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An Impact of Chronic Long-Distance Run, Middle Distance Run & Weightlifting Events on Structural Variations on Right & Left Ventricular Wall Thickness at Rest Among Elite Athletes

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Abstract

Background and need of study: There is developing proof that ethnicity may affect LVWT estimations in athletes. **Basavarajaiah S, Wilson M et al. (2008).** An underlying investigation of 260 dark American between university athletes indicated that 13% of the competitors showed left ventricular hypertrophy, with left ventricular wall thickness measurements ranging from 13 to 18 mm **Lewis JF, Maron BJ et al. (1989).** Extremely trained athletes unveil substantial left ventricular hypertrophy, with values amid 13 and 16 mm. There are number of empirical evidences to indicate that chronic long distance run, middle distance run and weight lifting activities leads to a significant shift in structure and functions of different organs of the body. The investigator after thoroughly going through the training impacts on cardiovascular systems, the investigator has chosen the present study to examine the impact of long distance , middle distance runs & weight lifting events on selected structural variations of right and left ventricular wall thickness of the heart among elite athletes.

Methodology: For the study (N= 45) elite long, middle distance athletes & weight lifters were volunteered as subjects, each group consists of 15 subjects. All the volunteered subjects are national varsity participants in their respective events such as long distance, middle distance runs & weight lifting events. All the selected elite players are with 5 to 7 years of sports age, the selected criterion variables are Right & Left ventricular wall thickness at rest. The selected variables were measured by using M-mode Doppler echo cardiogram with the help of cardiologist.

Results: Right Ventricular wall thickness at rest –The result indicates that the long distance, middle distance runs & weight lifting events have significantly influenced on Right & left ventricular wall thickness at rest. In order to find out the significance difference among three experimental groups One way Analysis of variance (ANOVA) is employed the obtained 'F' ratio of 21.666 is much greater than the table value 3.222 with df 2 and 42 requisite for significant at 0.05 level. Further the result conveyed that the long distance run has significantly increased the right ventricular wall thickness at rest as compared to middle distance run & weight lifters. Left Ventricular wall thickness at rest – It also significantly increased due to the selected subject sports activities long, middle distance runs & weight lifting events. The result indicates that the attained 'F' Ratio of 19.512 is much greater than the table

value of 3.222 for df 2 and 42 requisite for significant at 0.05 level of confidence, For both the variables post hoc test was applied to find out the paired means significant difference.

Conclusion and implications: A regular intensive chronic training in long distance runs, middle distance runs & weight lifting significantly influenced on the selected variables and leads to varieties of adaptations. The independent variables have increased the right & left ventricular wall thickness at rest, where both of them are strong indicators for the power packed ejection fractions. Hence, the present study has concluded that the aerobic training is well recommended for all the sports activities which are on aerobic demand.

Keywords: Elite athletes, long distance run, middle distance run, weight lifting, Right & left ventricular wall thickness of heart.

Introduction:

The right & left ventricular wall thickness refers to the thickness of the muscular walls of the heart's two main pumping chambers, the right ventricle and left ventricle. These walls play a crucial role in the heart's function, as they contract to pump blood to the lungs (right ventricle) and the rest of the body (left ventricle). The right ventricular wall is typically thinner than the left ventricular wall , as it primarily pumps blood to the nearby lungs , which have a lower resistance compared to the entire systemic circulation. The left ventricular wall is thicker and more muscular to withstand the higher pressure and resistance it encounters while pumping oxygenated blood throughout the body. Changes in ventricular wall thickness can be indicative of various heart conditions, such as hypertrophy .Monitoring these thicknesses is important in the diagnosis and management of heart-related functions. Participating in long-distance running, middle-distance running, and weight lifting events can have different effects on the right and left ventricular wall thickness at rest due to the tremendous physiological demands of competitive sports.

Long distance running events : such as marathons, places a significant demand on the cardiovascular system. Prolonged aerobic exercise can lead to increased left ventricular wall thickness, known as "athlete's heart." This is an adaptation to the increased volume of blood that the heart needs to pump over an extended period. The right ventricular wall thickness may also slightly increase as it needs to pump blood to the lungs during exercise. After cessation of long –distance running, these adaptations tend to return to normal levels when the athlete is at rest. **Middle-distance running events** like 800m or 1500m races, are with the combination of aerobic and anaerobic demands. While there may be some increase in left ventricular wall thickness due to the aerobic component, it may not be as prominent as in long-distance running. The right ventricular wall thickness might also experience minor adaptations, but they are generally less significant compared to long-distance running. These adaptations can return to baseline at rest. **Edward L Fox, Richard W Bowers, Merle L Foss (1989). Weight lifting events :** It involves brief, high-intensity efforts and is primarily anaerobic in nature. Weightlifting may not lead to significant changes in left ventricular wall thickness since it doesn't impose prolonged aerobic demands on the heart. However, there may be slight increases in right ventricular wall thickness due to the increased pressure generated during heavy lifting. These changes ted to be transient and may return to baseline relatively quickly after the lifting session. It's important to note that individual responses to exercise can vary, and these adaptations in ventricular wall thickness are part of the body's natural

response to physical training. Additionally, while some changes occur during exercise, they typically revert to baseline levels when at rest. Monitoring heart health and consulting with a healthcare professional or sports medicine specialist is essential for athletes to ensure their heart remains in optimal condition throughout their training and competition. athlete's heart is one of the oldest and most stimulating subjects for research in sports medicine. It is a Credit for the first description of the athlete's heart belongs to **Henschen (1899),**

Methodology:

The principal aim of this investigation was to find out the structural variations in right & left ventricles among elite athletes to achieve the purpose of this study 45 (N=45) men elite National varsity athletes were randomly selected as subjects of fifteen each, Group I - fifteen athletes (n=15) from long distance run (5000/10000 mtr race) Aerobic & Group II - fifteen athletes (n=15) from middle distance run (800/1500 mtr race) Aerobic & Anaerobic and Group III- fifteen athletes (n=15) from weight lifting Anaerobic. The Athlete's age is between 19 and 23 years, all the athletes were in top form during collection of data on selected variables. The investigator informed all of the selected elite athletes about the requirements of the study, and they all agreed to participate in the testing procedure. All of the subjects were in good health and trained by their coaches, and they competed at a national level and the subject's sports age is between 5 and 7 years. Investigation was entirely non-invasive, no authorization from the ethical committee was required, and All the subjects enthusiastically participated in tests. The cardiovascular systems effectiveness is crucial to success in competitive sports and activities. For top-class performance, each sport has particular cardiovascular system requirements. As a result, under the heading of cardiovascular parameters, the following criterion variables were chosen.

1. Right ventricular wall thickness at rest (RVWT at rest).
2. Left ventricular wall thickness at rest (LVWT at rest).

Right & left ventricular wall thickness is crucial to succeed in competitive sports. Coaches, fitness trainers, and players who benefit from various training methods and approaches always switch from one to another best training loads to get the most training benefits to improve, maintain and to stabilize the adaptations.

Structural Difference Between Right & Left Ventricles: The function of an atrium is to collect blood that is returning to the heart and convey. The functional demands on the right & left atria are similar and two chambers look almost identical. The demanded on the right & left ventricles, however are very different and the two have significant structural differences. Anatomical difference between the left and right ventricle are best seen in a 3-dimensional view. The lungs are close to the heart, and the pulmonary blood vessels are relatively short & wide. Thus the right ventricle normally does not need to work very hard to push blood through the pulmonary circuit. The wall of the right ventricle is relatively thin in sectional view it resembles a pouch attached to the massive wall of the ventricle. When it contracts the right ventricle acts like a billows squeezing the blood against the thick wall of the left ventricle. This mechanism moves blood very efficiently with minimal effort, but it develops relatively low pressures, a comparable pumping arrangement would not be suitable for the left ventricle, because 4 to 6 times as much pressure must be exerted to push blood around the systemic circuit as around the pulmonary circuit.

Left ventricle has an extremely thick muscular wall and its ground in cross-section, when these ventricle

controls one the distance between the base and a base decreases come on to the diameter of the ventricle chamber decreases. The effect is similar to simultaneously squeezing and rolling of the end of the toothpaste tube. The pressure generated is more than enough to open the aortic valve and eject blood in to the ascending Aorta. As the Powerful left ventricle contracts it also bulges into the right ventricle cavity .This action improves the efficiency of the right ventricle‘s efforts. **Frederic H.Martini et .al. (2009).** On the present context the investigator is investigating the structural variations take place due to different nature of workloads. Left Ventricular Wall Thickness: - **According to Sharma et al. (2000),** exercise changes the heart's physiological basis structure and function, as well as increasing left ventricular wall thickness. These improvements were made possible through a gradual increase in the internal dimension of the cardiac muscle while doing aerobic activity. **Palatine et al. (1988).**

Outcome measure:

Subjects were laydown on left side as per the procedure laid out for the Doppler echo cardiograph test. Transducer was placed on the chest of the subject. At the same time transmitter of ultrasonic impulse and receiver for the reflected echoes placed on the interior chest wall in inter costal parasternal space on the left side. Ultra sound rays were passed to the chest wall, then the left ventricle. The ultrasound rays passed through the front chest wall, next to right ventricle. The path of the ultrasound rays to the intra ventricular septum (IVS) after entered to right ventricle, then to cavity of the left ventricle, finally reached to the posterior cardiac wall. In this process the echo curves which were visible on the screen could be photo graphed and kept for record purpose. For the collection of data M-mode Doppler echocardiography was used as per **Rowland et al. (2000)** and **Vinet et al. (2001).**

Statistical analysis: The data was analyzed by using the Microsoft Excel and SPSS v25. The mean and standard deviation (SD) were calculated and reported for the quantitative variables. The numerical data on selected cardiovascular parameters taken from all three experimental groups was statistically analyzed for any suggestive variation by using ANOVA. The Indian Business Management Statistical Package for Social Sciences version 25 was used to analyses the complete dataset. Because the number of individuals was limited, the degree of conviction was set at 0.05 for purport. Due to numerous external influences, the chosen criterion may vary. When the F-Ratio is significant, the Scheffe‟S post hock test was used to find the paired mean significant difference, if any, among the groups of the each parameter separately.

Results:

RIGHT VENTRICULAR WALL THICKNESS AT REST

The analysis of variance for data on Right Ventricular Wall Thickness at rest of long distance run group, middle distance run group and weight lifting group were analyzed and displayed in Table I.

TABLE I
ANALYSIS OF VARIANCE FOR THE RIGHT VENTRICULAR WALL THICKNESS AT REST OF LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

Test	Long distance run group	Middle distance run group	Weight lifting group	Source of Variance	Df	Sumof Squares	Mean Squares	Obtained 'F' Ratio	Table 'F' Ratio
$\bar{X}$	0.7933	0.6600	0.6400	B:	2	0.208	0.104	21.666*	3.222
σ	0.08837	0.05071	0.06325	W:	42	0.201	0.0048		

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

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

The table I displays that the means of long distance run group, middle distance run group and weight lifting groups are 0.7933, 0.6600 and 0.6400cm respectively. The attained 'F' Ratio of 21.666 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 long distance run group, middle distance run group and weight lifting groups on RVWT at rest. To define the noteworthy variation among the means of three experimental groups, the Scheffe'S test was employed as post-hoc test and the outcomes were displayed in table I-A.

TABLE I-A
SCHEFFE'S POST-HOC TEST FOR RIGHT VENTRICULAR WALL THICKNESS AT REST ON THE DIFFERENCE BETWEEN LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

Long distance run group	Middle distance Run group	Weight lifting group	Mean deviations	Confidence Interval 0.05 Level
0.7933	0.6600	-	0.1333*	0.0179
0.7933	-	0.6400	0.1533*	0.0179
-	0.6600	0.6400	0.0200*	0.0179

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

The table I-A displays that the tests mean deviation on RVWT at rest between Long distance run group and Middle distance run group is 0.133 which is greater than the confidence interval value 0.0179 at 0.05 level of assurance. The test mean difference on RVWT at rest between Long distance run group and weight lifting group is 0.1533 which is much greater than the confidence interval value 0.0179 at 0.05

level of assurance. The test mean deviation on RVWT at rest between Middle distance run group and weight lifting group is 0.020 which is greater than the confidence interval value 0.0179 at 0.05 level of assurance. Hence, it is concluded from the results that there is a significant difference between long distance run group, middle distance run group and weight lifting groups on RVWT at rest.

From the results it was concluded that, Long distance run group has significantly increased the RVWT at rest as compared to the other two experimental groups. Further it is concluded that highest mean deviation exists between Long distance run and weight lifting group.

The tests mean values on RVWT at rest of three experimental groups were graphically portrayed in Figure I.

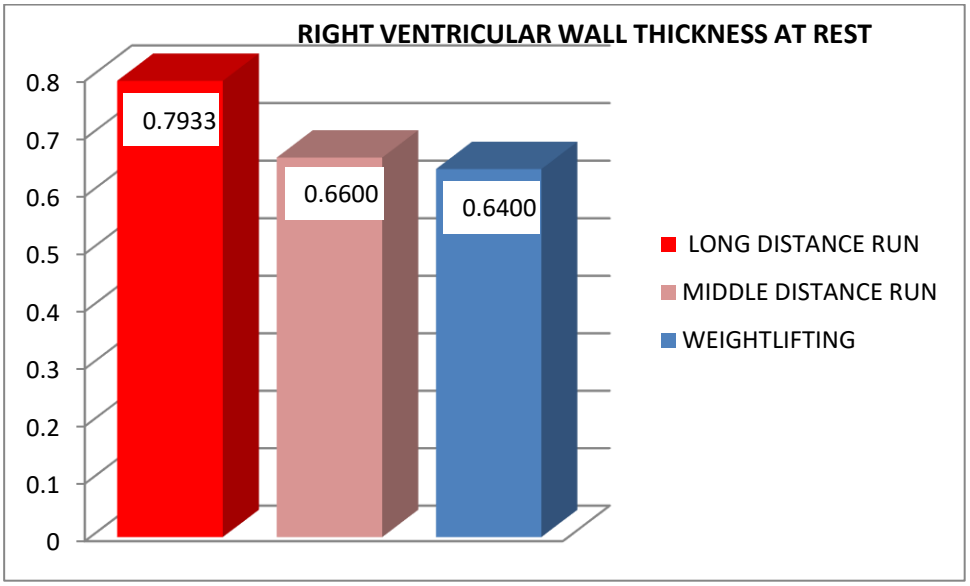

FIGURE I: BAR CHART ON RIGHT VENTRICULAR WALL THICKNESS AT REST MEANS OF LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

LEFT VENTRICULAR WALL THICKNESS AT REST

The analysis of variance for data on Left Ventricular Wall Thickness at rest of long distance run , middle distance run and weight lifting groups were analyzed and displayed in Table II.

TABLE II
ANALYSIS OF VARIANCE FOR THE LEFT VENTRICULAR WALLTHICKNESS AT REST DATA LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

Test	Long distance run group	Middle distance run group	Weight lifting group	Source of Variance	Df	Sumof Squares	Mean Squares	Obtained 'F' Ratio	Table 'F' Ratio
$\overline{x}$	1.2580	1.2460	1.2140	B:	2	0.016	0.008	19.512*	3.222

σ	0.0161	0.02197	0.0209	W:	42	0.017	0.00041		

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

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

The table II displays that the means of long distance run group, middle distance run group and weight lifting groups are 1.2580, 1.2460 and 1.2140cm respectively. The attained 'F' ratio of 19.512 is greater than the table value of 3.222 for df 2 and 42 required for significant at 0.05 level of assurance. The consequences of the study indicates that the significant difference exists among long distance run group, middle distance run group and weight lifting groups on LVWT at rest. To define the noteworthy variation among the means of three experimental groups, the Scheffe'S test was employed as post-hoc test and the outcomes were displayed in table II-A.

TABLE II-A

SCHEFFE'S POST-HOC TEST FOR LEFT VENTRICULAR WALLTHICKNESS AT REST ON THE DIFFERENCE BETWEEN LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

Long distance run group	Middle distance Run group	Weight lifting group	Mean deviations	Confidence Interval 0.05 Level
1.2580	1.2460	-	0.0120	0
1.2580	-	1.2140	0.0440	0
-	1.2460	1.2140	0.0320	0

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

The table II-A displays that the tests mean deviation on LVWT at rest between Long distance run group and Middle distance run group is 0.0120 which is greater than the confidence interval value 0 at 0.05 level of assurance. The test mean deviation on LVWT at rest between Long distance run group and weight lifting group is 0.044 which is much greater than the confidence interval value 0.0 at 0.05 level of assurance. The test mean deviation on LVWT at rest between Middle distance run group and weight lifting group is 0.0320 which is greater than the confidence interval value 0.0 at 0.05 level of assurance. Hence, it is concluded from the results that there is a significant difference between long distance run group, middle distance run group and weight lifting groups on LVWT at rest.

From the results it was concluded that, Long distance run group has significantly improved the LVWT at rest as compared to the other two experimental groups. Further it is concluded that highest mean deviation exists between Long distance run and weight lifting group.

The tests mean values on LVWT at rest of three experimental groups were graphically illustrated in Figure II.

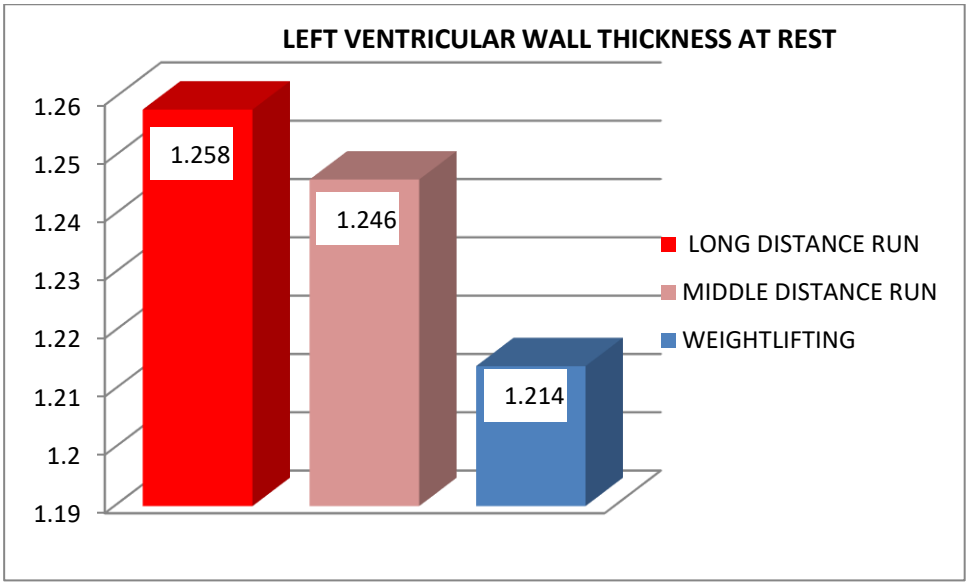

FIGURE II: BAR CHART ON LEFT VENTRICULAR WALL THICKNESS AT REST MEANS OF LONG DISTANCE RUN, MIDDLE DISTANCE RUN AND WEIGHT LIFTING GROUPS.

Discussions:

The present study reveals that there is a noteworthy difference in chosen cardiovascular variables due to different groups ofaerobic and anaerobic demands. The results of the study shows that RIGHT & LEFT ventricular wall thickness at rest, are positively influenced as a result of long distance run, Middle distance run and Weight lifting groups and the significant difference exists among three experimental groups. The following ungovernable factors which were affiliated with the study were considered as limitations.

- Special motivation techniques were not used during testing, hence, the difference that occurred in performance due to the lack of motivation were recognized as a limitation for the study.
- The investigator did not put any effort to assess the quality and quantity of food ingested separately since all the subjects were at their home town.
- The quantum of physical exertion, life style that influence the metabolic functions were also considered as limitations.
- The subject's social, economic and cultural backgrounds were not taken in to consideration.
- The Present study is limited to men elite athletes of long distance, middle distance runs & weight lifting events as independent variables and Right ventricular & Left ventricular wall thickness at rest as dependent variable.

From the consequences of the study it has been concluded that, all the three experimental groups long distance run, Middle distance run and Weight lifting group has significantly increased the RVWT & LVWT at rest however, long distance run group has significantly increased RVWT & LVWT at rest as compared to middle distance run and weight lifting group. The results indicate that the significant difference exists among three groups on RVWT & LVWT at rest.

Regular sport activity normally induces walls thickness and LV chamber dimensions are particularly involved in this structural adaptation **Alessio De Luca, Laura Stefani et al. (2011).**

According to **John Rawlins, Amit Bhan, Sanjay Sharma (2009)** the sporting discipline is a significant determinant of LVH in athletes. Athletes taking part in extreme endurance sports with a high isotonic and isometric segment, for example, rowing, canoeing, swimming, cycling, ultra-endurance running display the best increments in LVWT. Athletes doing predominantly isometric exercises have significant LVW hypertrophy and Endurance athletes have LV dilatation without noticeable wall hypertrophy when athletes doing isotonic exercise **Howald H, maire R et al. (1977).** Cardiovascular changes in long distance runners have been examined and increments in the left ventricular hypertrophy of the LVW caused by repeated and extended volume work in isotonic activity have been found **Markku J. Ikaheimo et al. (1979).** In the event that the individual take part in an aerobic exercise like marathon for quite a while, the eccentric LVH, in which the thickness of ventricle is not huge, though the left ventricular wall is a moderately expanded **Vinereanu et al. (2002).** Resistance activity like wrestling, weightlifting and body building work outs for long time the concentric left ventricle hypertrophy, the ventricular wall is not enormous, though the thickness of ventricle is expanded. Likewise, cyclists and rowing competitors who have the qualities of both aerobic and anaerobic activity systems have eccentric- concentric LVH **Baggish et al. (2010).**

Sharma et al. (2000) said that due to exercise as physiological basis structure and function of the heart has changed, and also increases left ventricular wall thickness. These futures carried about by slow enlarge in the internal measurement of the cardiac muscle by performing aerobic exercise with continuous management of HR and BP, in addition Cardiac output increased **palatine et al. (1988).** Hence, the researcher concluded that, long distance run ,Middle distance run and Weight lifting groups have increased LVWT at rest. The present study concludes that the findings are inconformity with the above said research findings.

Conclusion and Implications:

From the outcomes of the investigation the succeeding completions were drawn. Right & Left ventricular wall thickness at rest has been significantly increased by long distance run, Middle distance run and Weight lifting groups , however the long distance running group has increased better than other two experimental groups.

Conflict of Interest: No

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