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RESEARCH ARTICLE

ECHOCARDIOGRAPHIC STUDY OF CARDIAC STRUCTURE AMONG OPEN AND CLOSED SKILL ATHLETES

***Kulroop Kaur Badwal**

Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, India

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ABSTRACT

The present study was conducted to examine the echocardiographic parameters between open and closed skill athletes. To obtain data for this study, the investigator had selected seventy two (N=72) male university level athletes of 19 to 25 years of age group to act as subjects. They were further divided into two groups which includes thirty six (n= 36) open skill athletes and thirty six (n=36) closed skill athletes of various games. The purposive sampling technique was used to obtain the required data. To measure the cardiac morphology the echocardiography was administered. One way Analysis of Variance (ANOVA) was employed to find out the intra-group differences. To test the hypothesis, the level of significance was set at 0.05.The results revealed significant differences between open and closed skill athletes on the left ventricular internal dimensions and thickness. The study concludes that cardiac morphology is affected by the type of sport and training undertaken by the athletes.

INTRODUCTION

Athlete's heart term is used to describe a variety of alterations in the cardiac structure of athletes engaged in different sports. Morganroth *et al.* in 1975 were the first to postulate that 2 different morphological forms of athlete's heart can be distinguished i.e. a strength trained heart and an endurance trained heart depending upon training undertaken. Few studies (Csanady and Gruber, 1984; Gates *et al*., 2003) has supported the fact and some (Haykowsky *et al*., 2002; Wernstedt *et al.,* 2002; Whyte *et al.,* 2004) has not found clear demarcating evidence between different sports. The effect has been studied for few years now and its study on closed and open skilled athletes has not been explored. This present study was conducted to determine the significant difference among open and closed skill athletes with regards to echocardiography. A closed skill sport athlete basically knows when and how to execute the movements /skills, which are unlikely to change or influenced by external factors. Closed skill sports may include skills which are trained in a set pattern and have clear beginning and endings, such as athletics, swimming, bowling, gymnastics, shooting etc. Closed sports include skills which have the tendency to be self-paced and require focus on a relatively unchanged environment (Lerner *et al*., 1996). Open skilled sports are sports which include execution of skills which are determined by the constant change of the environment. Skills are adapted to the instability of the environment which are predominantly perceptual and paced externally (Knapp, 2002). These sports are such as football, tennis, badminton, handball and basketball etc. The effect of specific training given to closed and open skilled athletes on cardiac morphology will be different with respect to training and sports involved.

***Corresponding author: Kulroop Kaur Badwal**; *Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, India*

MATERIALS AND METHODS

Sample of respondents

To obtain data for this study, the investigator had selected seventy two (N=72) male university level athletes of 19 to 25 years of age to act as subjects. They were further divided into two groups which includes thirty six (n= 36) open skill athletes and thirty six (n=36) closed skill athletes of various games and sports. The purposive sampling technique was used to obtain the required data. All the subjects, after having been informed about the objective and protocol of the study, gave their consent and volunteered to participate in this study. The study is approved by ethics committee of the institution.

Table 1. Details of Selected Subject

Sr. No	*Open Skill*	*Sample Size*	*Closed Skill*	*Sample Size*
1	Basketball	12	Archery	12
2	Handball	12	Shooting	12
3	Volleyball	12	Gymnastic	12
	Total	(N_1- 36)	(N_2- 36)	(72)

Echocardiography

Echocardiography was performed by the same cardiologist every time and with the subject rotated to left side, using a PHILIPS iE33 Matrix (U.S.A) machine with 2.25 Hz transducer. The transducer was placed on the chest wall where maximum amplitude of the mitral valve was recorded. Three measurements were taken for each reading and average was then calculated. At rest, the left ventricular end diastolic and end systolic diameters, interventricular septum and left posterior wall thicknesses were measured from the parasternal long and short-axis view, just below the mitral valve level according to the recommendations of the American Society of Echocardiography (Devereux *et al*., 1987; Sahn J *et al*., 1978). Left ventricular mass

(LVM, gram) was calculated from the formula (Douglas PS *et al.*, 1987). LVM = 0.8{1.04 [({LVEDD + IVS + PWT] ^{3} –LVEDD^3})] +0.6. (LVEDD= Left ventricular end diastolic diameter (mm), PWT= posterior wall thickness (mm), IVS= Interventricular septal thickness (mm) in diastole. LVM index (g/m^2) was also calculated taking height and weight of the participants in consideration.

Left ventricular internal dimensions

There was a significant difference between the groups of athletes with respect to left ventricular end- diastolic. Left ventricular end systolic dimension didn't show significant differences.

Interventricular septum thickness

There was significant with respect to interventricular septum thickness in closed skilled athletes.

Posterior wall thickness

There was a significant difference in the posterior wall thickness in closed skilled athletes as compared to open closed athletes.

Left ventricular mass

The mean left ventricular mass of both the groups was found to be significant. Left ventricular mass index was calculated which was also significant for athletes.

Statistical Techniques

One way Analysis of Variance (ANOVA) was employed to find out the intra-group differences. To test the hypothesis, the level of significance was set at 0.05.

RESULTS

It is evident from Table 2 that results of Analysis of Variance (ANOVA) among various sport groups (basketball, handball and volleyball) with regard to open skill athletes on LVEDD were found statistically significant (P<.05). The results with regard to open skill athletes on LVESD were found statistically insignificant (P>.05). The result of Analysis of Variance with regard to open skill athletes on IVS were found statistically insignificant (P>.05). As, the F-values with regard to open skill athletes on PWT were found statistically insignificant (P>.05). It can be judged from Table 2 that results of Analysis of Variance (ANOVA) among various sport groups (basketball, handball and football) with regard to open skill athletes on LV Mass were found statistically significant (P<.05).The results with regard to open skill athletes on LV Mass Index of open skill athletes were found statistically significant (P<.05). Since 'F' ratio was not found statistically significant in all the sub-variables, therefore, there is no need to apply the post hoc test. It is evident from Table 3 that results of Analysis of Variance (ANOVA) among various sport groups (archery, shooting, gymnastic) with regard to closed skill athletes on LVEDD were found statistically insignificant (P>.05).

The results with regard to closed skill athletes on LVESD were found statistically insignificant (P>.05). The result of Analysis of Variance with regard to closed skill athletes on IVS were found statistically significant (P<.05). The F-values with regard to closed skill athletes on PWT were found statistically significant (P<.05). It can be judged from Table 2 that results of Analysis of Variance (ANOVA) among various sport groups (archery, shooting, gymnastic) with regard to closed skill athletes on LV Mass were found statistically significant (P<.05). The results with regard to closed skill athletes on LV Mass Index of open skill athletes were found statistically significant (P<.05). Since 'F' ratio was not found statistically significant in all the sub-variables, therefore, there is no need to apply the post hoc test.

Table 2. Analysis of Variance (ANOVA) results with regard to echocardiographic among open skill athletes (basketball, handball and volleyball)

		LVEDD				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	230.484	2	115.242	10.791*	.000
Handball	Within Groups	352.428	33	10.680		
Volleyball	Total	582.912	35			
		LVESD				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	37.257	2	18.629	2.501	.097
Handball	Within Groups	245.812	33	7.449		
Volleyball	Total	283.069	35			
		IVS				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	5.190	2	2.595	.954	.396
Handball	Within Groups	89.759	33	2.720		
Volleyball	Total	94.948	35			
		PWT				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	5.210	2	2.605	1.242	.302
Handball	Within Groups	69.226	33	2.098		
Volleyball	Total	74.436	35			
		LV Mass				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	16127.056	2	8063.528	6.760*	.003
Handball	Within Groups	39361.500	33	1192.773		
Volleyball	Total	55488.556	35			
		LV Mass Index				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Basketball	Between Groups	5790.734	2	2895.367	7.556*	.002
Handball	Within Groups	12645.776	33	383.205		
Volleyball	Total	18436.510	35			

(LVEDD: Left ventricular end diastolic dimension; LVESD: Left ventricular end systolic dimension; IVS: inter-ventricular septal thickness; PWT: posterior wall thickness; LV Mass: Left ventricular mass; LV Mass Index: Left ventricular mass index). All readings are mentioned in millimeter, (mm) and LVM in gram, LVM Index in g/m^2

Table 3. Analysis of Variance (ANOVA) results with regard to echocardiographic among closed skill athletes (archery, shooting, gymnastic)

		LVEDD				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	3.796	2	1.898	.260	.772
Shooting	Within Groups	240.608	33	7.291		
Gymnastic	Total	244.403	35			
		LVESD				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	8.874	2	4.437	.372	.692
Shooting	Within Groups	394.022	33	11.940		
Gymnastic	Total	402.896	35			
		IVS				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	12.509	2	6.254	7.204*	.003
Shooting	Within Groups	28.650	33	.868		
Gymnastic	Total	41.159	35			
		PWT				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	12.172	2	6.086	7.732*	.002
Shooting	Within Groups	25.976	33	.787		
Gymnastic	Total	38.147	35			
		LV Mass				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	29016.889	2	14508.444	11.852*	.000
Shooting	Within Groups	40397.667	33	1224.172		
Gymnastic	Total	69414.556	35			
		LV Mass Index				
Category	**Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Archery	Between Groups	2875.722	2	1437.861	3.303*	.049
Shooting	Within Groups	14363.917	33	435.270		
Gymnastic	Total	17239.639	35			

(*LVEDD: Left ventricular end diastolic dimension; LVESD: Left ventricular end systolic dimension; IVS: inter-ventricular septal thickness; PWT: posterior wall thickness; LV Mass: Left ventricular mass; LV Mass Index: Left ventricular mass index). All readings are mentioned in millimeter, (mm) and LVM gram, LV Mass Index in g/m^2*

DISCUSSION

Eccentric left ventricular hypertrophy is characterized by an increase in the internal diameter of the left ventricle with a proportionate increase in wall thickness; this is attributed to volume overload. Concentric hypertrophy does not produce changes in the internal diameter, but left ventricular wall thickness is increased as a result of pressure overload (Fagard 1996, 2003). In our study subjects of open skilled athletes have shown that they clearly develop eccentric hypertrophy as evidenced by the increased left ventricular cavity dilatation with the repeated volume overloading of predominantly isotonic endurance training. The closed skilled athletes have showed increase in the ventricular thickness such as IVS and PWT. As the dimension increases the volume of the left ventricular chamber also increases to pump more blood during the increased demands of the exercise period. The increase in left ventricular mass correlates with increase in left ventricular dimensions and thickness. Increased myocardial mass has been found to be due to both cavity dilatation and thickness in endurance athletes (Fagard 2003; Pluim *et al*., 2000).

Conclusion

The results showed that regular participation in sports induces cardiac hypertrophy or the athlete's heart and athletic training has a causal role in the development of sports specific profiles of cardiac structure. The increase of ventricular wall thickness in relation to the ventricular dimension appears to be proportionate in open skilled sportspersons; while closed showed increase in ventricular thickness as compared to internal dimensions. Hence open show eccentric hypertrophy and closed showed concentric hypertrophy.

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