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ANATOMICAL EVALUATION OF VENTRICULAR SEPTAL THICKNESS DIMENSIONS BY TRANSTHORACIC ECHOCARDIOGRAPHY

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ABSTRACT

Background The perception of cardiac anatomy and pathophysiology radically changed for all of medicine in general and cardiology in particular.The use of ultrasound to study the structure and function of the heart and great vessels defines the field of echocardiography.was a prospective study in which Echocardiographic examination of patients referred to CVTS Centre Government Medical College Aurangabad were attended and readings were noted for 104 adult individuals above 18 years of age (62 females and 42 males).Patients diagnosed by senior cardiologist for normal Left Ventricular Function(EF > 50%)and normal Right Ventricular function as seen on echocardiography were included in the study.**Objective** To study the dimensions of Inter Ventricular Septal thickness and to compare & contrast sexual differences in Inter Ventricular Septal thickness.**Results** Inter Ventricular Septal thickness for total study population was in the range of 0.5 cm to 1.1cm and the mean was 0.9519 cm ± 0.1123cm. **Conclusion** All the cardiac dimensions were greater in male population than female population. The parameters Interventricular septal thickness does not correlate with weight of study population whereas a significant correlation was found with age and hieght Measurements of Inter Ventricular septal Thickness of present study corresponded well with those reported by previous studies

Key words Echocardiography Ventricular septal Thickness

INTRODUCTION

An Austrian Karl Dussik was probably the first to apply ultrasound for medical diagnosis in 1941. He initially attempted to outline the ventricles of the brain. His approach used transmission ultrasound rather than reflected ultrasound. With the invention of non invasive imaging techniques [echocardiography, computed tomography (CT), magnetic resource imagine (MRI) and single-photon-emission computed tomography (SPECT)] over the past two decades, the perception of cardiac anatomy and pathophysiology radically changed for all of medicine in general and cardiology in particular.The use of ultrasound to study the structure and function of the heart and great vessels defines the field of echocardiography.[2] Echocardiography is a unique noninvasive method for imaging the living heart. It is based on detection of echoes produced by a beam of ultrasound (very high frequency sound) pulses transmitted into the heart.From its introduction in 1954 to the mid 1970's, most echocardiographic studies employed a technique called M-mode, in which the ultrasound beam is aimed manually at selected cardiac structures to give a graphic recording of their positions and movements. M-mode recordings permit measurement of cardiac dimensions and detailed analysis of complex motion patterns depending on transducer angulation. A more recent development uses electromechanical or electronic techniques to scan the ultrasound beam rapidly across the heart to produce two-dimensional tomographic images of selected cardiac sections. This gives more information than M-mode about the shape of the heart and also shows the spatial relationships of its structures during the cardiac cycle. A comprehensive echocardiographic examination, utilizing both M-mode and two dimensional recordings, therefore provides a great deal of information about cardiac anatomy and physiology, the clinical value of which has established echocardiography as a major diagnostic tool. [3]

In the present work Trans thoracic echocardiography (TTE) was chosen as a tool for the study of various dimensions of heart as it is a very commonly used diagnostic modality of present time to reveal in-vivo anatomy and function of heart being safest (absence of radiation hazards), painless, and non invasive method available today. Echocardiography allows a detailed assessment of the functional anatomy of the heart.[4] The gross anatomy of the heart can be evaluated by two-dimensional echocardiography in the para-sternal, apical, suprasternal and subcostal positions .The standardized planes used are long axis, short axis and four-chamber.[4]Due to their high temporal resolution (>1000 Hz), M-mode is helpful for characterizing the motion of cardiac structures. Almost all routine measurements are made from the parasternal long or

short axis orientation .To ensure proper alignment with the chamber or area of interest, alignment of all M-mode recordings is performed with 2D guidance. Failure to do so often results in non perpendicular orientations with overestimation or underestimation of true dimensions. 2D guided M-mode measurements of the aortic leaflets and left atrium, mitral leaflets and left ventricle can be obtained Patients referred to Cardio Vascular Thoracic Surgery Centre (CVTS) for cardiac and non cardiac complaints but found to be with normal Left ventricular (EF>50) and normal right ventricular function and absence of Hypertensive Heart Disease (IVS thickness <12), absence of structural heart disease, Mitral regurgitation and Mitral stenosis were included in the study. In present study measurements were obtained by 2D guided M MODE on Trans Thoracic Echocardiography for dimensions of Inter ventricular septum,.Observations were made for the ranges of these parameters in study population and analysis was done for age and sex differences in the study population. In the present study parameters were evaluated for relation with height, weight and body surface area and significant correlation was observed between them. Thus Body Surface Area, Height and Weight should be taken into account while considering normal ranges of these parameters for that population. Needless to mention various cardiac diseases are common in India. Studies on Indian population with normal cardiac function are very few in number. Further the mean age of present study population is 44.64 years. As India is ageing population and heart diseases are more common in this age group; our study is useful for this population.

OBJECTIVES

To study the dimensions of Inter Ventricular Septal thickness,.
To compare & contrast sexual differences in Inter Ventricular Septal thickness,
Tocompare and contrast differences in Inter Ventricular Septal thickness with that given in Literature.
To compare contrast age related differences in morphometry of Inter Ventricular Septal thickness,

MATERIAL AND METHODS

A comprehensive study titled "anatomical evaluation of aortic root diameter dimensions by transthoracic echocardiography" was performed in the Department of Anatomy in collaboration with Department of CVTS Centre GMC. Echocardiographic examination of patients referred to CVTS Centre Government Medical College were attended and readings were noted for 104 adult individuals above 18 years of age (62 females and 42 males).Patients diagnosed by senior cardiologist for normal Left Ventricular Function(EF > 50%)and normal Right Ventricular function as seen on echocardiography were included in the study.The Aortic root diameter parameters were selected for the studyThe data obtained from the echocardiography of the patients was pooled and analysed for the above parameters and for male and female differences, age differences and compared with that given in literature and other studies.
The permission of the Ethics committe was taken. The permission of the Head of Department Medicine (CVTS centre) was takenPatients were given detailed information about the study and written informed consent was obtained from them for the use of their Echocardiographic data for the purpose of this study before enrolling them in to the study. Height and Weight of the patients were carefully measured and recorded.Echocardiography of these patients was performed on PHILIPS iE33 ECHO machine with transducer S 51 for adult 1.7 to 3.4 HZ .All scans were performed in left lateral decubitus with left arm above and below shoulder

Study design: Prospective study

Sample size: 104 (all patients with normal echocardiographic examination who underwent echocardiography in the span of two years).

INCLUSION AND EXCLUSION CRITERIA FOR THE STUDY

Inclusion Criteria:

1) Patients undergoing TTE at CVTS GMC
2) Age >18 years
3) Patients with normal LV function (LVEF >50%) and normal RV function as seen on TTE

Exclusion Criteria:

1) Patients with Hypertensive Heart disease
   (Inter Ventricular Septal thickness >12 mm on TTE)
2) Patient with Mitral Regurgitation and Mitral Stenosis.
3) Age < 18 years.
4) Patient with Left Ventricular function < 50% and poor Right Ventricular function as seen on 2D Echocardiography.
5) Patients with Structural heart disease.
6) Patients in whom high quality TTE is not obtainable.

Materials

PHILIPS iE33 ECHO machine with transducer S 51 for adult 1.7 to 3.4 HZ

Weighing machine
Sliding wall scale for height measurements.

OBSERVATIONS AND RESULTS

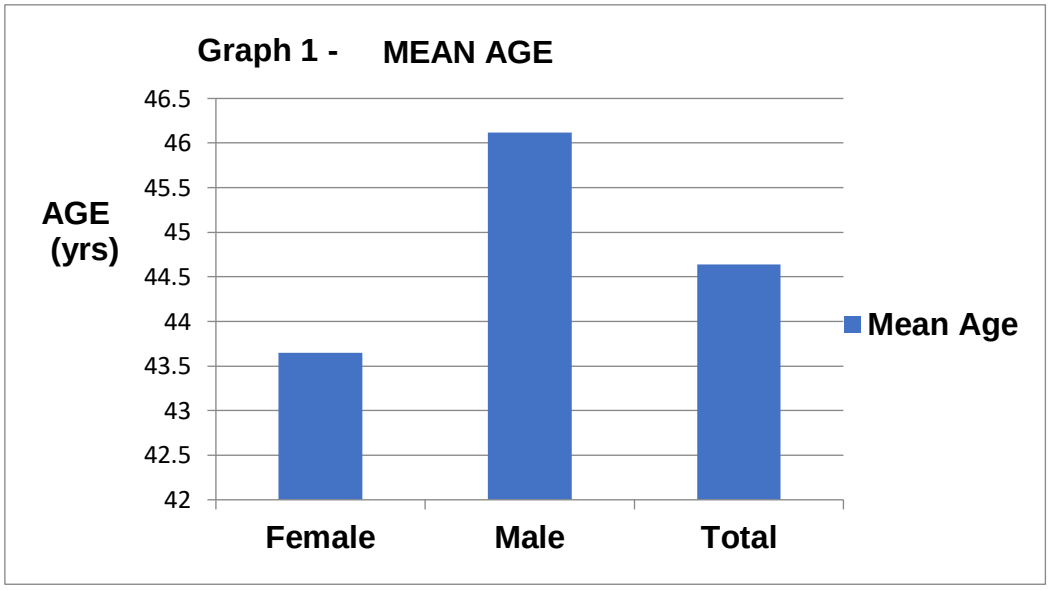
The mean age of the study sample and its gender wise distribution was found out. Similarly gender wise distribution of the means and standard differences of the physical characteristics the Height, weight, Body Surface Area were calculated.Various dimensions of human heart like Left Atrium, Aortic root, Inter ventricular septum thickness, Left ventricular posterior wall thickness, Mitral Valve area were measured echocardiographically and its correlation with various physical characteristics like height, weight, body surface area were obtained.Study population was grouped and studied gender wise and age wise for any statistical difference Total 104 patients were included in this study, out of which 42 were male and 62 were female.

Gender wise Age distribution among the study sample

The mean age in years was 46.12 with SD of 16.60 in males and 43.65 with SD of 15.21 in female. And mean age in years for the total study sample was44.66 with S.D of 15.75.

Table1: showing gender wise age distribution.
yrs –years, S.D.-Standard Deviation.

Sex	Number of subjects	Age Range (yrs)	Mean age (yrs)	S.D.
Female	62	18-80	43.65	15.21
Male	42	18-75	46.12	16.60
Total	104	18-80	44.64	15.75



Graph 1: comparison of mean age in Male, Female and Total population

Age and Sex Distribution in groups among the study

Youngest patient of the study sample was 18 years old, and the oldest patient was of 80 years . The mean age of the sample was 44.64 years with a SD of 15.75. Minimum and maximum height recorded in subjects was 135cm and 175 cm respectively while mean height of study sample was 156.82cm with SD 8.26 cm.Minimum and maximum weight recorded was 27 kg and 87 kg respectively while mean weight of the study sample was 57.29 kg with SD 11.75 kg. Similarly BSA (Body Surface Area) calculated from Height and Weight of a patient using Du bois formula was found to be in the range of 1.021 to 1.956 with mean BSA of population being 1.56 with SD of 0.174.

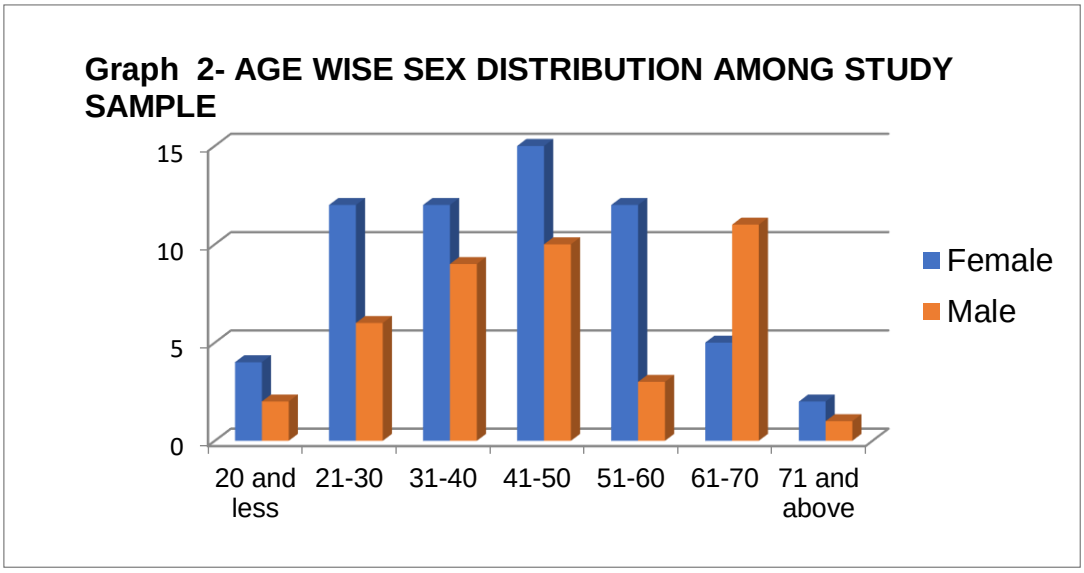
Table 2: Distribution of physical characteristics among the study sample

	Minimum	Maximum	Mean	SD
Age (years)	18	80	44.64	15.75
Height (cm)	135	175	156.82	8.26
Weight (kg)	27	87	57.29	11.75
BSA	1.021	1.956	1.56	0.174

Age and Gender Distribution in groups among the study sample
Subjects were further grouped in the age groups of less than or equal to 20, 21 to 30, 31 to 40, 41 to 50, 51 to 60, 61 to 70 and more than or equal to 71.

Table 3: Age and Gender Distribution in groups among the study sample

Age Group (years)	Number of Female	Number of Male	Total
20 & less	4	2	6
21 – 30	12	6	18
31 – 40	12	9	21
41 – 50	15	10	25
51 – 60	12	3	15
61 – 70	5	11	16
71 & above	2	1	3
Total	62	42	104



Graph 2: Age wise sex distribution among study sample

Since the frequency was very less in age group of 20 and 71 & above they were merged with groups of 21- 30 & 61 – 70 respectively for statistical purpose.

Table 3 :showing comparison of Physical characteristics in males , females and total population.

SEX	N	HEIGHT mean+/- SD	WEIGHT mean+/- SD	BSA mean+/- SD
FEMALE	62	152.29 +/- 6.16	54.48+/-12.17	1.49+/-0.166
MALE	42	163.50+/-6.19	61.43+/-9.86	1.65+/-0.137
TOTAL	104	156.82+/-8.26	57.29+/-11.75	1.56+/-0.174

Total 104 subjects were included in the study of which 62 were females and 42 were males. For female population mean height was 152.29 cm with SD 6.16 cm. Mean+/- SD observed in female population for weight and BSA was 54.48 +/- 12.17kg and1.49+/-0.166 respectively.In males mean and SD for height, weight and BSA were 163.50+/-6.19, 61.43+/-9.86, 1.65+/-0.137 respectively. While mean height , weight and BSA for total study population was156.82+/-8.26, 57.29+/-11.75, 1.56+/-0.174 respectively.
the range and mean of the various cardiac dimensions

Measurements of cardiac dimensions in total study population
Inter Ventricular Septal thickness for total study population was in the range of 0.5 cm to 1.1cm and the mean was 0.9519 cm ± 0.1123cm

Measurements of cardiac dimensions in Male study population
Inter Ventricular Septal thickness was in the range of 0.7cm to 1.1cm and the mean was 0.990cm ± 0.01cm

Measurements of cardiac dimensions in Female study population
Inter Ventricular Septal thickness was in the range of 0.5 cm to 1.1cm and the mean was 0.926cm ± 0.014cm.

Inter Ventricular Septal thickness (IVS)
The mean IVS was 0.9231 with SD of 0.1081. The mean IVS was higher among males 0.948 (mms) with SD of 0.016than that of females 0.906 mms with SD of 0.014. The difference was statistically significant (T-Value = -2.99 P-Value = 0.004 DF = 88).

Table 17: showing Comparison of Inter Ventricular Septal thickness(IVS) in Male Female and Total population.

SEX	N	MEAN(mm)	SD
FEMALE	62	0.926	0.014
MALE	42	0.990	0.017
TOTAL	104	0.9519	0.1123

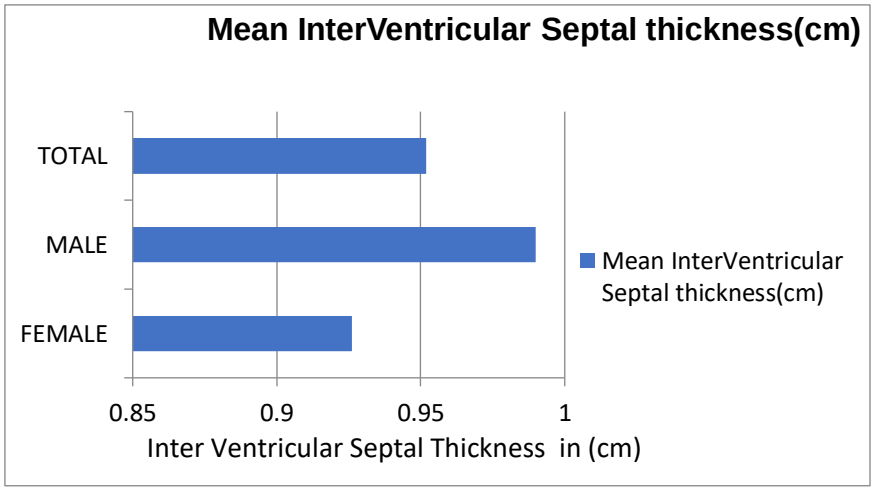


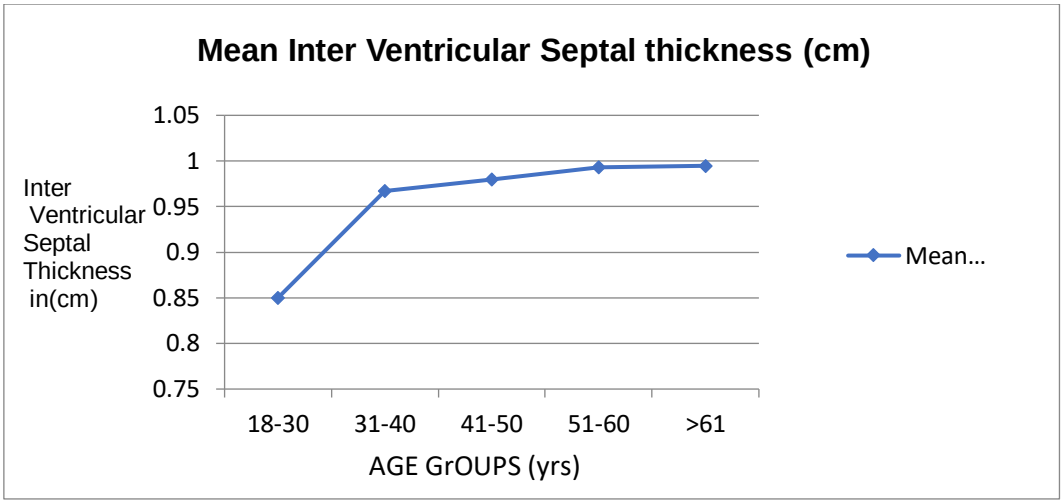
Table 18:Correlation Coefficient for IVS

Parameter	R	P	Correlation
Age	0.394	0.000	Moderate
Height	0.215	0.028	Weak
Weight	0.200	0.041	Weak
BSA	0.242	0.013	Weak

Pearson's Correlation Coefficient showed a moderate correlation of IVS with age with r value of 0.394, However height, Weight, and BSA showed only weak correlation with IVS with r values of (o.215,0.200,0.242) respectively

Table 19:showing Comparison of Inter Ventricular Septal thickness (IVS)among various age groups

Age Group (years)	Mean IVS (cm)	SD	Total
1 (Less than or =30)	0.8500	0.1216	24
2 (31 – 40)	0.9667	0.1155	21
3 (41 – 50)	0.9800	0.0086	25
4 (51 – 60)	0.9933	0.0079	15
5 (61 & above)	0.9947	0.0070	19
Total	0.9519	0.1123	104



The mean IVS increased with increasing age groups and the comparison of means among the age groups showed statistically significant difference when ANNOVA (Analysis of Variance) was done.

DISCUSSION

The range of Inter ventricular septal thickness was 0.5 to 1.1 cm with mean and SD of 0.9231 +/-0.1081cm. Age correlated significantly with IVS thickness with coefficient correlation of 0.394. However weak correlation was found between IVS thickness and height, weight and BSA with correlation coefficient r(215, 200,242) respectively.

Table 26 Comparison of the range and meanInter ventricular septal thickness

Sr no	Study	n	Age range Years	IVS thickness of heart (cm)	
				Range	Mean+/-SD
1	present study	104	18-80	0.5-1.1cm	0.95+/-0.11
2	Rubin S. Valdez, Jorge A. Motta. et al .(1979);	177	_	1+/-0.4	M 0.9+/-0.6 F 1+/-0.4
3	Marcomichelakis J, Withers R et al(1983);	_	20-70	Median 0.83-1.12cm	_
4	Devereux RB, Lutas EM. et al. (1984)	78 M	_	0.98+/-0.17 (1.31)	_
		55 F	_	0.9+/-0.18(1.24)	_
5	Sanjiv Kaul. et al. (1985);	6	_	_	1.06+/-0.11cm
		6	_	_	0.99+/-0.1 cm
6	Harvey Feigenbaum (1994)	137	13-54 mean26	0.6-1.1	,mean 0.9 cm
7	Hursts (2001)	50	24+/-6	range 0.7-1.2 cm	0.9+/- 0.1 cm.
8	Paulo Roberto Schvartzman, Flavio Danni Fuchs et al (2000)	100 (48M 52F)	_	_	0.8+/-0.2 (M) 0.71+/-0.1(F)
9	MS Gupta. et al. (2004);	100	mean age 69.2+/-4.18	_	0.92+/-0.19 cm

The mean IVS thickness was higher among males 0.948 (mms) with SD of 0.016than that of females 0.906 mms with SD of 0.014 & this difference statistically significant (t-value = -2.99 p-value = 0.004 DF = 88). The males had significantly higher IVS thickness than females. The mean IVS thickness increased with increasing age groups and the comparison of means among the age groups showed statistically significant difference on ANNOVA (Analysis of Variance) . Post hoc test showed statistically significant difference in means between the age groups 1&2, 1&3, 1&4 1&5. This shows that the age groups above 30 had significantly higher IVS than those age groups below 30 years.Julius M Gardin, Walter L Henry.(et al,1979); studied136 adults (78 men and 58 women,20 to 97 years of age)without evidence of cardiovascular disease. When patients were subdivided into six age groups, progressive changes were found in mean normal values for various parameters. When they compared oldest group (over 70 years) with the youngest group (21-30 years), significant

(p<0.01)increases ,in ventricular septal(20 percent).Kansal S et al, (1979);They related septal thickness in normal subjects to body surface area (p less than 0.02).Rubin S. Valdez, Jorge A. Motta. et al .(1979);in their study mean end diastolic interventricular septum thickness for 177 individuals was 1+/-0.4cm;for females mean+/- S.D.was 0.9+/-0.6cm and for males it was 1+/-0.4cm . In their study effect of sex on end diastolic interventricular septum thickness measurement was statistically significant in uncorrected for BSA but was not significant in when measurements were corrected for body surface area.Marcomichelakis J, Withers R et al(1983); found that the interventricular septum thickness increased from a median of 8.3 mm in the age group 20-29 to 11.2 mm in the age group 60-70. In their study the difference in the medians between the groups 20-29 and 60-70 was statistically significant for interventricular septum (Pless than 0.02). They inferred that the interventricular septum measurement should be related to age in order to assess its significance.Devereux RB, Lutas EM. et al. (1984); Found that the measurements of wall thickness differed between men and women in both series (p less than 0.01 to p less than 0.001).in their study the interventricular septal thickness for male in 28 clinical based and 78 population based was 9.5+/-1.7 (12.8) and 9.8+/-1.7 (13.1)repectively. For 64 clinical and 55 population was 8.1+/-1.5(11) and 9+/-1.8(12.4) mm respectively.Sanjiv Kaul. et al. (1985); found mean diastolic inter ventricular septal thickness in 6 normal subjects by 2D method to be10.6+/-1.1mm and by MRI 9.9+/-1 mm. **Kitzman DW**, **Scholz DG**et al(1986) **;** did a quantitative anatomic study on 765 autopsied normal human hearts with age ranging from 20 to 99 years. They found that indexed mean values for ventricular septal thickness increased significantly between the 3rd and 10th decade of life (P less than 0.001)Echocardiography, Fifth Edition, Harvey Feigenbaum (1994) **;** presented data obtained in 1972 that represented the oldest normal values .In their study 137 individuals of age ranging from 13-54years(mean26 year) showed interventricular septal wall thickness to be in the range of (0.6-1.1)cm with mean of 0.9.Paulo Roberto Schvartzman,Flavio Danni Fuchs et al (2000**);** In their study on 100 healthy adult inhabitants they found the mean diastolic interventricular septum thickness in male was 0.8+/-0.2 and female 0.71+/-0.1cm.The measurements adjusted or not for body surface area or height, were significantly higher in males p<0.006.Hursts The Heart 10th edition (2001); Published values evaluated by M mode echocardiography for 50 normal patients with mean age 24+/- 6 years with mean Body Surface Area 1.81+/-0.34. The range and mean +/- SD given for systolic Interventricular septum were 7-12mm and 9+/-1 mm respectively.Carol J Salton, BA. et al. (2002); carried outcardiovascular magnetic resonance study onrepresentative sample of 318 Framingham Heart Study (FHS) offspring participants. They found that unidimensional measures (posterior wall thickness and interventricular septum thickness)were significantly greater ($p < 0.001$) in men than in women and remained greater ($p < 0.02$) after adjustment for subject height.

CONCLUSIONS

All the cardiac dimensions were greater in male population than female population. The parameters Interventricular septal thickness does not correlate with weight of study population whereas a significant correlation was found with age and hieght Measurements of Inter Ventricular septal Thickness of present study corresponded well with those reported by previous studies

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