ISSN: 0971-1260
Vol-22-Issue-14- December-2019

# Influence Of Different Proportions Of Aerobic And Anaerobic Training On Heart Rate, Stroke Volume And Cardiac Output Among Elite Athletes

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## ABSTRACT
Exercise and sports performance depend enormously on the ability of the cardiovascular system to react to a wide scope of metabolic need and physical effort. In this scientific study influence of different proportions of aerobic and anaerobic training on heart rate, stroke volume and cardiac output among elite athletes, Forty five (N=45) men elite athletes have volunteered to success the aim of this study. Subjects were randomly allocate into three groups as 10% aerobic and 90% anaerobic proportions (200 mtr race) , 50% aerobic and 50% anaerobic proportions (1500 mtr) and 90% aerobic and 10% anaerobic proportions (10000 mtr run) **(Edward L. Fox, 1989)**. The subject's age was between 20 and 25 years. Their sports age is between 5 years to 7 years. To measure the Heart Rate (HR) at rest, Stroke Volume (SV) at rest and Cardiac Output ($\dot{Q}$) at rest, all the subjects underwent M-mode Doppler echocardiography, Obtained Values were analyzed by employing SPSS Package. The result indicates that 90% aerobic and 10% anaerobic group and 50% aerobic and 50% anaerobic group have significantly decreased HR at rest and increased SV at rest compared to 10% aerobic and 90% anaerobic group and there is insignificant difference exists in cardiac output among three experimental groups at 0.05 level of confidence. Further it is concluded that 90% aerobic and 10% anaerobic training was better training proportion to decrease HR at rest, increase the SV at rest and also the highest mean difference exists between 90% aerobic and 10% anaerobic group and 10% aerobic and 90% anaerobic group.

**Keywords:** Sports Training; Aerobic and Anaerobic training; Heart Rate; Stroke Volume; Cardiac Output; Elite Athletes; Cardiovascular system.

## INTRODUCTION
Systematic sports activity produces physiological hypertrophy depending on the duration and intensity of training regimens. Exercise and sports performance depend enormously on the ability of the cardiovascular system to react to a wide scope of metabolic need and physical effort. With constant endurance exercise training, the cardiovascular system redesigns and can experience various changes, prompting upgrades in internal cardiac efficiency and overall

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

exercise capacity of fitness. Aerobic endurance training leads to different physiological adaptations with in the body **Narasimham T.K. (2009).**

"Most extreme advantage of the training stimulus can be acquired when reproduce the developments on vitality systems engaged with the sports". Expanded interest for oxygen take-up and use during activity rely upon satisfactory adjustments of the peripheral vasculature and this is encouraged by an expansion in cardiac output to enhance oxygen conveyance **Guido E Pieles, Gergely Szantho et al. (2014).**

The essential compensations of physical workout are to an upturn the cardiac output and an augmentation of the inherent ability of muscles to extract and to employ oxygen from the blood **Harsh Patel, Hassan Alkhawam et al. (2017).** The change in SV, in response to exercise associated with exercise training, is the main adaptation providing the impetus for increase in maximal$\dot{Q}$, that is why endurance trained athletes are capable of continuously increasing their SV **Gledhill et al. (1994).**

According to **K M Gallagher (1999)** Resting and submaximal exercise $\dot{Q}$ are not changed by exercise training; however, maximal $\dot{Q}$ can be twice as much in elite athletes than in untrained individuals. The changes in maximal cardiac output are primarily due to changes in stroke volume because maximal heart rate is unaffected by training.

According to **K. Rama Subba Reddy et al. (2010)** Parasympathetic extraction delivers the initial upsurge in $\dot{Q}$ but when this becomes deficient, sympathetic activity is amplified. Cardiovascular moments of dynamic exercise include improved HR, SV, $\dot{Q}$ and declined peripheral resistance. With systematic dynamic workout, a different other cardiovascular properties are superimpose on the acute responses.

In this study the investigator has analyzed how 10% aerobic and 90% anaerobic and 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic trainings are going to influence on Heart Rate at rest, Stroke Volume at rest and Cardiac Output at rest.

The investigator has chosen elite athletes who have been successfully participating at National and University level competitions. Subject underwent regular training program under the supervision of their regular coaches as per specialized sports event. The subjects age between 20 and 25 years. The training diary revealed that volunteered elite athletes subject were not reported any injuries during their training period and their sports age is 5 to 7 years.

## METHOD

Forty Five (N=45) healthy male elite athletes were volunteered as subjects from different parts of Andhra Pradesh and Telangana, India. The investigator has elect 10% aerobic and 90% anaerobic and 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic proportions as independent variables, to meet this criteria fifteen men (n=15) elite athletes from 200 mtr, fifteen men (n=15) elite athletes from 1500 mtr and fifteen men (n=15) elite athletes from 10,000 mtr race respectively **(Edward L. Fox, 1989)** who have been effectively taking an interest at National and University level sports. Subject underwent regular training program under the direction of their regular coaches as per specialized sports event. The subjects age between 20 and 25 years. The training diary revealed that volunteered elite subject athletes were not reported

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

any injuries during their training period and their sports age is 5 to 7 years. The assessed parameters are HR at rest, SV at rest and $\dot{Q}$ at rest. They were measured by 'M-mode Doppler echocardiography (Philips CX50 ultra image system) at Lakshya Cardiac Center, Prodatur, and Andhra Pradesh, India'.

## STATISTICAL ANALYSIS

The composed data on HR at rest, SV at rest and $\dot{Q}$ at rest has been analyzed and presented below. The data collected from experimental groups HR at rest, SV at rest and $\dot{Q}$ at rest were statistically tested for substantial difference, if any by employing Analysis of variance (ANOVA) and data were analyzed by using computer with IBM-25, SPSS package. The level of confidence was fixed at 0.05 for significance. To determine the significance difference among the three groups, the Scheffe'S test was applied as post-hoc test.

ABBREVIATIONS

HR - Heart Rate
SV- Stroke Volume
$\dot{Q}$ - Cardiac Output
$\overline{X}$ - mean
□□□□Standard Deviation

## RESULTS

### Heart Rate at Rest

The analysis of variance for data on heart rate at rest of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group were analyzed and displayed in Table I.

**TABLE I: Analysis of variance for the heart rate at rest data on 10% Aerobic and 90% Anaerobic group, 50% Aerobic and 50% Anaerobic group and 90% Aerobic and 10% Anaerobic group**

| Test | 10% Aerobic and 90% Anaerobic Group | 50% Aerobic and 50% Anaerobic Group | 90% Aerobic and 10% Anaerobic Group | Source of Variance | df | Sum of Squares | Mean Squares | Obtained 'F' Ratio | Table 'F' Ratio |
|---|---|---|---|---|---|---|---|---|---|
| $\overline{X}$ | 56.07 | 50.87 | 46.00 | B: | 2 | 760.31 | 380.16 | 197.932* | 3.222 |
| □□□ | 1.49 | 1.55 | 1.07 | W: | 42 | 80.67 | 1.92 | | |

***Significant at 0.05 level of assurance.***

The table value for purport at 0.05 level with df 2 and 42 is 3.222.

The table I displays that the means of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups are 56.07, 50.87 and 46.00 beats/ min severally. The attained 'F' ratio of 197.932 is greater than the table value of 3.222 for df 2 and 42 requisite for significant at 0.05 level.

The consequences of the study indicates that the significant difference exists among 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group on HR at rest**.** To define the noteworthy variation among the means of three

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

experimental groups, the Scheffe'S test was employed as post-hoc test and the outcomes were exhibited in table I-A.

**TABLE I-A: Scheffe’S post-hoc test for Heart Rate at rest on the difference between 10% Aerobic and 90% Anaerobic group, 50% Aerobic and 50% Anaerobic group and 90% Aerobic and 10% Anaerobic group**

| 10% Aerobic and 90% Anaerobic Group | 50% Aerobic and 50% Anaerobic Group | 90% Aerobic and 10% Anaerobic Group | Mean deviations | Confidence Interval 0.05 Level |
|---|---|---|---|---|
| 56.07 | 50.87 | - | 5.20* | 0.911 |
| 56.07 | - | 46.00 | 10.07* | |
| - | 50.87 | 46.00 | 4.87* | |

***Significant at 0.05 level of assurance.***

The table I-A displays that the test mean deviation on HR at rest between 10% aerobic and 90% anaerobic group and 50% aerobic and 50% anaerobic group is 5.20 which is much greater than the confidence interval value 0.911 at 0.05 level of assurance. The test mean deviation on HR at rest between 10% aerobic and 90% anaerobic group and 90% aerobic and 10% anaerobic group is 10.07 which is much greater than the confidence interval value 0.911 at 0.05 level of assurance. The tests mean deviation on HR at rest between 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group is 4.87 which is greater than the confidence interval value 0.911 at 0.05 level of assurance. Hence, it is concluded from the consequences that the noteworthy deviation exists between 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group on HR at rest.

From the results it was concluded that, 90% aerobic and 10% anaerobic group has decreased the HR at rest as compared to the 10% aerobic and 90% anaerobic group and 50% aerobic and 50% anaerobic group. Further it is concluded that highest mean deviation exists between 10% aerobic and 90% anaerobic group and 90% aerobic and 10% anaerobic group.

The tests mean values on HR at rest of three experimental groups are graphically depicted in Figure I.

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

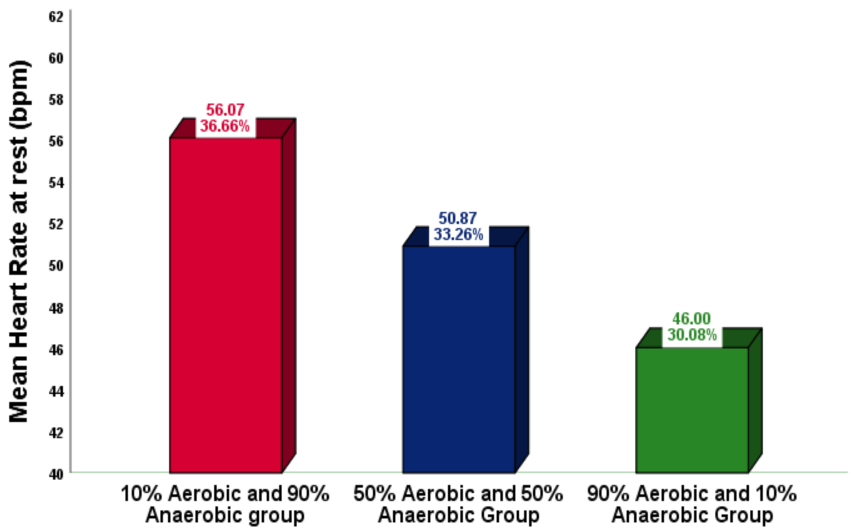



**FIGURE I: BAR CHART ON HEART RATE AT REST MEANS OF 10% AEROBIC AND 90% ANAEROBIC GROUP, 50% AEROBIC AND 50% ANAEROBIC GROUP AND 90% AEROBIC AND 10% ANAEROBIC GROUP**

## Stroke Volume at Rest

The analysis of variance for data on SV at rest of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group were analyzed and displayed in Table II.

**TABLE II: Analysis of variance for the stroke volume at rest data on 10% Aerobic and 90% Anaerobic group, 50% Aerobic and 50% Anaerobic group and 90% Aerobic and 10% Anaerobic group**

| Test | 10% Aerobic and 90% Anaerobic Group | 50% Aerobic and 50% Anaerobic Group | 90% Aerobic and 10% Anaerobic Group | Source of Variance | df | Sum of Squares | Mean Squares | Obtained 'F' Ratio | Table 'F' Ratio |
|---|---|---|---|---|---|---|---|---|---|
| $\bar{X}$<br>□□<br>□ | 82.63<br>2.26 | 91.50<br>2.80 | 102.08<br>1.99 | B:<br>W: | 2<br>42 | 2845.52<br>236.77 | 380.156<br>5.637 | 252.376* | 3.222 |

***Significant at 0.05 level of assurance.**

The table value for purport at 0.05 level with df 2 and 42 is 3.222.

The table II displays that the means of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups are 82.63, 91.50 and 102.08 ml/beat severally. The attained 'F' ratio of 252.376 is much greater than the table value of 3.222 for df 2 and 42 required for significant at 0.05 level.

The consequences of the study indicates that the significant difference exists among 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups on SV at rest. To define the noteworthy variation among the means of three

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

experimental group, the Scheffe'S test was employed as post-hoc test and the outcomes were exhibited in table II-A.

**TABLE II-A: Scheffe'S post-hoc test for Stroke Volume at rest on the difference between 10% Aerobic and 90% Anaerobic group, 50% Aerobic and 50% Anaerobic group and 90% Aerobic and 10% Anaerobic group**

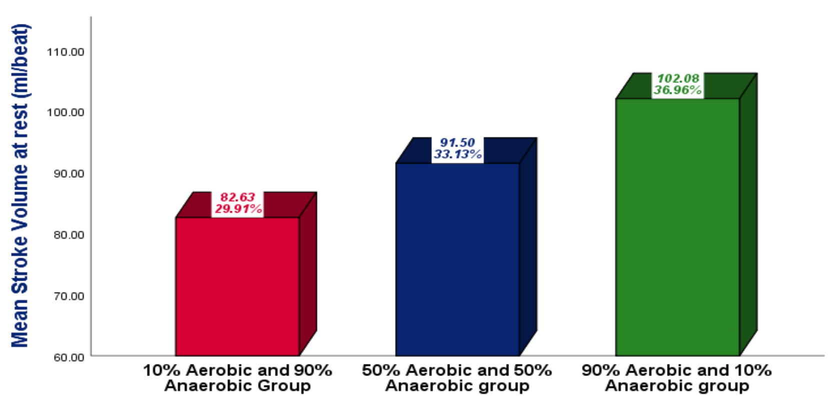
| 10% Aerobic and 90% Anaerobic Group | 50% Aerobic and 50% Anaerobic Group | 90% Aerobic and 10% Anaerobic Group | Mean deviations | ConfidenceInterval 0.05 Level |
|---|---|---|---|---|
| 82.63 | 91.50 | - | 8.87* | 1.56 |
| 82.63 | - | 102.08 | 19.45* | |
| - | 91.50 | 102.08 | 10.58* | |

***Significant at 0.05 level of assurance.***

The table II-A displays that the test mean deviation on SV at rest between 10% aerobic and 90% anaerobic group and 50% aerobic and 50% anaerobic group is 8.87 which is greater than the confidence interval value 1.56 at 0.05 level of assurance. The test mean deviation on SV at rest between 10% aerobic and 90% anaerobic group and 90% aerobic and 10% anaerobic group is 19.45 which is much greater than the confidence interval value 1.56 at 0.05 level of assurance. The tests mean deviation on SV at rest between 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group is 10.58 which is greater than the confidence interval value 1.56 at 0.05 level of assurance. Hence, it is concluded from the consequences that the noteworthy deviation exists among three experimental groups on SV at rest.

From the results it was concluded that, 90% aerobic and 10% anaerobic group has increased the SV at rest as compared to the 10% aerobic and 90% anaerobic group and 50% aerobic and 50% anaerobic group. Further it is concluded that highest mean deviation exists between 10% aerobic and 90% anaerobic group and 90% aerobic and 10% anaerobic group.

The test means values on SV of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups were graphically presented in Figure II.



ISSN: 0971-1260
Vol-22-Issue-14- December-2019

**FIGURE II: BAR CHART ON STROKE VOLUME AT REST MEANS OF 10% AEROBIC AND 90% ANAEROBIC GROUP, 50% AEROBIC AND 50% ANAEROBIC GROUP AND 90% AEROBIC AND 10% ANAEROBIC GROUP**

## Cardiac Output at rest

The analysis of variance for data on Cardiac output at rest of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group were assessed and displayed in Table III.

**TABLE III: Analysis of variance for the Cardiac output at rest data on 10% Aerobic and 90% Anaerobic group, 50% Aerobic and 50% Anaerobic group and 90% Aerobic and 10% Anaerobic group**

| Test | 10% Aerobic and 90% Anaerobic Group | 50% Aerobic and 50% Anaerobic Group | 90% Aerobic and 10% Anaerobic Group | Source of Variance | df | Sum of Squares | Mean Squares | Obtained 'F' Ratio | Table 'F' Ratio |
|---|---|---|---|---|---|---|---|---|---|
| $\bar{X}$<br>□□ | 4631.02<br>125.25 | 4650.47<br>49.99 | 4694.43<br>88.29 | B:<br>W: | 2<br>42 | 31653.66<br>359624.26 | 15826.83<br>8562.48 | 1.848 | 3.222 |

***Significant at 0.05 level of assurance.***

The table value for purport at 0.05 level with df 2 and 42 is 3.222.

The table III displays that the means of 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups are 4631.02, 4650.47 and 4694.43 ml/min severally. The procured 'F' ratio of 1.848 is less than the table value of 3.222 for df 2 and 42 required for significant at 0.05 level.

The results of the study indicates that there is an insignificant difference among 10% aerobic and 90% anaerobic group, 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic groups on $\dot{Q}$ at rest. Hence, it is insignificance difference among the means of three experimental groups. Hence, Scheffe'S test was not exercised as post-hoc test.

The tests mean values on $\dot{Q}$ of three experimental groups were graphically depicted in Figure III.

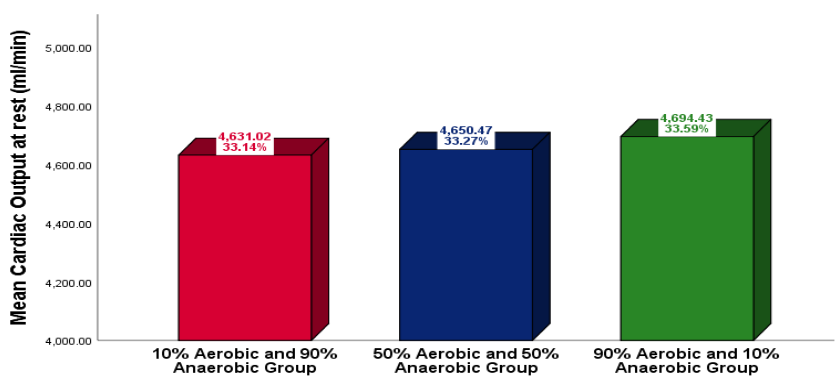



**FIGURE III: BAR CHART ON CARDIAC OUTPUT AT REST MEANS OF 10% AEROBIC AND 90% ANAEROBIC GROUP, 50% AEROBIC AND 50% ANAEROBIC GROUP AND 90% AEROBIC AND 10% ANAEROBIC GROUP**

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

## DISCUSSIONS

### Heart Rate at rest

From the results of the study it has been concluded that, all the three experimental groups the 10% aerobic and 90% anaerobic, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic group has significantly decreased the heart rate at rest however 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic groups have significantly decreased heart rate at rest as compared with 10% aerobic and 90% anaerobic group. The results indicate that the significant difference exists among three 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)** 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)**. According to **Goldsmith et al. (1992)** 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 present similar cardiac autonomic changes when equated with long distance runners after exposure to prolonged exercise training **Lepretre et al. (2012)**. Heart rate variability is reduced when athletes present overreaching and overtraining symptoms **Kiviniemi et al. (2014)**.

People who exposed to aerobic exercise their resting HR is 40-60 bpm, which is near bradyrhythmia likewise SV is also huge **Maron and Pelliccia (2006)**. **Sullivan and bell (2000)** found in a cohort of previous sedentary subjects that 6 weeks of regular, moderate aerobic exercise is sufficient to produce a substantial lowering heart rate.

**Franklin (1997)** stated that the increased aerobic capacity in athletes appears to be primarily the result of increased maximal cardiac output, due to a greater increment in heart rate and to lesser extent stroke volume, rather than an increased peripheral extraction of oxygen. Because there is little variation in maximal heart rate and maximal systemic arteriovenous oxygen difference with training.

**Bonaduce (1998)** concluded that mechanisms for decrease of intrinsic heart rate following training may include changes in ionic concentrations with the sinoatrial node. Mechanical extending of the sinoatrial node is a combination of different factors. An augmented modulation following rigorous exercise training may assist to the maintenance of bradycardia following the alteration. **Leicat et al. (2003)** find that 8 weeks of cycling has significantly reduced resting and exercise bradycardia and Vegas modulation during rest and at the entire exercise work rates. Hence, the researcher concluded that, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic groups have reduced resting heart rate. The present study concludes that the findings are inconformity with the above research findings.

### Stroke Volume at rest

From the results of the investigation it has been concluded that, all the three experimental groups the 10% aerobic and 90% anaerobic, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic group has significantly increased the stroke volume at rest however, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic groups have significantly increased stroke

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

volume at rest as compared with 10% aerobic and 90% anaerobic group. The results indicate that the significant difference exists among three groups on stroke volume at rest.

**Maron (1986)** coined that High SV is kept up with low HR, while low SV is kept up with a high HR. which increment cardiac output. As indicated by **Hoogsteen et al. (2004)** athletes who do aerobic exercise and are practiced hard, unusual reconstruction change was appeared, it is then the internal dimension of the ventricle was expanded as a result of such eccentric hypertrophy and due to huge left ventricular volume and the SV. Likewise, a high SV in the aerobic activity group was appeared with low HR.

**Enrique et al. (2002)** found that interestingly, athletes accomplished a considerably expanded cardiac output fundamentally through an uninterrupted enhancement of stroke volume; their activity HR was like that of stationary people. The incredibly expanded stroke volume resulted from both expanded end diastolic volume and marked abatement in end systolic volume as contrasted and those in stationary people. These volumetric changes were reflected in a striking increment in EF.

Endurance athletic training improves maximal work capability as proved by higher maximal oxygen uptake, SV, and by lower HR and BP **Goodman JM and Liu PP et al. (1991)**. Aerobic activity includes movement of enormous muscle group. The marked arteries dilatation for example volume overload that produces LV eccentric hypertrophy by expanding venous return and thusly, LVEDV is augmented and LVESV is decreased and subsequently, SV and EF are enlarged **Pluim BM and Zwinderman AH et al. (2000).**

**Misserli and ketelhut (1990)** expressed that physiological hypertrophy that happens with aerobic exercise is portrayed by abnormal or expanded coronary save and ventricular filling. It is notable that sports have produces a physiological hypertrophy yet the pervasiveness differs relying upon the duration and intensity of training regimens, kind of endurance sport performed. An expansion in size of the heart is basic to the capacity to produce a huge SV **John Rawlins, Amit Bhan and Sanjay Sharma (2009**). Hence, the researcher concluded that, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic groups have increased stroke volume. The present study concludes that the findings are inconformity with the above research findings.

**Cardiac Output at rest**

From the results of the investigation it has been concluded that, all the three experimental groups 10% aerobic and 90% anaerobic, 50% aerobic and 50% anaerobic and 90% aerobic and 10% anaerobic groups has improved cardiac output at rest. Further the results indicate that there no significant difference in cardiac output at rest among three experimental groups.

Intensive physical activity is related with central and peripheral cardiovascular adjustments that encourage the generation of enormous and sustained $\dot{Q}$ and upgrade the extraction of oxygen from practicing muscle for aerobic glycolysis **John Rawlins, Amit Bhan and Sanjay Sharma (2009).**Aerobic exercise increases the mechanical efficiency of the heart by increasing cardiac output **Anju Madan Gupt and Mukesh Kumar et al. (2015**).

The inborn points of interest of physical exercise originate from an expansion in the cardiac output and an improvement of the natural capacity of muscles to extricate and to use oxygen from the blood. This advantage is additionally aggravated by the advantage of physical exercise has on high density lipoprotein cholesterol **Williams PT (1996).**

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

High SV is kept up with low HR, while low SV is kept up with a high HR. Likewise habitual physical activity makes the progression of the venous blood smooth, in this manner augmenting the volume of blood coming back to diastolic heart, which augment $\dot{Q}$**Maron (1986)**,**Enrique Z. Fishman Michael Motro et al. (2002)** viewed that substantially increased cardiac output fundamentally through a prominent augment in stroke volume; their exercise heart rate was similar to that of untrained human.

**Turkvich et al. (1988)** concluded highly trained endurance athletes heart have altered to physical training by significantly augmenting stroke volume, lower heart rate can provide optimal $\dot{Q}$. **Kanstrup et al. (1995)** stated that 12 weeks of exercise training heightened $\dot{Q}$was due to an increase in HR and SV.

According to **Richard Allen (1999**) the cardiovascular system achieves this by improve cardiac output and redistributing blood flow to the dynamic muscle through neural guidelines of the hemodynamic reactions and nearby regulation of the flow with in the dynamic muscle. This blood (250 to 400 ml/100g/min) neural guideline of the cardiovascular system manages hemodynamic reactions by expanding HR, stroke volume, and cardiac output and $O_2$ extraction at the tissue level.

**Willmore (1994)** said that when muscles demand for $O_2$ during physical activity the cardiac output augment directly. When the level of activity surpasses 40%, 60% of the individual capabilitystroke volume has either level or started to increment at a much slower rate. In this way further increment in cardiac output is to a great extent the results of increment in heart rate.

**Sullivan et al. (1992) and Keul et al. (1981)** stated that vascular resistance increases due to mechanical compression of the vessels. Despite stroke volume reaction, cardiac output increases modestly due to increase heart rate. Whereas athletes differ in several aspects from the classic response (i.e. stroke volume and ejection fraction increased while systolic and vascular resistance decreased). This cardio circulatory behavior resembles the normal response to isotonic exercise.The present study concludes that the findings are inconformity with the above research findings.

## CONCLUSIONS

From the outcomes of the investigation the succeeding completions were drawn.

1. Heart rate at rest has been significantly reduced by 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group as compared to 10% aerobic and 90% anaerobic group.
2. Stroke Volume at rest has been significantly increased by 50% aerobic and 50% anaerobic group and 90% aerobic and 10% anaerobic group as compared to 10% aerobic and 90% anaerobic group.
3. Cardiac Output at rest has no difference among the three experimental groups

   Cardiac output is a combination of HR and SV so when HR decreases SV is increased, when HR increases SV decreased but there is no change in Cardiac output.

## RECOMMENDATIONS

From the result of the study the following recommendations were drawn.

ISSN: 0971-1260
Vol-22-Issue-14- December-2019

1. 90% aerobic and 10% anaerobic training is well recommended to reduce HR at rest,
2. 90% aerobic and 10% anaerobic training is quite suitable to increase the SV at rest, $\dot{Q}$ at rest.
3. \

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ISSN: 0971-1260
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