Echocardiographic Evaluation of Left Ventricular Mass among Adult Bangladeshi Population

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Abstract

Background: Left Ventricular Mass (LVM) refers to the weight of the left ventricle, which is determined using echocardiography. Various studies regarding LVM were conducted in different countries. There is a lack of data on LVM in our country. The current study aimed to provide baseline normative data on LVM among the adult Bangladeshi population.

Materials and methods: This descriptive cross-sectional study included 100 adults who had normal echocardiography from the Outpatient Department of Cardiology and Medicine of Chittagong Medical College Hospital.

Results: Overall, LVM ranged from 63.90 gm to 186.58 gm with a mean ±SD of 123.55±24.38gm. The mean ± SD of LVM in males was significantly higher than female (136.30±20.65 vs. 110.80±21.03 gm, $p<0.001$). There was a significant positive correlation between age and LVM ($r=0.612$, $r^2=0.374$, $p<0.001$) and between BMI and LVM of the participants [$r = 0.393$, $r^2=0.154$, $p<0.001$]. About 37% and 15% variability of the LVM of an individual could be explained by their age and BMI respectively.

Conclusion: The normal LVM in Bangladeshi adult population was found to be higher in male and LVM increased with increasing age and BMI.

Key words: Echocardiography, Myocardial infarction; Left ventricular mass.

Introduction

Left Ventricular Mass (LVM) reflects the weight of left ventricle. It represents the cumulative effect of blood pressure on the heart.[1,2] LVM begins to increase at puberty by increasing chamber dimension and wall thickness in the case of males.[3] In another study Liu, found that LVM increased with age up to around 60 years, it plateaued or slightly decreased after that age in individuals free of cardiovascular diseases.[4] Left ventricular remodeling may be physiological when the heart increases in size but maintains normal function during growth, physical training and pregnancy.[5] Variations of LVM may be pathological due to hypertension, cardiomyopathy, myocardial infarction or valvular heart disease.[6] LVM is a strong predictor of cardiovascular risk and is used to predict LVH.[7,8] LVM estimation is based upon the subtraction of the left ventricular cavity volume from the volume enclosed by the left ventricular epicardium to obtain left ventricular muscle volume.[9] M-mode and 2D echocardiography have become the most widely used technique for measuring human LVM.[10] Linear measurements have well-established normal ranges and reference values. It is simple to perform as well as cost-effective.[11] This study aimed to observe the impact of age and gender on the LVM of the heart in adult Bangladeshis using echocardiography.

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Materials and methods

This descriptive cross-sectional study was conducted in Chittagong Medical College Hospital during January 2023 to December 2023. Ethical approval was obtained from the Ethical Review Committee of Chittagong Medical College. Criteria for enrollment :(1) Adult individuals with normal echocardiogram age between 18-60 years who gave written informed consent were included in this study from the Department of Cardiology and Medicine of Chittagong Medical College Hospital.

Patients with hypertension, any previous cardio-vascular disease, thyroid disorders, Diabetes Mellitus (DM) chronic respiratory disease and chronic renal disease, Over weight (BMI 25kg/m^2 (WHO 25-29kg/m^2) were excluded from this study.

Participants were stratified by sex (50 male and 50 female) and age groups (20 in each five age groups: 18-20, 21-30, 31-40, 41-50, and 51-60 years).

Echocardiography examinations were performed using Echocardiogram machines with one active transducer port, 5-6 Hz frequency linear probes and a high-resolution monitor. The PLAX (Para sternal long axis) view was obtained by placing the transducer index marker toward the patient's right shoulder at around the 10^{o}, clock position. The Inter Ventricular Septal Thickness in Diastole (IVSTd) Left Ventricular Internal Dimension in diastole (LVIDd) and Posterior Wall Thickness at end-diastole (PWTd) were measured on a frozen M-mode image. LVM was calculated by using the Devereux and Reichek "Cube" formula [LVM = $0.8\times\{1.04\times [(LVIDd + IVSTd + PWTd)^3 - LVIDd^3]\} +0.6g$].

Data were processed and analyzed using Statistical Package for Social Sciences (SPSS-26.0) software. An Independent sample t-test was used for comparison of differences of LVM between male and female participants. Correlation between age and LVM was determined by Pearson correlation coefficient. $p<0.05$ was considered as statistical significant.

Results

The age of the respondents ranged from 18-60 years with the mean ± SD age of 36.25±13.41 years. Age was distributed into five equal groups. Each group comprises 20 participants:10 male and 10 female). The mean age and BMI was similar between males and females. The mean height, weight, SBP and DBP were significantly higher in males than females (Table I).

Table I Age, height, weight, BMI, SBP and DBP of the participants stratified by gender (n=100)

Variables	Total (n=100)	Male (n=50)	Female (n=50)	p value*
Age, years	36.25±13.41	36.48±13.72	36.02±13.22	0.865
Height, m	1.59±.089	1.65±0.066	1.52±.048	<0.001
Weight, kg	57.59±8.57	63.16±7.56	52.02±5.28	<0.001
BMI, kg/m^2	22.50±2.15	22.58±2.35	22.42±1.95	0.713
SBP, mm Hg	109.30±9.84	113.20±8.850	105.40±9.30	<0.001
DBP, mmHg	72.25±6.56	74.20±5.56	70.30±6.95	0.003

Data were expressed as mean ±SD. *Independent sample t test.

In this study LVM in males ranged from 186.58-93.96gm with a mean of 136.30±20.65gm and in females ranged from 63.90-147.42 gm with a mean of 110.80±21.03 gm. Unpaired student's t-test was done and the finding was statistically significant, p-value <0.001 (Table II).

Table II Echocardiographic parameters (IVSTd, LVIDd, PWTd and LVM) of the participants stratified by gender (n=100)

Variables	Total (n=100)	Male (n=50)	Female (n=50)	p value
IVSTd	9.07±1.10	9.37±1.06	8.76±1.06	0.005
LVIDd	43.34±4.96	45.24±4.07	41.44±5.07	<0.001
PWTd	8.74±1.24	8.90±1.31	8.58±1.162	0.200
LVM (gm)	123.55±24.38	136.30±20.65	110.80±21.03	<0.001

Data were expressed as mean ±SD. *Independent sample t test.

To observe the correlation between LVM and age Pearson's correlation test was performed. The result revealed a positive correlation between the parameters and it was statistically significant [$r=0.612$, $r^2=0.374$, p-value <0.001] (Figure 1). About 38% of the variability in LVM of the participants could be explained by their age.

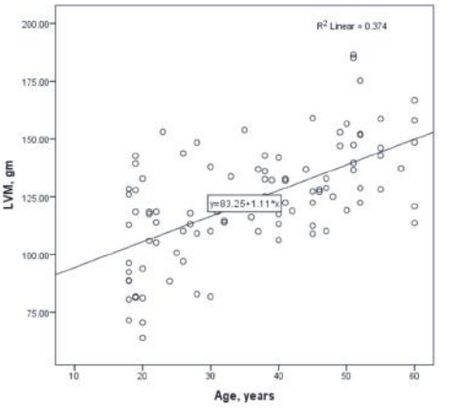

Figure 1 Scatter diagram with regression line showing distribution of LVM according to age of the participants.

There was a significant positive correlation between BMI and LVM of the participants [$r = 0.393$, $r^2 =0.154$, $p<0.001$] (Figure 2). About 15% of the variability in LVM of the participants could be explained by BMI.

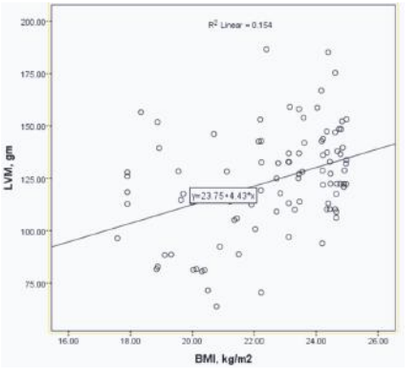

Figure 2 Scatter diagram with regression line showing distribution of LVM according to BMI of the participants

Discussion

Estimating Left Ventricular Mass (LVM) by echocardiography provides prognostic information that surpasses traditional cardiovascular risk factors. An increase in LVM is associated with a higher incidence of clinical events related to cardiovascular disease.[12] Abnormalities in LVM can indicate various cardiac conditions such as hypertrophy, dilated cardiomyopathy or heart failure. LVM can guide treatment decisions in patients with hypertension, by monitoring LVM over time to assess the effectiveness of antihypertensive medication in reducing cardiac strain and improving outcomes.[13]

In the present study, LVM ranged from 63.90-186.58 gm with a mean±SD of 123.55 ± 24.38gm. This finding of the present research aligns with the results of the investigation conducted by Rashid and colleagues. They analyzed 2245 study participants from Kashmir, North India where LVM ranged from 56-213 gm with a mean of 125.5±32.74 gm.[14] The research by Morais et al. took place in Luanda, Angola, where they discovered an average LVM of 147.08±40.73 gm, which differs from the results of the present study.[15] The differences could be attributed to racial factors and variations in sample size.

In the current study, the LVM in males typically ranges from 93.96 gm to 186.58 gm with a mean of 136.30±20.65 gm, and in females from 63.90 gm to 147.42 gm with a mean of 110.80±21.03 gm. The finding of this study is similar to the study carried out by Anil et al.[2] The finding of this study is dissimilar from the study conducted by Ugwuanyi et al. among 1,192 healthy adults aged 18 years and above. The mean ±SD of LVM in females was 118.23±30.02gm and in males was 117.52±31.49 gm which was not statistically significant.[16] These dissimilarities are due to sample size.

To observe the correlation between LVM with age Pearson's correlation test was performed. The result revealed a positive correlation between LVM and age andit was statistically significant. The results of this research are consistent with a study performed by Funjan et al. involving 75 adult participants in Baghdad, Iraq. They found a significant positive correlation of LVM with age where r= 0.288, p=0.012.[17]

Another study was conducted by Ugwuanyi et al. in Nigeria among 1,192 healthy adults aged 18 years and above.[16] They revealed a non-significant positive correlation between LVM and age (p =0.172). Participants with higher BMI had higher LVM and this finding was also similar tothe study by Savage DD et al where the population consisted of 2,226 men and 2,746 women (Mean age 51 years, range 17 to 90). Body mass index (BMI) (A measure of obesity) were statistically significant and independent correlates of LV mass in both sexes ($p < 0.001$).[18]

Limitations

The sample was obtained from only a single centerin Chattogram City. The current study might not accurately reflect the entire Bangladeshi population.

Conclusion

The normal LVM in the Bangladeshi adult population was found to be higher in male and LVM increased with increasing age and BMI. The present study provided baseline normative data for future research in this field, which may also benefit cardiologists.

Recommendations

Further studies can be done to determine the LVM among normotensive and hypertensive Bangladeshi adults. A population study is suggested with all age groups from different regions of Bangladesh to establish better normative reference data in this field.

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Contribution of the authors

AS-Conception, design, acquisition of data, interpretation of data, drafting and final approval.
SU-Data collection, critical revision and final approval.
MR-Data analysis, data collection, drafting and final approval.
UC-Data collection, data analysis, manuscript writing and final approval.
RD-Design, data analysis, critical revision and final approval.
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Disclosure

All the authors declared no competing interests.

References

1. Guleri N, Rana S, Chauhan RS, Negi PC, Diwan Y, Diwan D. Study of left ventricular mass and its determinants on echocardiography. Journal of Clinical and Diagnostic Research: JCDR. 2017;11(9):OC13.

2. Anil OM, Chaudhary N, Nikhil OM, Tiwari A, Singh G, Thakur A, et al. Study of Left Ventricular Mass in Normal Nepalese Population. Journal of Nobel Medical College. 2022;11(2):27-31.

3. de Simone G, Devereux RB, Daniels SR, Meyer RA. Gender differences in left ventricular growth. Hypertension. 1995;26(6):979-983.

4. Liu F. Left ventricular mass and volume with increasing age in subjects free of cardiovasculardiseases. American Journal of Cardiology. 2017;245: 92-98.

5. Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA et al. Recommendations for chamber quantification. European journal of echocardiography. 2006;7(2):79-108.

6. Sutton MG, Sharpe N. Left ventricular remodeling after myocardial infarction: Pathophysiology and therapy. Circulation. 2000;101(25):2981-2988.

7. Gardin JM, Wagenknecht LE, Anton-Culver H, Flack J, Gidding S, Kurosaki T et al. Relationship of cardiovascular risk factors to echocardiographic left ventricular mass in healthy young black and white adult men and women: the CARDIA study. Circulation. 1995;92(3):380-387.

8. Koren MJ, Devereux RB, Casale PN, Savage DD, Laragh JH. Relation of left ventricular mass and geometry to morbidity and mortality in uncomplicated essential hypertension. Annals of Internal Journal. 1991;114(5):345-352.

9. Ilercil A, O'Grady MJ, Roman MJ, Paranicas M, Lee ET, Welty TK et al. Reference values for echocardiographic measurements in urban and rural populations of differing ethnicity: The Strong Heart Study. Journal of the American Society of Echocardiography. 2001;14(6):601-611.

10. Jaafar MS, Hamid O, Khor CS, Yuvaraj RM. Preliminary studies of left ventricular wall thickness and mass of normotensive and hypertensive subjects using M-mode echocardiography. The Malaysian journal of medical sciences. 2002;9(1):2835.

11. Mukherjee A, Halder SK, Nandi S, Mandal M, Khanra D, Biswas K. A study on normal reference values of echocardiographic chamber dimensions in young eastern Indian adults. Indian Heart Journal. 2021 ;73(1):77-84.

12. Levy D, Garrison RJ, Savage DD, Kannel WB, Castelli WP. Prognostic implications of echocardiographically determined left ventricular mass in the Framingham Heart Study. New England journal of Medicine,1990; 322:1561-1566.

13. Myerson S G, Montgomery H E, World M J, Pennell D J. Left ventricular mass. Hypertension. 2002;:40:673-678.

https://doi.org/10.1161.HYP.0000036401.99908.DB.

13. Das DK, Agarwal T, Garg B, Pant DC, Gupta S. Left Ventricular Mass Assessment in Prehypertensive Subjects by Echocardiography. International Journal of Pharmaceutical and Clinical Research. 2023; 15(5): 1709-1714.

14. Rashid A, Shah AA, Rather H, Rasool V, Hafeez I, Ajaz S, et al. Echocardiographic Measurements in Normal Healthy Adult Population of North India. Cureus. 2023;15(10); 1-18.

15. Morais H, Feija A, de Victoia Pereira S. Global longitudinal strain and echocardiographic parameters of left ventricular geometry and systolic function in healthy adult Angolans: Effect of age and gender. Global Cardiology Science & Practice. 2022;2022(1-2).e202202.

16. Ugwuanyi DC, Chiegwu HU, Eze CU, Nwagbara CT, Eze JC, Ogolodom MP. Echocardiographic Evaluation of Normal Adult Left Ventricular Geometry in a Nigerian Population. Health Science Journal. 2021;15(1): 1-9.

17. Funjan MM, Estephan MF. Effect of sex, age, and anthropometric measurements on left ventricular mass index in a sample of Iraqi adults. Journal of Faculty of Medicine Baghdad, 2011;53(3):327-332.

18. Savage DD, Levy D, Dannenberg AL, Garrison RJ, Castelli WP. Association of echocardiographic left ventricular mass with body size, blood pressure and physical activity (the Framingham Study). American Journal Cardiol, 1990; 65(5):371-376.
DOI: https://doi.org/10.1016/0002-9149(90)90304-j.