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RELATIONSHIP OF CARDIAC PERFORMANCE TO DISTANCE RUNNERS AND DISTANCE SWIMMERS

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ABSTRACT

The purpose of the study was to find out the relationship of cardiac performance to the performance of long distance running and long distance swimming, further to compare distance runners and swimmers on cardiac performance. Thirty university level athletes consisting of 15 long distance runners and 15 long distance swimmers were selected for the study. The long distance runners were selected from the athletes participating in the Kerala University Inter Collegiate Cross Country Championship. In case of long distance swimmers, the subjects were selected from the Kerala University Swimming and Water polo teams during their preparatory coaching camp for the Inter University competitions. The cardiac performance variables selected for this study were - 1) Resting heart rate, 2) Left ventricular end-systolic diameter, 3) Left ventricular end-diastolic diameter, 4) Ejection fraction, 5) Fractional shortening, and 6) Stroke volume. In case of performance variables, the performance of long distance runners during the Kerala University inter-collegiate cross country championship was taken as criterion measure. In case of swimmers, the time trial conducted for 1500 mts. swimming performance during their coaching camp was considered as the criterion measure. The relationship of the cardiac performance variables to the performance of long distance runners and swimmers were found out by using Pearsons's product moment correlation. In order to find out the significance of difference in the selected cardiac performance variables between the long distance runners and swimmers, the t-ratio was applied. The level of significance employed was set at 0.05. On the basis of obtained results it was concluded that – there was significant positive relationship between resting heart rate and long distance running performance; there was significant negative relationship between stroke volume, and left ventricular end diastolic diameter to long distance running performance; and there were significant differences obtained between long distance runners and long distance swimmers on stroke volume.

Keywords: *Cardiac performance, distance runners, distance swimmers.*

1. INTRODUCTION

The development of physical efficiency for different types of sports and games is of great significance and required a great deal of selectivity, specificity and training improvements of sports performance depend up on several disciplines of sports sciences are required to work in a co-ordinated manner. The scientific study of exercise physiology is becoming increasingly important with the growing realization of the relation of exercise to health. Field and laboratory observations of exercise human subject are being supplemented with physiological and biochemical studies on laboratory animals. With the result many of the phenomena associated with acute and chronic exercise can now be explained at cellular and molecular levels. Sports performance is indeed an aspect of complex human performances, which has several dimensions. Hence several disciplines of sports sciences are required to

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work in a coordinated manner to explore the nature of sports performance, and the process of improving sports performance.

Endurance is usually defined as the ability of the body to undergo prolonged activity or to resist stresses set up as a result of prolonged activity. Endurance is primarily dependent up on the various aspects of cardiac efficiency, which in turn exerts influence on the performance of the other portions of the human organism. Marathon running and cross-country race are popular since the beginning of competitive sports. Previously it was thought that heredity plays a dominant role in determining heart size. But it is proved that differences in cardiac hypertrophy are related to the type of sport or activity performed by the athlete, thus indicating that heart size is influenced by training. A long period of continuous and vigorous training makes an athlete to achieve the qualities of a long distance runner.

Endurance swimming is designated as a swimming distance beyond the middle distance of 400mts. And short of the marathon distances in excess of a mile. In competitive swimming the focus is primarily on the 1500m event. Even though both long distance running and long distance swimming are placed in the list of endurance activities, there are too many similarities as well as differences between both the types of activities, as body types, training methods, skill, etc. Distance runners performed the skill in upright position while swimmers are in lying position (horizontal).Body movements and leg movements are entirely different in both the sport activities. Medium 9water0 exerts resistance over the body of a swimmer, which causes movements slower. Floating capacity (Buoyancy) has to be developed by a swimmer. These differences may affect both in cardiac performance and biochemical profile in both long distance runners and swimmers.

The purpose of the study was to find out the relationship of cardiac performance to the performance of long distance running and long distance swimming and to compare distance runners and swimmers on cardiac performance.

It was hypothesised that there will be significant relationship between selected cardiac performance variables to the performance of long distance runners and swimmers.

2. METHODS AND MATERIALS

2.1 Participants

Thirty university level athletes consisting of 15 long distance runners and 15 long distance swimmers were selected for the study. The long distance runners were selected from the athletes participating in the Kerala University Inter Collegiate Cross Country Championship. In case of long distance swimmers, the subjects were selected from the Kerala University Swimming and Water polo teams during their preparatory coaching camp for the Inter University competitions.

2.2 Variables for the Study

The cardiac performance variables were selected for this study were - Resting heart rate, Left ventricular end-systolic diameter, Left ventricular end-diastolic diameter, Ejection fraction, Fractional shortening, and Stroke volume.

In case of performance variables, the performance of long distance runners during the Kerala University inter collegiate cross country championship was taken as criterion measure. In case of swimmers, the time trial conducted for 1500 mts. swimming performance during their coaching camp was considered as the criterion measure.

2.3 Collection of Data

The data of the subjects for the cardiac performance variables were obtained from the M-mode echocardiography. The performance of long distance runners was assessed during the Kerala University Inter-collegiate cross country championship. In case of swimmers, the time trial conducted for 1500 mts. swimming performance during their coaching camp.

Reliability of data was established by ensuring instrument reliability and tester competency. Highly sophisticated echocardiography machine was used to assess cardiac performance data and was assessed by a senior cardiology consultant. Cardiac performance variables were tested prior to inter university tournaments at the peak of their performance. Resting heart rate was measured by palpation at carotid artery. Rest of the variables were drawn out from M-mode echocardiography, a non-invasive technique.

From the obtained data, ejection fraction and fractional shortening were calculated by using following formula-

$$\text{Ejection fraction (EF)} = \frac{\text{Ventricular Diastolic volume-Left ventricular systolic volume}}{\text{Left ventricular diastolic volume}} \times 100$$

$$\text{Fractional Shortening} = \frac{\text{Left ventricular Diastolic Circumference-Left ventricular systolic Circumference}}{\text{Left ventricular diastolic volume}} \times 100$$

2.4 Statistical Technique

The relationship of the cardiac performance variables to the performance of long distance runners and swimmers were found out by using Pearsons's product moment correlation. In order to find out the significance of difference in the selected cardiac performance variables between the long distance runners and swimmers, the t- ratio was applied. The level of significance employed was set at 0.05.

3. RESULTS

The statistical analysis of data collected on 15 long distance runners and 15 long distance swimmers of Kerala University is presented. The coefficient of correlations of the selected cardiac performance variables to long distance running and long distance swimming performance is presented in Table 1.

Table 1: Coefficient of correlations of selected cardiac performance variables to long distance running performance

Variables Correlated	Coefficient of Correlation
Resting heart rate and Running performance	0.67*
Stroke volume and Running performance	-0.72*
Left ventricular end diastolic diameter and Running performance	-0.78*
Left ventricular end systolic diameter and Running performance	0.07
Ejection fraction and Running performance	0.15
Fractional shortening and Running performance	-0.05

*Significant at 0.05 level *r*- value required for significance at 0.05 level is 0.497

Table1 reveals the coefficient of correlation of selected cardiac performance variables and running performance of long distance runners. Significant positive correlation was observed between heart rate and running performance (0.67). Significant negative correlations were obtained for stroke volume (-0.72) and left ventricular end diastolic diameter (-0.78) to long distance running performance. The correlation coefficients obtained for left ventricular end systolic diameter, ejection fraction, and fractional shortening were 0.07, 0.15, and -0.05 respectively which were not statistically significant.

Table 2: Coefficient of correlations of selected cardiac performance variables to long distance swimming performance

Variables Correlated	Coefficient of Correlation
Resting heart rate and Swimming performance	0.34
Stroke volume and Swimming performance	-0.005
Left ventricular end diastolic diameter and Swimming performance	-0.08
Left ventricular end systolic diameter and Swimming performance	-0.12
Ejection fraction and Swimming performance	-0.39
Fractional shortening and Swimming performance	0.01

*Significant at 0.05 level *r*- value required for significance at 0.05 level is 0.497

Table 2 of the coefficient of correlations of selected cardiac performance variables to long distance swimming performance indicates no significant correlations for the selected variables to swimming performance. The coefficient of correlations obtained were 0.34 for resting heart rate; -0.005 for stroke volume; -0.08 for left ventricular end diastolic diameter; -0.12 for left ventricular end systolic diameter; -0.39 for ejection fraction; and 0.01 for fractional shortening.

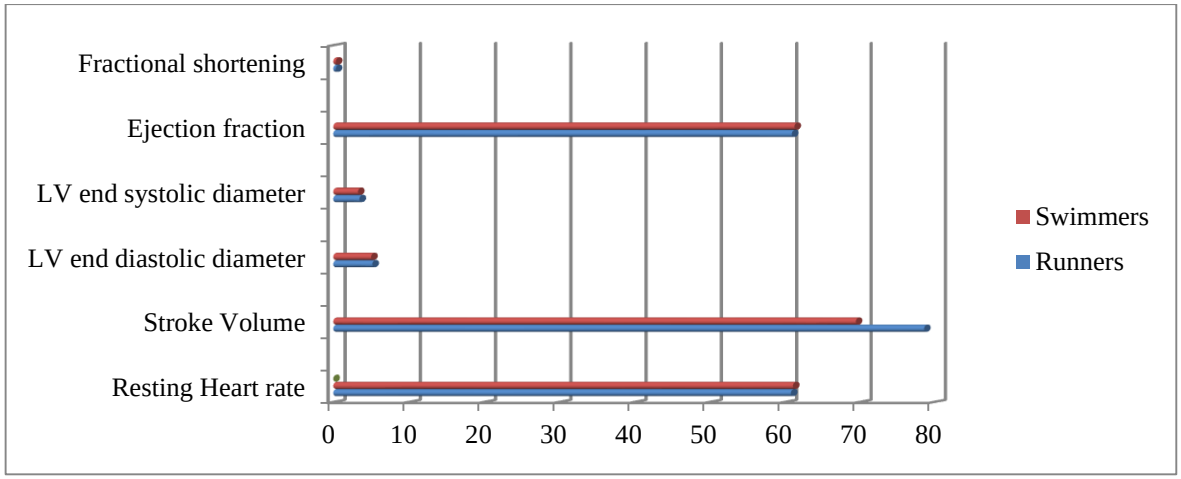
Table 3: Significance of differences of selected cardiac performance variables between long distance runners and long distance swimmers

Variables	Mean		t ratio
	Runners	Swimmers	
Resting heart rate	60.80	61.07	0.161
Stroke Volume	78.69	69.51	3.142*
Left ventricular end diastolic Diameter	05.19	05.03	1.269
Left ventricular end systolic Diameter	03.48	03.28	0.564
Ejection fraction	60.93	61.27	0.173
Fractional shortening	0.33	0.34	0.621

*Significant at 0.05 level $t_{0.05(28)}$=2.048

Table 3 indicates that the *t* ratio obtained for stroke volume was 3.142, which is significant as it is much greater than the *t* ratio of 2.048 required for significance at 0.05 level. However, the *t* ratios obtained for resting heart rate (0.161), left ventricular end diastolic diameter (1.269), left ventricular end systolic diameter (1.564), ejection fraction (0.173), and fractional shortening (0.621) were not significant, since all these obtained t-ratios were lesser than the t value of 2.048 required for significance at 0.05 level.

Figure 1: Cardiac performance variables between long distance runners and long distance swimmers



4. DISCUSSION

The findings of the relationship of cardiac performance variables to running performance (12.5 km) of long distance runners revealed significant positive correlation for heart rate (0.67) and significant negative correlations for stroke volume (-0.72) and left ventricular end diastolic diameter (.0.78). The other variables namely left ventricular end systolic diameter, ejection fraction and fractional shortening however did not show any significant relationship to long distance running performance. In case of the relationship of cardiac performance variables to swimming performance, none of the selected variables showed significant relationship.

In case of distance running performance resting heart rate showed significant relationship to performance. A lower resting heart rate is a pre requisite for prolonged endurance activities. One of the most obvious and earliest of training induced change is a decrease in resting heart rate both at rest and at fixed intensity of sub-maximal exercise.

Though there were no significant difference between the long distance runners and long distance swimmers in resting heart rate, both the groups showed lower level of resting heart rate, this may be due to the enlargement of ventricular cavity and increased parasympathetic inhibition. Athletes participating in high endurance events like marathon skiing etc., attain enlarged, ventricular cavity and normal thickness of ventricular wall of their heart, which enhances the efficiency of heart by reducing rate of stroke.

The present study observed significant correlation between stroke volume and distance running performance of long distance runners. Lower heart rate and increased stroke volume are the effect of long term aerobic exercise. Training induced changes in cardiac performance include slowing of heart rate, increase in stroke volume, both at rest and during exercise in the physical dimensions of the heart.

The comparison between long distance runners and long distance swimmers, revealed significantly increased stroke volume for the long distance runners. Dwyer reports that, training for several hours at a time, immersed in the supine position may alter cardiac loading in marathon swimmers, leading to structural adaptations different from those observed in runners and short distance collegiate swimmers.

The hypothesis is accepted in case of resting heart rate, stroke volume and left ventricular end diastolic diameter, since these variables showed significant relationship to distance running performance. In case of the rest of the cardiac performance variables for long distance runners, and all the cardiac performance variables of long distance swimmers, the hypothesis remains rejected.

5. CONCLUSION

Recognizing the limitations of the present study the following conclusions were drawn-

- There is significant positive relationship between resting heart rate and long distance running performance.
- There is significant negative relationship between stroke volume, and left ventricular end diastolic diameter to long distance running performance.
- There are significant differences were obtained between long distance runners and long distance swimmers on stroke volume.

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