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Original Article

Study of Left Ventricular Mass in Normal Nepalese Population

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Abstract

Background
A prospective study was conducted to find distribution of the left ventricular mass in normal adult Nepalese population in order to establish the upper reference limit.

Materials and Methods
A total of 100 consecutive male and 100 female participants of age 18 years and above visiting for cardiac checkup were enrolled prospectively in this study. Participants with hypertension, diabetes, obesity and significant cardiovascular disease were excluded.

Results
Mean age of study population was 43 years. Mean left ventricular mass in total, male and female population was 127.45±29 gm, 136.48±30.64gm and 118.43±24.24 gm respectively. Mean left ventricular mass index (LVMI) in total, male and female population was 74.52±15.78 gm/m^2, 80.04±16.5 gm/m^2 and 69.17±13.05 gm/m^2 respectively. Left ventricular mass and left ventricular mass index increased with age, Body Mass Index, Systolic and Diastolic Blood Pressure, and were statistically significant (p-value <0.05).

Conclusion
Normal left ventricular mass in Nepalese Population was found to be lesser in female compared to male. Left ventricular mass increased with increasing age and body mass index.

Keywords: *Echocardiography, Index, Nepal*

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Introduction

Left ventricular mass (LVM) is the weight of the left ventricle, which is estimated by using echocardiography, and is thought to represent the cumulative effect of blood pressure on the heart. LVM is an independent predictor of cardiovascular morbidity and mortality in different clinical settings including general population, hypertensive cohorts, and patients with diabetes, coronary artery disease and chronic kidney disease [1–5].

In past, multiple studies were conducted over LVM on the basis of gender, age, body size, obesity, and different ethnicities. However, there reference values of LVM were different in western world and south Asian world [6-12]. In order to measure the LVM in our population we follow the American society of echocardiography guidelines [13].

To the best of our knowledge, till now, the study of LVM was not conducted in our population therefore; we aimed to perform a prospective study of LVM in healthy Nepalese population in order to provide reliable echocardiographic reference values for defining the criteria of LVH.

Materials and Methods

In this study, a total of 200 healthy participants were enrolled in this cross sectional study conducted prospectively at National Cardiac Centre, Kathmandu. We took data of 100 consecutive male and 100 consecutive female who visited for cardiac check up from March 2022 to May 2022. Participants who met inclusion and exclusion criteria and gave consent were included in this study. Healthy adults of age 18 years and above without any known illness and coming for regular health checkup in OPD were enrolled in the study. Participants with systolic BP above 139 mmHg and/or diastolic BP above 89 were excluded from the study. Similarly participants with diabetes mellitus, BMI > 29.9kg/m2, established cardiovascular disease, valvular heart disease; congenital heart disease, poor echo window and insufficient clinical or laboratory data were also excluded from the study. After obtaining informed consent, all participants underwent comprehensive clinical evaluation at the outpatient clinic of National Cardiac Centre.

Data on medical history, physical examination, blood & urine samples and BP measurements in the sitting position were obtained. BP measurements were obtained with automatic Philips bedside monitor (intelliVue X3) after 10 minutes of rest. Two BP measurements were taken at a gap of 5 minutes and mean of both values were taken for analysis. Height was recorded to the nearest 0.5 cm using a standardized wall-mounted height board. Body weight was recorded to the nearest 0.1 kg using a calibrated electronic scale with the individuals wearing light clothing without shoes. Echocardiography was performed and LV mass was calculated according to American Society of Echocardiography (ASE) guidelines from 2D guided M-mode.12 M-mode and two-dimensional echo examinations were carried out with a commercially available advanced technology ultrasound machine (Philips EPIQ CVx). Parasternal short-axis M-mode measurements of the mid-ventricle, just below the mitral annulus, were made using a leading-edge-to-leading-edge method measured from M-mode tracings recorded at 50–100 cm/s speed, during at least three consecutive cycles. Left ventricular end diastolic dimension (LVEDD), interventricularseptal thickness (IVSd), and left ventricular posterior wall thickness (PWd) were measured at the peak of the electrocardiographic R wave. All echocardiographic tracings were obtained by single skilled operator. The Devereux formula for calculation of left ventricular (LV) mass was used. The formula, stated as 0.8{1.04[([LVEDD + IVSd + PWd]3 – LVEDD3)]} + 0.6 where LVEDD, IVSd, and PWd represent left ventricular , interventricularseptal, and posterior wall thickness in diastole, respectively, was derived assuming LV dimensions in centimeters. Data analysis was performed using SPSS 25.0 software (SPSS, Inc., Chicago, IL, USA).

Data was expressed as means ± standard deviation (SD). Unpaired t test, two tailed, was use to test the significance of data and statistical significance was set at $P < 0.05$.

Results

Two hundred participants, aged 18 to 80 years (mean age 43.86±16.54 years) meeting the inclusion criteria, were enrolled in this study. Mean age of male and female participants were 44.33±16.64 years and 43.38±16.51 years respectively. Age, height, weight, Body Mass Index (BMI), Body Surface Area (BSA), SBP and DBP among men and women were comparable (Table 1). Mean SBP and DBP in study population were 113.01±6.4 mmHg and 69.38±3.01 mmHg respectively. Similarly, mean BMI and BSA were 24.97±2.4 kg/m2 and 1.71±0.13 m2 respectively (Table 1).

Table 1: Baseline Characteristics

	Total (n=200)	Male (n=100)	Female (n=100)	p-value
Age (years)	43.86±16.54	44.33±16.64	43.38±16.51	0.68
Height (cm)	161.54±8.22	161.56±8.22	161.51±8.27	0.97
Weight (kg)	65.13±7.51	64.92±7.43	65.33±7.63	0.70
BMI (kg/m2)	24.97±2.4	24.88±2.31	25.06±2.49	0.60
SBP (mm of Hg)	113.01±6.4	113.68±7.07	112.33±5.62	0.14
DBP (mm of Hg)	69.38±3.01	69.63±3.08	69.13±2.94	0.20
BSA (m2)	1.71±0.13	1.71±0.13	1.71±0.13	0.79

(Data is represented as mean ±standard deviation)

Among echocardiographic parameters, IVSd and PWd were comparable among male and female participants except LVEDD which was significantly higher in male compared to female participants (4.34±1.35 vs 4.02±1.25, P-value <0.001). LVM and LVMI in the study population was 127.45±29gm and 74.52±15.78gm/m2 respectively. Mean LVM and LVMI in male participants were significantly higher than female participants. Mean LVM was 136.48±30.64gm among male participants and 118.43±24.24gm among female participants. Mean LVMI was 80.04±16.5gm/m2 among male participants and 69.17±13.05gm/m2 among female participants. (Table 2)

Table 2: Echocardiographic Findings

	Total	Male (n=100)	Female (n=100)	p-value
IVSd (cm)	0.95±0.3	0.96±0.3	0.94±0.29	0.14
LVEDD (cm)	4.18±1.31	4.34±1.35	4.02±1.25	<0.05
PWd (cm)	0.93±0.29	0.94±0.29	0.93±0.29	0.65
LVM (gm)	127.45±29	136.48±30.64	118.43±24.24	<0.05
LVMI (gm/m2)	74.52±15.78	80.04±16.5	69.17±13.05	<0.05

(IVSd = Inter-Ventricular Septum (in diastole), LVEDD = Left Ventricular End Diastolic Dimension, PWd = Posterior Wall thickness (in diastole), LVM = Left Ventricular Mass and LVMI = Left Ventricular Mass index)

LVM in male participants above and below 50 years was 155.57±27.46gm and 123.75±25.79 gmrespectively. LVM in female participants above and below 50 years was 132.77±21.95gm and 109.26±21.09gm respectively. Similarly, LVMI in male participants above and below 50 years was 92.02±15.21gm/m2 and 71.77±11.71 gm/m2 respectively. LVMI in female participants above and below 50 years was 78.41±12.29gm/m2 and 63.26±9.72gm/m2 respectively. (Table 3) LVM and LVMI increased with age, BMI, Systolic and Diastolic Blood Pressure, and were statistically significant (p-value <0.05) (Figure 1a, b, c and d).

Table 3: LVM and LVMI distribution by age group

	Male All (n = 100)	Male <50 years (n = 60)	Male = 50 years (n = 40)	Female All (n= 100)	Female <50 years (n=61)	Female = 50 years (n=39)
LVM (gm)	136.48±30.64	123.75±25.79	155.57±27.46	118.43±24.24	109.26±21.09	132.77±21.95
LVMI (gm/m²)	80.04±16.5	71.77±11.71	92.02±15.21	69.17±13.05	63.26±9.72	78.41±12.29

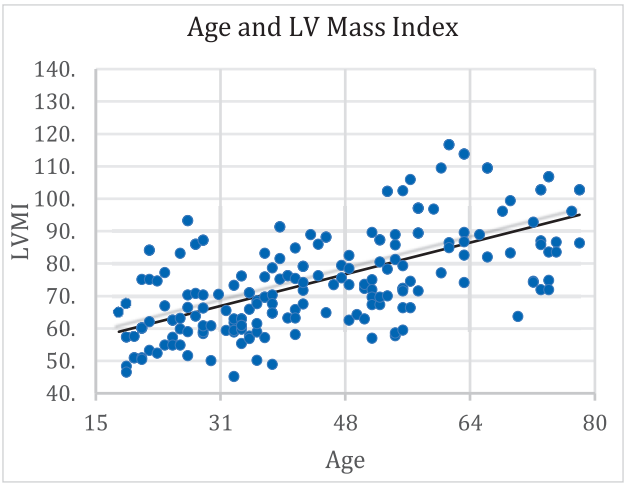

Figure 1a: Distribution of Left Ventricular Mass Index (g/m²) according to age (in years)

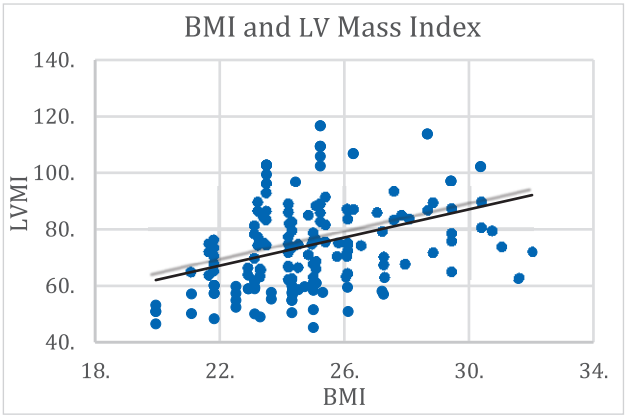

Figure 1b: Distribution of Left Ventricular Mass Index (g/m²) according to BMI (in kg/m²)

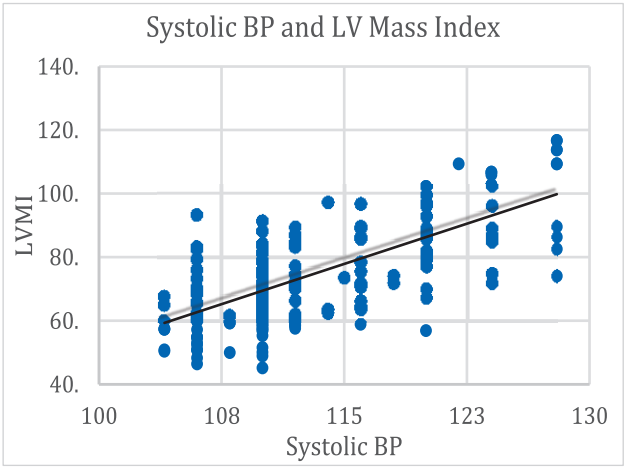

Figure 1c: Distribution of Left Ventricular Mass Index (g/m²) according to Systolic Blood Pressure (in mm of Hg)

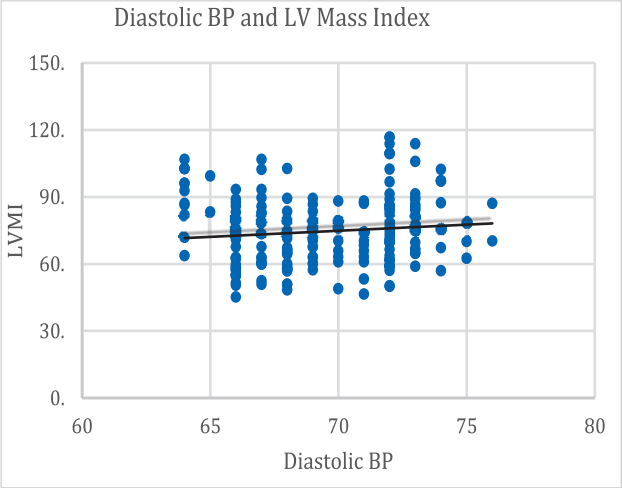

Figure 1d: Distribution of Left Ventricular Mass Index (g/m^2) according to Diastolic Blood Pressure (in mm of Hg)

Discussion

LVM and LVMI in this study were comparable to previous data of south Asian and Indian population, but it differs significantly from published figures from the West [14–18]. LVM and LVMI were higher in male compared to women and this result was consistent with previous studies. Similarly, LVM increased with increasing age and higher body mass index. In most of the studies, LVM increased with age in both sexes and findings of our study was consistent with these studies. Similarly participants with higher BMI had higher LVM, and this finding was also similar to previous studies [15, 19, 20]. Among Framingham Heart Study participants comprising 2,226 men and 2,746 women of mean age 51 years, age, height, systolic BP, and BMI were independent correlates of LVM in both genders [19]. According to Shub et al [21], LVM also increased with increase in Systolic and Diastolic Blood Pressure within normal range. SBP was better predictor of increased LVM than DBP in previous study, which is consistent with this study. In our study LVMI was higher in both sexes in age group above 50 compared to below 50. Klein et al, [15] similarly reported significantly larger LVM/BSA in women >50 years old compared to younger but no such relationship was observed in men.

Increase in LVM in male population of this study was mainly contributed by increase in left ventricular diastolic dimension. Interventricular septum thickness and posterior wall thickness in both sexes were comparable. The reference values for left-ventricular mass cannot be expected to be entirely similar in studies that differ for various factors like distribution of age, sex prevalence, ethnicity and geography that affect left-ventricular mass value. It has been also shown by Poppe et al. [12] that the upper limits of left-ventricular mass differ among ethnic groups. It was lower in normal populations from the Asian or Indian subcontinent than in normal cohort from Europe, the Middle-East and North America suggesting that ethnic specific reference ranges for left-ventricular mass need to be developed. However, It is important to again emphasize that some sources of errors should be avoided. One of them consists in the inclusion of patients with diabetes, masked hypertension, borderline hypertension, obesity or cardiovascular disease all of which importantly modulates cardiac structure and affect left ventricular mass.

The 95th percentiles of mean LVMI in our study were 109 and 89 g/m2 in men and women, respectively. This was Cut-off Values for the Diagnosis of LVH according to this study, while current ASE guideline suggests diagnosis of LVH when LVMI is above 115 g/m2 in men and 95 g/m2 in women. In our population the upper limits of left-ventricular mass were substantially lower than those adopted by the ESH/ESC guidelines on hypertension [22] the difference being similar both in men (109 vs. 125 g/m^2) and in women (89 vs. 110 g/m^2). Both ASE and ESC guidelines have higher cut off values for diagnosis of LVH in regard to South Asian population.

In best of our knowledge, this is the only study conducted to find out normal left ventricular mass in Nepalese population. Findings on LVM in this study are comparable to Indian and other South Asian data. Result of this study further emphasize the need of considering special cut of value for diagnosis of left ventricular hypertrophy by both American and European Society of echocardiographic guidelines in South Asian Ethnic population. The diagnostic criteria for concentric left-ventricular geometry provided by the present study and based on sex specific and more conservative thresholds than previous ones, should be adopted after validation by prospective investigations

Unlike previous studies, our study doesn't include confounding factors like diabetes, borderline hypertension and overweight population. This study has also included wide age range. Baseline characteristics among male and female participants were comparable. But, smaller number of participants was the main limitation of this study.

Conclusion

Normal left ventricular mass in Nepalese Population was found to be lesser in female compared to male. Left ventricular mass increased with increasing age and body mass index.

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Conflict of interest: None

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