduct on larger samples including other sports and parameters.

Keywords: anthropometry, boxing, effectiveness of training, heart rate, Nepalese players

Introduction

Boxing is a combat sport in which competitors attempt to defend themselves from assaults from their opponents while also striking their opponents. In complicated motions during matches, practically all muscle groups are involved in short bursts of maximum and/or supramaximal effort intensity, which cause quick accelerations and decelerations of body segments (Kravitz et al., 2003). Boxers are required to possess a combination of cardio-vascular endurance, explosive strength, speed, agility and muscular coordination along with suitable physique of the game (Meetei & Singh, 2017). Thus , physical activities demand different body size and proposition that is why top level sports men of different sporting events have been found to possess different physique and morphological characters (Singh, Kaur & Kau, 2003). The speed, coordination, and force of the punches, as well as the boxer's psychomotor skills, all have a significant impact on their ability to perform at their absolute best. Thus, throughout training and coaching, boxers must learn to show their intricate coordination in a high-speed, explosive, agile, and flexible manner (Meetei & Singh, 2017).

It would be helpful to know the cardiovascular demand and the extent of anaerobic metabolism activation throughout a bout in order to have a knowledge of the physiological capacities behind boxing performance. These physiological indicators would serve as standards for enhancing and tracking athletes' training programs (Faude et al. 2007). Additionally, as it would make it possible to evaluate an athlete's potentials and limits, it may serve as a foundation for athletic performance plans (Ribeiro et al. 2006). The ability to immediately and quickly assess the physiological profile of performance in a particular discipline as well as assess the physiological demands is provided by heart rate (HR) monitoring (Meyer et al. 2005). Heart rate (HR) has been shown to be a good indicator of exercise intensity (Chamari et al., 2004) in both endurance sports and prolonged efforts including intermittent intense exercise (Gilman, 1996). The measurement of HR during boxing game could thus provide insight into the game intensity and help to determine the relationships between game heart rate and laboratory parameters of aerobic capacity such as VO_2max, $Th1_{vent}$, and $Th2_{vent}$. If relationships indeed exist, this might offer coaches a helpful tool for building better programmes and monitoring during training.

Anthropometry, in general, is a systematic technique that classifies the objective features of the human body according to its dimensions and structure features with certain measurement methods and principles (Özer, 1993). Somatotype is classification based on the physical structure elements made by considering the external features of the body structure and the values are obtained by anthropometric measurements. Somatotype refers to the morphological features of the body and it is classified into three main components: endomorph (fatty), mesomorph (muscular), ectomorph (weak) (Bal et al., 2021). As a result of the effects that body size and proportion have on the outcome of sports, body composition became an important factor affecting physical performance (Maud & Foster, 1995). For boxers, anthropometry (body size and composition) is a crucial aspect of fitness. To optimize their muscular mass for their specific weight category, boxers must be as thin as possible. The importance of assessing sports-specific skills as well as selected anthropometric and physiological characteristics of athletes in different sporting events is most important to determine their performance level (Gabbett & Georgieff, 2007). Therefore, the purpose of the current study was to measure the HR response of boxing players during the four rounds of a pinching before and after training to determine effectiveness of the training.

Method

The present study was conducted on five male international boxing players participating in Asian Boxing Championship. The purposive sampling method was used to select the samples. The data were collected during preparation camps for the championship. Each athlete was tested for various Anthropometric measurements necessary for the exact decimal ratings of Endomorphy, Mesomorphy and Ectomorphy equations developed by Carter and Heath (1990). Lafayette Skinfolds caliper was used to measure the skin folds and for bone width measurement, small sliding caliper manufactured by Ross Craft. Standard procedures were followed for taking Height and weight of the athletes. For the Body Composition calculation, Drinkwater and Ross fractionation procedure (1980) was followed using Phantom model.

Determining Somatotype

In order to find the somatotype values of anthromopetric measurements, the rates of Carter and Heath (Carter & Heath, 1990) were used, which was developed to determine the somatotypical characteristics and can be used in every field.

- Endomorphy =- 0.7182 + 0.1451 * x – 0.00068 * x2+ 0.0000014 * x3 (x = "triceps" skinfold thickness + "suprailiac" skinfold thickness + "subscapula" skinfold thickness)

  Height Correction Formula= x * 170.18 / height (cm)

- Mesomorphy = [0.858 + 0.601 * elbow width-"bicondylarhumerus" (cm) + 0.601 * knee width -"bicondylarfemur" (cm) + 0.188 * arm circumference (cm) + 0.161 * thigh circumference (cm)] – [height (m) * 0.131] + 4.50
- Ectomorphy = (Height-mass ratio) * 0.732 – 28.58 (Height-mass ratio = Height/3√Mass)

The nature of Boxing bouts is of interval type. There are four rounds and one-minute break in between these each round. So, to study how their heart rate responds at the end of each round and how quickly they recover within that one-minute break was the main purpose of the study. For this Cardio-sport Heart Rate monitor manufactured by Healthcare Technology limited-UK was used.

Heart rate were recorded in the beginning of the punching bag (20Kg) and after continuous two minutes of punching maximum heart rate was noted. One-minute rest was given sitting on the chair and just beginning of the next round again heart rate was noted. This procedure was continued for the next three rounds. Same procedure was followed exactly after 7 weeks for the study of the heart rate on the same subjects. If the boxer's fitness level had improved then there must be sharp drop in their recovery heart rates.

Results & Discussion

The result obtained from the Nepalese international Boxers' somatotype values are shown in the table 1. According to the results, average Endomorphy value was 1.97±0.65, average Mesomorphy value was 4.49±0.51 and average Ectomorphy value was 2.23±0.36.

Table 1

Somatotype of Nepalese International Boxers

Subject		Endomorphy	Mesomorphy	Ectomorphy
1		1.62	4.22	2.83
2		2.63	4.37	2.08
3		2.74	3.90	2.39
4		1.50	4.74	2.06
5		1.38	5.24	1.95
	Mean	1.97	4.49	2.23
	SD	0.65	0.51	0.36

Nepalese Boxers were found with average somatotype of 1.97 – 4.49 – 2.23 falling in Ectomorphic – Mesomorph category. Endomorphically and Ectomorphically Nepalese Boxers can be categorized on low and meromorphically moderately developed. Carter (1984) had reported of 1.7 – 5.1 – 2.7 somatotype among different Olympic participants boxing athletes which means morphologically Nepalese Boxers have suitable somatotype for the game. Bal, et al. (2021) found Endomorphy values were 3.42±1.03; Mesomorphy values were 4.398±0.84 and Ectomorphy values were 3,121±0,95 among the Turkish national Boxers. Similarly, Noh et al. (2014) found lower endomorphic component values and much higher percentage of mesomorph types in the elite boxer group. This result was also seen in other studies, with athletes in other combat sports, such as judo, Korean wrestling also called ssireum, wrestling, and jujitsu, tending to have a mesomorphic somatotype (Noh et al., 2014). Boxers have to avoid attacks and powerful hits by their opponent and continue to move their entire body until the end of the match. As they require speed, power, and endurance, they have lower endomorphic component values and higher mesomorphic component values than athletes in other combat sports (Noh et al., 2014).

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Table 2

Body Composition of Nepalese International Boxers

Subject	Age	Height (cm)	Body Weight (kg)	Body Fat %	Muscle Mass %	L. B .M (%)	Maximum Vo2 (Ml/kg/min)
1	23.44	162.8	50	8.53	44.39	91.47	51.99
2	22.35	167.7	60	7.96	49.31	92.04	52.88
3	27.64	182.7	75	13.49	47.04	86.51	53.92
4	22.1	161.7	55	7.96	44.83	92.04	52.58
5	23.60	165.5	60	7.37	48.93	92.63	51.84
Mean	23.83	168.1	60.0	9.06	46.9	90.94	52.64
SD	2.23	8.5	9.35	2.51	2.26	2.5	0.83

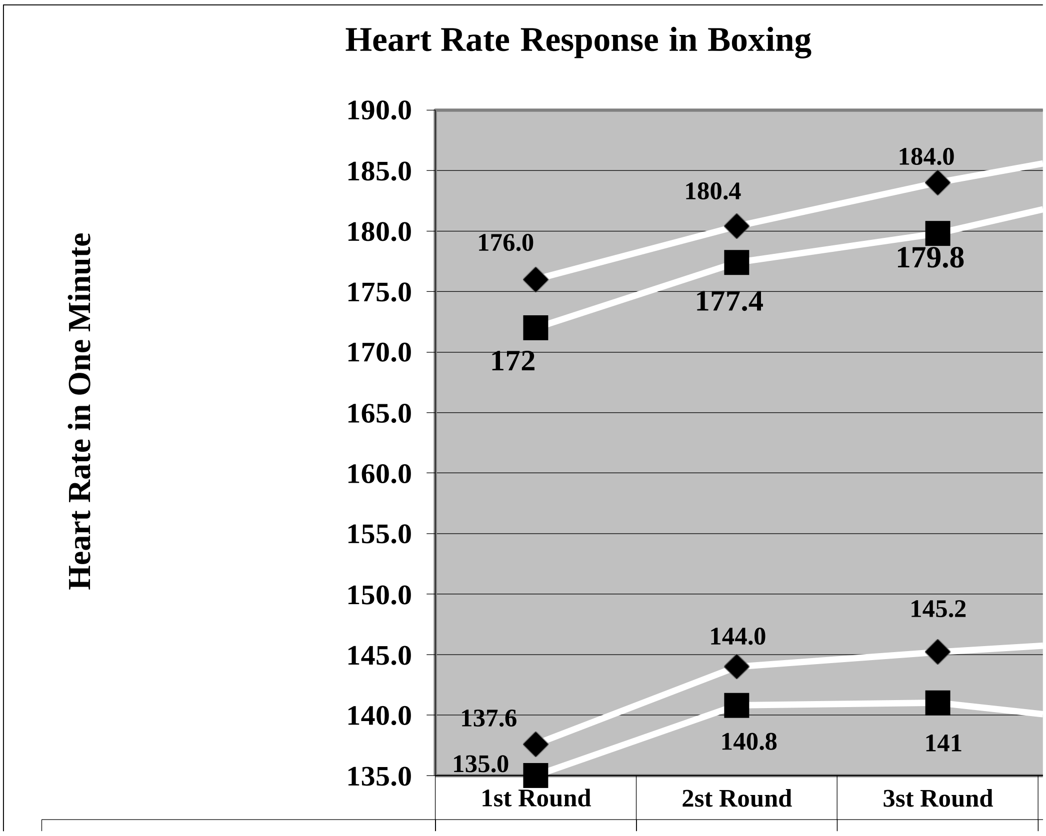
Nepalese International Boxer's average age, height, body weight is 23.83 (S.D. 2.23), 168.1 cm (SD 8.5 cm) and 60.0 kg (SD 9.35) respectively. Nepalese Boxers are having 9.06 % body fat percentage and muscle mass 46.9 %. Since they are having less body fat percentage it is natural that they'll be having more lean body mass (more than 90%), which is good for them and there won't be accumulation of extra energy in the form of fat in their body. Smith (2006) reported higher body fat (10.1±2.6%) among junior elite-level boxers than among senior elite-level ones (9.1±2.3%). The mean body composition of international-level male boxing athletes was approximately 12% fat (Chaabene et al., 2014). This discrepancy can be explained by the maturational stage of the boxers or by the more frequent usage of weight loss techniques by senior boxers.

Maximal oxygen consumption is essential in combat sports as well as in other sport branches. Kravitz, et al. (2003) found that the maximal oxygen consumption level of boxing athletes was found to be 41.0 ± 6.5 mL/kg/min. In another study conducted on boxing athletes, it was observed that the maximal oxygen consumption was 52.2 ± 7.2 mL/kg/min (de Lira et al., 2013). This study found that maximal oxygen consumption was 52.64 ± 0.83 mL/kg/min among Nepalese international boxing players.

In many sports it is a great disadvantage for an athlete to carry extra weight. This is especially true where he must support the athlete. The data obtained from champion performers permit as to speculate that the highly trained runners may achieve greater success if his body fat is less than 5% of body weight (Costill, D.L. 1981). Frank Shorter, 1972 Olympic marathon champion and 1976 Olympic silver medallist revel a body fat content of only 1.6% of body weight. In competitive sports and recreational activity the functional ability of muscles is increasingly becoming a focus of interest, because all physical performance is dependent upon muscle activity. The importance of the musculature lies in the fact that it constitutes a major part of dry body mass. In women, muscle consists of 30-35%, and in men, 42-47% of entire body mass. And the percentage of the muscle in the entire body mass can be increased by strength training or decreased by physical inactivity (Hartmann & Tunnemann, 1989).

Figure 1

Heart Rate Response of Participants



The above figure showed that the average maximum heart rate response and average recovery heart rate were gradually increasing after every round. The difference in maximal HR between fourth round (187 bpm) and first round (176 bpm) was 11 beats per minute before the training and 11.6 bpm after the training.

Table 3

Paired Sample Statistics of Max HR and Recovery HR

	Mean	N	Std. Deviation	Std. Error Mean
Pre Test of Max HR	181.75	4	4.787	2.394
Post Test of Max HR	178.25	4	5.058	2.529
Pre Test of Recovery HR	143.20	4	3.840	1.920
Post Test of Recovery HR	139.25	4	2.363	1.181

Table 4

Paired Sample T-test of Max HR and Recovery HR

	Mean	SD	Std. Error Mean	t	df	Sig. (2-tailed)
Pre-Test of max HR - Post Test of max HR	3.500	.577	.289	12.124	3	.001***
Pre Test of Recovery HR-Post Test of Recovery HR	3.950	2.380	1.190	3.320	3	.045*

A paired-samples t-test was conducted to compare heart rate response and recovery heart rate before and after the training. There was a significant difference in the scores for heart beat per minute before the training (M=181.75, SD=4.787) and after the training (M=178.25, SD=5.058); t(3)= 12.124, p = .001. Likewise, there was a significant difference in the scores for recovery heart rate before the training (M=143.20, SD=4.3.84) and after the training (M=139.25, SD=2.363); t(3)= 3.320, p = .045. These results suggest that the training improved the heart rate response and heart rate recovery of boxing athletes.

One of the main purposes of sports training is to increase their fitness level in the course of time. If this purpose is not fulfilled, then there is a loss of time, effort and energy of coaches and the athletes. From the above table and figure it is revealed that all the boxers improved their fitness level. They reduced their maximum heart rate after 2 minutes of punching on the bag and after one minute of recovery their average recovery heart rate as well. It was a good indication that they had reduced their recovery heart rate.

Conclusion

Nepalese Boxers were observed with average somatotype of 1.97 – 4.49 – 2.23 falling in Ectomorphic – Mesomorph category. Nepalese International Boxer's average age, height, body weight is 23.83 (S.D. 2.23), 168.1 cm (SD 8.5 cm) and 60.0 kg (SD 9.35) respectively. Nepalese Boxers are having 9.06 % body fat percentage and muscle mass

46.9 %. Since they are having less body fat percentage it is natural that they'll be having more lean body mass (more than 90 %), which is good for them and there won't be accumulation of extra energy in the form of fat in their body. In spite of these, they are having more oxygen consumption capacity (52.64 $\pm$ 0.83). In this way we can say that they have good endurance capacity. Since they have only 46.9% of muscle in their body it is suggested that they should give more emphasis in weight training. The participants have improved their fitness level. They have reduced their maximum heart rate after 2 minutes of punching on the bag and after one minute of recovery their average recovery heart rate as well. The current study has important strengths and limitations. The application of the above suggestions might be limited by various methodological issues. A larger sample would allow the generalizability of findings and the stratified analyses by sex, BMI, and sports practice time. Future studies should conduct on larger samples including other sports and parameters.

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