P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2019; 6(5): 232-236

www.kheljournal.com
Received: 28-07-2019
Accepted: 30-08-2019

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Scientific analysis on the impact of different proportions of aerobic and anaerobic trainings on heart rate and stroke volume

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Abstract
Background: Scientific sports training is most importance for every athlete to achieving excellence in sports. This present scientific study was to analysis on the impact of different proportions of aerobic and anaerobic trainings on heart rate (HR) and stroke volume (SV).
Methods: Thirty men elite athletes were taken for this study, aged between 20 and 25 years. They were further divided into two groups. Group I (n=15) 90% aerobic and 10% anaerobic proportion (10,000 mtr race), Group II (n=15) 10% aerobic and 90% anaerobic proportion (200mtr race). (Edward L. Fox, 1989) [5] For both the groups cardiovascular parameters HR and SV were measured by using Electro cardiograph (ECG) and M-mode Doppler echocardiograph respectively. All subjects were elite athletes. Subjects underwent their respective training regimen under the supervision of their regular coaches.
Result: The HR at rest mean values of 90% aerobic and 10% anaerobic and 10% aerobic and 90% anaerobic group 46.00 and 56.07 beats/min (p=0.05) respectively. SV at rest mean values of both groups 102.08 and 82.63 ml/beat (p=0.05) respectively. The values obtained were analyzed with data obtained from athletes by SPSS. The result indicates that 90% aerobic and 10% anaerobic group has significantly decreased HR and increased SV as compared to 10% aerobic and 90% anaerobic group.
Conclusion: It is concluded that 90% aerobic and 10% anaerobic training is better training protocol to decrease the heart rate and increase stroke volume among athletes for better physiological efficacy.

Keywords: Sports training, different proportions of aerobic, anaerobic training, heart rate, stroke volume, elite athletes, cardiovascular system

1. Introduction

"Athlete is an incredible human being who swims in the ocean of lactic acid", It is well discovered that the aerobic training with different proportion results in a noticeable abatement in resting HR and SV together. Regular and systematic dynamic exercises leads to a variety of cardiovascular changes are super imposed on the acute and chronic rejoinders (K.R.S. Reddy *et al*. 2010) [13].

The demand of an acute bout of exercise demands in cardiovascular activity that at first achieved by central command and adjusted by peripheral afferent information sources. Among athletes the parasympathetic withdrawal at first increment in cardiac output ($\dot{Q}$), when it converts inadequate sympathetic activity is improved. The cardiovascular outcomes of a unique exercise incorporate HR and SV (O'Sullivan 2000 [20] Greenleaf *et al*. 1981) [9].

When a sportsman systematically undergoes the chronic training the different organisms will get impact differently with different adaptation period. Heart is one of the unique organs that require a different adaptation period as compared to other organisms. Further the training with different intensities certainly leads to different physical and physiological training effects, When he/she undergo training with maximum intensity leads to improvement of speed abilities whereas with low intensities leads to improve different types endurance abilities. Apart when a sport man undergo very low intensity training it does not impact on performance factor but it is good for accelerating recovery process (Hardayal Singh, 1991) [10].

According to Raglin and Willson (2000) if an athlete seek a significant change on selected cardiovascular parameters the subjects should expose to greater volume of training than that of the amount required to achieve physical fitness. 90% of aerobic training and 10% of anaerobic training results in lower HR and increased SV as a result of Starling law of mechanism.

Endurance training in patients with cardiovascular disease has appears to be productive in bringing down resting HR and expanding chronotropic reserve (Florent Besnier *et al*. 2017) [7]. SV is approximately 70 to 80 ml/beat at rest in normally active men but can be as high as 130 to 150 ml/beat in endurance trained athletes. The SV of average fit individual's increases at the onset of exercise and continually increases until values of 120 to 140 ml/beat have been attained at 40% to 50% of maximal oxygen consumption (K. M. Gallagher *et al*., 1999) [12]

The cardiac efficacy among people who expose to long term endurance activities, the resting HR significantly lower and which is close to Brady arrhythmia and impact on large SV (Bo-Ae Lee, Deuk-Ja Oh, 2016) [3] If the individual take part in endurance activity likes 10,000 mtr or marathon for a longtime the eccentric left ventricle hypertrophy in which the thickness of ventricle isn't great while the left ventricular wall is a moderately expanded (Vinereanu D. *et al*. 2002) [22].

In Sports Hr is widely used as a marker for exercise intensity. Hr is the "individual aerobic threshold" (Rocker and Horstmann *et al*., 1998). Resting and post exercise HR variability are responsive to the impact of training loads in endurance and team sports. Vagally related heart rate variability indices at rest are augmented in rejoinder to training loads, to develop exercise performance (Nummela *et al*. 2010) [18]. HR variability is useful for sprinters to know the possibility of training related adaptations (Cesar Abad *et al*. 2017) [4].

In this paper the investigator is trying to put an effort to discover how 90% aerobic and 10% anaerobic and 10% aerobic and 90% anaerobic training are going to influence on selected cardiovascular variables such as HR and SV which are having a direct association with intensity of load and volume of load.

The investigator has chosen 90% aerobic and 10% anaerobic and 10% aerobic and 90% anaerobic proportions as independent parameters to meet these criteria. 15 men elite athletes from 10,000 mtr run, whereas 10% aerobic and 90% anaerobic combinations 200 mtr run male elite athletes as subjects who have been effectively contributing at national and varsity level sports (Edward L. Fox,1989) [5] All of them were healthy.

2. Methods

The sample of this study consisted of 30 men elite athletes from different areas of Andhra Pradesh and Telangana. Men elite athletes were selected as subjects. Whose specialized sport is 10,000 and 200 mtr race respectively and their age between 20 and 25 years In order to be qualified as volunteered subjects each elite athlete they gave written informed consent to the investigator. Fifteen subjects (n=15) from 10,000 mtr race at varsity level and national level were assigned to be 90% aerobic and 10% anaerobic group. Fifteen subjects (n=15) from 200 mtr race at varsity level and national level were assigned to be 10% aerobic and 90% anaerobic group. All the subjects were sustained from smoking, alcohol and drug. Subjects underwent their respective training regimen under the direction of their regular coaches, as per the training diary of the elite male Athletes subjects they were not stated any injuries throughout their training age range from 5 to 7 years.

2.1 Testing: The subjects of 90% aerobic and 10% anaerobic and 10% aerobic and 90% anaerobic were tested after two days of the training. Parameters of HR and SV measured by using Electro cardiograph (ECG) (Philips page writer TC20) and 'M-Mode Doppler echocardiography (Philips CX50 ultra image system) respectively at Lakshya Cardiac Center', Proddatur, A.P. India.

2.2. Calibration and procedure

ECG was performed on a Philips page writer TC20, Philips Medical Systems, USA. The subject was asked to lay down on the table of echocardiograph comfortably. The investigator put leads around the chest, legs and hands. Press the power button and after reading press the ECG button. Pulse showing on led screen of ECG device was order for print on graphical paper. Heart rate shows on the printed paper.

'M-mode Doppler echocardiography was implemented on a Philips CX50 imaging ultra-image system, Philips medical systems, USA, with 2.5 to 3.5 MHz transducer' was used to determine the stroke volume by subtraction of end systolic volume (ESV) from end diastolic volume (EDV).

Stroke volume (SV) = EDV-ESV

2.3. Statistical analysis

The investigated data on selected parameters has been evaluated and presented underneath. The information gathered from experimental groups on HR at rest and SV at rest were accurately tested for significant difference, if any by utilizing (ANOVA) and data were evaluated by utilizing PC with IBM-25, SPSS. The degree of certainty was fixed at 0.05 for uniqueness.

3. Results and Discussions

3.1 Results

3.1.1 Heart rate at rest

Means, Standard deviation (SD) and the ANOVA for data on HR at rest of 90% aerobic and 10% anaerobic group, and 10% aerobic and 90% anaerobic group were analyzed and presented in the table 1. The table value for significance at 0.05 level with df 1 and 28 is 4.20.The table 1 displays that the means of 90% aerobic and 10% anaerobic group and 90% anaerobic and 10% aerobic groups are 46.00 and 56.07 beats/ min respectively. The acquired 'F' ratio of 453.43 is greater than the table value of 4.20 for df 1 and 28 required for significant at 0.05 level.The result of the study indicates that the considerable difference occurs among both experimental groups on HR at rest. Hence, it is determined from the results that 90% aerobic and 10% anaerobic training group has markedly reduced the heart rate at rest as compared to 10% aerobic and 90% anaerobic training group.The test mean values on HR at rest of 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic groups are graphically conferred in Figure 1.

3.1.2 Stroke volume at rest

Means, SD and the ANOVA for data on stroke volume at rest of 90% aerobic and 10% anaerobic group, and 10% aerobic and 90% anaerobic groups were evaluated and given in table 2.

The table value for significance at 0.05 level with df 1 and 28 is 4.20.

The table 2 displays that the means of 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic groups are 102.08 and 82.63 ml/beat respectively. The acquired 'F' ratio of 624.803 is much greater than the table value of 4.20 for df 1 and 28 required for significant at 0.05 level.

The result of the study indicates that the significant dissimilarity exists among 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic groups on SV at rest. From the results it was concluded that, 90% aerobic and 10% anaerobic training group has significantly augmented the SV at rest as compared to the 10% aerobic and 90% anaerobic training group.The test mean values on SV of 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic groups are graphically portrayed in Figure 2.

3.2 Discussion on Findings

Research evidence indicates that Long distance runners have extreme increasing cardiovascular changes compared to short distance runners. In this study 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic groups has acquired cardiovascular modifications but 90% aerobic and 10% anaerobic training group underwent extreme cardiovascular adaptations as compared to 10% aerobic and 90% anaerobic training group.

3.2.1 Impact of Aerobic training on Heart rate at rest

From the results of the study it has been concluded that, 90% aerobic and 10% anaerobic training group has significantly decreased heart rate at rest as compared to 90% anaerobic and 10% aerobic training group. The results indicate that the significant difference exists between both groups on heart rate at rest. The resting heart rate is reduced by a balance between sympathetic and parasympathetic tone with a prevalence of the latter (Lakatta EG, 1995) [15] on this basis, few reports expressed that an expanded vagal tonus is the main fundamental instrument for the bradycardia initiated by aerobic physical training (Smith ML, Hudson DL, *et al*. 1989) [5] According to Goldsmith *et al*. (1992) [8]. the bradycardia shown by endurance trained people is attributed, in any event to a limited extent to greater parasympathetic activity.

Sprinters present comparative HRV initiates when contrasted with endurance sprinters (Abad *et al*. 2014). Suggest that former populations might be present akin cardiac autonomic changes when equated with endurance runners after expose to prolonged training activity (Lepretre *et al*. 2012) [19] Heart rate variability is diminished when athletes present outreach and overtraining symptoms (Kiviniemi *et al*. 2014**)** [14] People who exposed to aerobic exercise their resting heart rate is 40-60 bpm, which is near bradyrhythmia likewise SV is also huge (Maron and Pelliccia, 2006) [17] Sullivan and bell (2000) [20] found in a troop of previous inactive subjects that 6 weeks of systematic, moderate aerobic exercise is adequate to outcome a considerable lowering heart rate. Franklin (1997) stated that the increased aerobic capacity in athletes appears to be primarily the aftereffect of augmented maximal cardiac output, because of a more noteworthy addition in HR and to lesser extent SV, as opposed to an extended peripheral extraction of oxygen. Because there is little variety in maximal HR and maximal systemic arteriovenous oxygen contrasts with training. Bonaduce (1988), concluded that, mechanisms for decrease of inherent heart rate following training may include changes in ionic concentrations with the sinoatrial node. Mechanical stretching of the sinoatrial node on a combination of several reasons. An increased modulation following exhaustive exercise training may subsidize to the maintenance of bradycardia following the adaptation. Leicat *et al*. (2003) [2] found out that 8 weeks of cycling has significantly reduced resting and exercise bradycardia and Vegas modulation during rest and at the entire exercise work rates. The present investigation concludes that the outcomes are inconformity with above research evidence.

3.2.2 Impact of Aerobic training on Stroke volume at rest

From the outcomes of the study it has been concluded that, 90% aerobic and 10% anaerobic training group has significantly increased stroke volume at rest as compared to 90% anaerobic and 10% aerobic training group. The result indicates that the significant difference exists between two groups on stroke volume at rest. Maron (1986) [16]. coined that high SV is kept up with low heart rate, while low SV is kept up with a high HR. Additionally standard exercise makes the progression of the venous blood smooth, along these lines expanding the amount of blood coming back to diastolic heart, which increment cardiac output. According to Hoogsteen *et al*. (2004) [11]. athletes who do continuance practices and are prepared hard, eccentric progression change was appeared, it is then categorized that the internal diameter of the ventricle was expanded on account of such eccentric hypertrophy, and due to huge left ventricular volume, the SV was additionally high. Furthermore, a high SV in the vigorous aerobic exercise group was appeared with low HR. Enrique *et al*. (2002) [6] found that in contrast, athletes accomplished a generously augmented $\dot{Q}$ essentially through a noticeable increment stroke volume; their activity HR was related to that of inactive subjects. The extremely augmented SV resulted from both increments in end diastolic volume and noticeable diminishes in end systolic volume contrasted and those in inactive individual. These volumetric changes were reflected in a striking increment in ejection fraction.

The present investigation concludes that the outcomes are inconformity with above research findings.

4. Tables and Figures

Table 1: Analysis of variance for the heart rate at rest data on 90% aerobic and 10% anaerobic group, and 10% aerobic and 90% anaerobic group

Test	90% Aerobic and 10% Anaerobic Group	10% Aerobic and 90% Anaerobic Group	Source of Variance	Df	Sum of Squares	Mean Squares	Obtained 'F' Ratio	Table 'F' Ratio
Mean	46.00	56.07	B:	1	760.033	760.033	453.43*	4.20
SD	1.07	1.49	W:	28	46.933	1.676		

*Significant at 0.05 level of confidence.

The table value for significance at 0.05 level with df 1 and 28 is 4.20.

Table 2: Analysis of variance for the stroke volume at rest data on 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic group

Test	90% Aerobic and 10% Anaerobic Group	10% Aerobic and 90% Anaerobic Group	Source of Variance	df	Sum of Squares	Mean Squares	Obtained 'F' Ratio	Table 'F' Ratio
Mean	102.08	82.63	B:	1	2838.241	2838.241	624.803*	4.20
SD	1.99	2.26	W:	28	127.193	4.543		

*Significant at 0.05 level of confidence.
The table value for significance at 0.05 level with df 1 and 28 is 4.20.

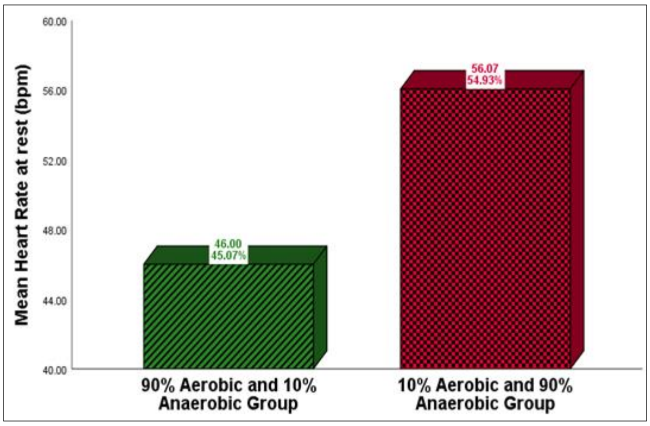

Fig 1: Bar diagram on heart rate at rest means of 90% aerobic and 10% anaerobic training group and 10% aerobic and 90% anaerobic training group

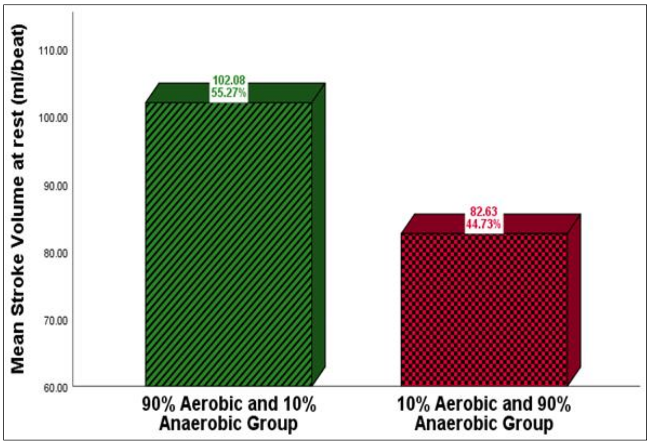

Fig 2: Bar diagram on stroke volume at rest means of 90% aerobic and 10% anaerobic training group and 10% aerobic and 90% anaerobic training group

5. Conclusions
Findings of the data have significant difference exist between 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic group regarding their influence on HR and SV. From the results of the study 90% aerobic and 10% anaerobic group has markedly reduced the Heart rate and significantly increased the stroke volume as compared to 10% aerobic and 90% anaerobic group.

6. Implications
Based on the findings of the study 90% and 10% proportions of aerobic and anaerobic training is an effective proportion to bring down the resting heart rate among elite athletes. Further, 90% aerobic and 10% anaerobic training is better training protocol to decrease the heart rate and increase stroke volume among athletes for better physiological efficacy.

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