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Research Article

COMPARISON OF CARDIAC AUTONOMIC PROFILE OF ELITE ARCHERS AND BOXERS AT SPORTS AUTHORITY OF INDIA

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ABSTRACT

Background: Physical exercise and sports training have a beneficial effect on the cardiac autonomic profile of individuals. The exact impact of sports discipline on the autonomic profile is still unclear. The aim of the present study is to evaluate the differences in the cardiac autonomic profile of archers and boxers, using the measurement of heart rate variability.
Methodology: Time domain and frequency domain parameters of heart rate variability were studied in 28 sports persons (15 boxers and 13 archers) using the Neurobiofeedback (Biograph Infiniti, Thought Technology). The measurements were done for 10 minutes for each individual in resting state. All HRV parameters were compared for both the groups using independent samples t-test in SPSS 17.
Results: The mean of the LF/HF ratio for boxers is 2.31 and archers 1.32 ($p<0.05$). HF and SDRR in archers were significantly higher ($p<0.05$) than in boxers. All these results indicate greater parasympathetic drive in archers. No significant difference was found in other parameters of HRV.
Conclusions: Sport specific training leads to a difference in the autonomic profile of sports persons. Boxing is a sport which is aggressive and requires flight and fight responses, which explains the greater sympathetic tone in boxers as compared to archers, which is a more relaxed and focused game. Archery has a favorable effect on the cardiac autonomic profile.

INTRODUCTION

The beats of the healthy heart are not absolutely regular. It varies due to several factors, such as exercise, stress, both physical as well as mental stress (Conger *et al*., 1994). This variation in the beat to beat intervals is called the Heart Rate Variability (HRV). HRV is defined as the capacity of the heart to change the interval between beats when faced with different situations, where these variations are modulated mainly by the autonomic nervous system (Sztajzel, 2004).

The primary control of the heart and the circulatory system is at the higher brain centre and by the cardiovascular control area located in the brainstem, through the activity of the autonomic nervous system. The ANS comprise of the sympathetic and the parasympathetic nervous outflow to the heart and blood vessels, which are regulated by the medulla (Triposkiadis *et al*., 2009). In the medulla, the nucleus tractus solitarius receives sensory input and stimulates cardiovascular responses for emotion and physical stress. From the medulla, the parasympathetic vagus nerve innervates the heart. The right and left vagus nerves to innervate the sinus atria (SA) and atrioventricular nodes, respectively. Sympathetic efferent nerves are present throughout the atria, particularly in the SA node and ventricles. Sympathetic stimulation increases the heart rate, whereas parasympathetic system has the opposite effects. Although, sympathetic and parasympathetic systems are active at rest, the parasympathetic fibres release acetylcholine, which acts to retard the pacemaker's potential of SA node and thus reduce heart rate (O'Shea *et al*., 1989).

Heart rate variability (HRV) is a well-established non-invasive tool which can be used to study the effect of mental stress on autonomic control of the heart rate (HR) (Akselrod *et al*, 1981; Acharya *et al*, 2006; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). There is clinical evidence about the specificity and sensitivity of the HRV parameters to assess the reduction in parasympathetic activity related to several anxiety forms (Friedman, 2007). Although in the sport competitive field the relationship between HRV and emotions have been less studied, the reduction in parasympathetic cardiac control has been found in chess players in a real situation (Schwarz *et al*, 2003).

The measurement of heart rate variability over a duration of 5 minutes has been reported to be sufficient as stated in the guidelines provided by European Heart Journal (European Society of Cardiology [ESC], 1996).

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Archery and boxing are two very different sports having completely exclusive requirements of personality. Archers are more relaxed and focused individuals, whereas boxers are more aggressive. Considering these traits, we hypothesize that the HRV variables in the players of these sports might differ with archers having the greater parasympathetic drive as compared boxers.

MATERIALS AND METHODS

Subjects

The study was conducted on 28 sports persons, out of which 15 were boxers and 13 archers. All the players were proficient in their sport, boxers having an experience of 4.88 ± 1.17 years and archers 5.92 ± 2.27 years. The boxers (n=15) were from the National Boxing Academy and archers (n=13) were the National Campers at the Rajiv Gandhi Sports Complex. Almost all the players had international level participation experience. As per the ethical norms, informed consent was taken from each player before the conduct of the measurements.

Methodology

Heart Rate Variability measurements were taken for each player for the duration of 10 minutes with the Biofeedback (Biograph Infiniti, Thought Technology) in the resting state. The measurements were done in sitting position and at the same time during the day so that the circadian rhythm does not have an effect on HRV. The electrode for the measurement was put on the distal phalanx of the index finger of left hand and an average measurement of 10 minutes duration was taken. The parameters that were measured included the heart rate and time domain parameters (SDRR, NN50) and frequency domain parameters (VLF, LF, HF, LF/HF).

Inclusion criteria: Age 15-20 years

Having at least National Level Participation in their respective sport

Exclusion criteria: Player having any history of medical illness was excluded

Drinkers and smokers were excluded

Statistical Analysis

Independent sample t-test was used to compare means of different variables between the two groups. The statistical analysis was done using the Statistical Package for the Social Sciences (SPSS 17).

RESULTS

The comparison of the HRV between boxers and archers stated that archers had higher HRV values as compared to boxers. This finding is in agreement with our hypothesis. SDANN values of archers was significantly ($p<0.05$) higher as compared to boxers. Similarly, the frequency domain parameter of HRV, HF was also significantly higher in archers. The ratio of LF to HF which signifies the balance between the sympathetic and the parasympathetic system was found to be higher than the balance values in boxers. However, the LF/HF ratio was within balance range in the case of archers (LF/HF = 1.32 ± 0.685).

The other parameters of HRV (pNN50, VLF, LF) did not show any significant differences between the two groups. Also, the measurement of VLF over short term has been considered dubious, thus comparison of VLF between two groups must not be considered, as our recordings were short term (ESC, 1996; Loturco *et al*., 2016; Esco & Flatt, 2014).

Table 1 General data of players

S. No.	Variables	Mean ± SD	
		Boxers	Archers
1	Age	17.44 ± 1.85	18.41 ± 0.9
2	Years of training	4.88 ± 1.17	5.92 ± 2.27
3	BMI	21.11 ± 2.17	22.82 ± 2.67
4	HR	74.47 ± 12.11	77.14 ± 14.48

Table 2 Comparison of HRV parameters of boxers and archers

Variables	Boxers	Archers	p value
LF/HF	2.31 ± 1.17	1.32 ± 0.685	<0.05*
VLF	225.08 ± 230.8	261.86 ± 224.97	n.s.
LF	332.3 ± 398.12	510.33 ± 393.17	n.s.
HF	199 ± 299	530 ±520.86	<0.05*
pNN50	15.56	14.12	n.s
SDRR	65.4 ± 13.8	102 ± 39.6	<0.01*

* Significant
n.s. Not Significant

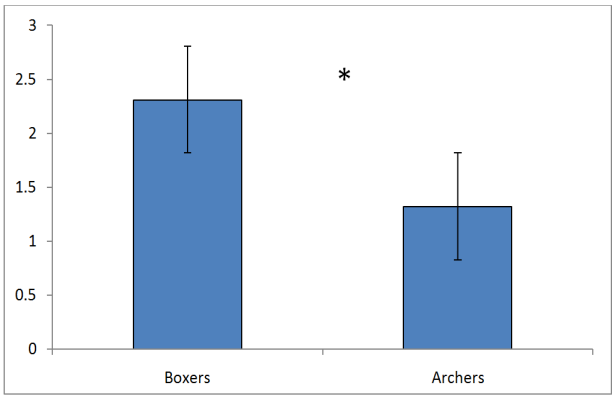

Figure 1 Comparison of means of LF/HF ratio between boxers and archers.
* Significant ($p<0.05$)

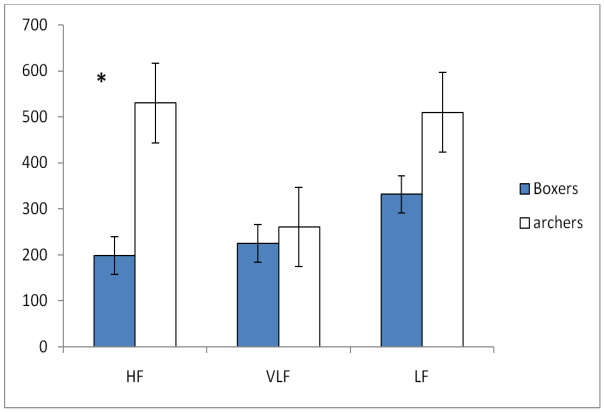

Figure 2 Graph showing comparison of means of VLF, LF and HF between the two groups.
* Significant difference ($p<0.05$)

DISCUSSION

Archery is a game of skill, focus, and concentration. The experience of the archers helps to improve their arousal control and consequently, the balance between the sympathetic and parasympathetic systems (Clemente *et al*, 2011). A higher

parasympathetic activity has been reported to be beneficial to the performance within the sport (Lo *et al*, 2008). Archers show neuroticism and extraversion stability in their behavior (Dabas *et al*, 2014). Thus with training, archers develop a greater parasympathetic drive as compared to sympathetic. Our results suggest the similar finding. Archers showed significantly greater values of HF parameter in the HRV, which is a parameter of the parasympathetic measure. The balance between the two systems as shown by the ratio of LF/HF was maintained in archers and it was towards the sympathetic side in case of boxers.

The characteristic demands of training in boxing and competitive activity in this sport can have a specific effect on the psychological profile of boxers as compared to other sports. They show significantly higher symptoms of neuroticism (Bacanac, 2001). Raised neuroticism refers to the instability of the vegetative nervous system which is too active, labile and reacts to the outer stimuli too strongly. When things become during a match, the panic rises, because there is a real fear of injuries, physical as well as psychological. Some writers have called the game of boxing 'physical chess', as it requires both the psychological as well as physical contributions (British Association of Sport and Exercise Sciences [BASES]). It is a brutal sport in which a boxer is said to 'fight' rather than 'play' a match. This is a sport in which high level of anxiety is considered facilitative to the performance of the sport provided the player knows to maintain the control. In challenge state, such as boxing, high levels of anger are useful to the performance (Jones *et al*, 2009). The relationship between type of personality and HRV has been reported earlier. Aggression was found to be associated with the high sympathetic activity (Zohar *et al*, 2013).

Limitations

One of the limitations of our study was small sample size. It is suggested that the autonomic control be studied in a greater number of experienced boxers and archers. It has been proven in literature that 5 minutes recording of HRV is sufficient for determining the autonomic profile of an individual (Min *et al*, 2008). However, it suggested that 24-hour monitoring of HRV be done for the analysis of the variation in autonomic control of archers and boxers.

Major findings

Our major finding from this study is that the boxers have a sympathetic drive when compared to archers as the both the sports have different psychological as well as physiological profiles. It can be concluded that if archers are given heart rate variability training using biofeedback they will be helped in their progression towards the higher performance.

CONCLUSION

Our results are consistent with our hypothesis that boxers have sympathetic drive whereas archers have more balanced autonomic control. However, 24-hour analysis of heart rate variability must be undertaken for a more clear understanding of the difference in cardiac autonomic profile between archers and boxers.

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