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Normative data of left ventricular mass index in middle aged population of Vidarbha

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Abstract
Patients with left ventricular hypertrophy (LVH) are more prone to cardio-vascular events than one without LVH. Hence it is important to detect left ventricular hypertrophy at an early stage. Left ventricular hypertrophy denotes increase in mass of left ventricle (LVM). Variety of factors influences left ventricular hypertrophy including various anthropometric parameters. Since LVM is significantly correlated with body surface area (BSA). Left ventricular mass is routinely indexed for body surface area to calculate LVM Index (LVMI). LVMI gives information about presence or absence of left ventricular hypertrophy. In this study 120 normotensive subjects including male and female who were free from any diseases were selected. BSA of participants was measured; the mean value was 1.64 m^2. Left Ventricular Mass was estimated by 2-D-Echocardiography, the mean value was 143.38 g. We observed Left Ventricular Mass was significantly correlated with Body Surface Area. Left Ventricular Mass was indexed for Body Surface Areato determines normal range of Left Ventricular Mass using LVM Index. The normal limits of Left Ventricular Mass Index were between 83.95 to 89.69$g/m^{2.}$

Keywords: Echocardiography, Left ventricular mass, Body surface area, Left ventricle mass Index.

Introduction
Among heart diseases Coronary Artery Disease (CAD) is the most common fatal disease. One of the important risk factor for development of CAD is hypertension. India is no exception to it, it is also following the same trend. With passage of time there is heavy increment in the cases of CAD. Majority of deaths in this situation are attributed to complication of hypertension i.e. Left ventricular hypertrophy (LVH). LVH denotes increase in the mass of left ventricle associated with hypertrophy of individual muscle fiber.[1-4] In general Heart responds to hypertension i.e. increase in afterload by increase in wall thickness of chamber and increasing its mass. Early diagnosis of LVH is important to prevent complications like Arrhythmia, Myocardial Infarction and Sudden death.[1,5-7] Echocardiography offers diagnosis of LVH by measuring wall thickness and by calculating left ventricular mass (LVM).

Many factors such as age, sex, race, dietary sodium intake, insulin resistance, adrenergic stimulation have already been positively correlated with LVM and shown to promote LVM.[8-11] Anthropometric factors like height, weight, BSA and BMI also positively correlate with LVM but BSA correlated more strongly. Increasing BSA Increases LVM. Hence for reducing variance among normal subjects LVM is indexed for BSA to get normal values in the form of LVM index. The aim of present study was to study normal limits of LVM using LVMI.

Materials and Methods
In this study 120 normotensive subjects in the age group of 35 to 65 yrs were selected from O.P.D. of Medicine. Out of 120, 62 were males and 58 were female. Written consent was taken from each of the subject. Permission of Institutional Ethical Committee was taken. Following inclusive criteria were applied:

1. Age between 35 to 65 yrs
2. Systolic BP < 140 mmHg
3. Diastolic BP < 90 mmHg
4. No Overt evidence of cardio-vascular disease
5. No diabetes

Cardiovascular diseases were ruled out by history taking and clinical examination. Diabetes was ruled out by estimating random blood sugar level. Each participant was subjected to measurement of height in cm and weight in Kg. Each participant was subjected to detailed history taking followed by careful clinical examination. B.P. was recorded in supine position after15 minute of rest. Both Systolic and Diastolic B.P. were recorded. All the individuals were subjected to M-mode echocardiographic examination, done on acuson computed sonography 128 x P/10c echocardiography machine 2.5 MHz, 13 mm transducer was used. It was done as per recommendation of American Society of Echocardiography (ASE).[12] In each individual Left Ventricular Internal Diameter at end diastole (LVIDd), Left Ventricular Posterior wall thickness at end diastole (PWTd) and Inter Ventricular Septal Thickness at end Diastole (IVSd) were noted. As per recommendation of ASE thickness of Right and left septal endocardial echoes were included in IVS and posterior endocardial echoes were included in Left ventricular posterior wall. LVIDd did not include septal and posterior wall endocardial echoes, it was the maximum distance from

left ventricular posterior wall endocardium and left septal endocardium.

The normal measurements are[13]:

1. IVSd thickness 6 to 11 mm
2. PWTd thickness 6 to 11 mm
3. LVIDd 35 to 57 mm

With above recorded data, LVM was automatically calculated by echocardiography machine using "ASE (corrected) cube formula[6] i.e.

$LVM = 0.8\ [1.04\{(LVIDd+IVSd+PWTd)^3 - (LVIDd)^3\}]+0.6$ g

LVM is expressed in gram (g).

Apart from LVM, the body surface area of all individuals were calculated by using Du Bois' formula (1916)[14]

i.e. BSA = 0.0001×71.84 (weight in Kg)$^{0.425}$ x (height in cm)$^{0.725}$. BSA expressed in Square meter (m^2).

Statistical Analysis

Simple correlation test was used to assess the association between LVM and BSA. Statistical software STATA version 14.0 was used for statistical analysis. Indexation of LVM for BSA was done to calculate LVM index (LVMI). It is expressed as g/m^2.

Results

In the present study various parameters viz. BSA, LVM and LVMI were studied in total 120 subjects. All the subjects were in the range of 35 to 65 yrs of age. Their physical characteristics were noted in the form of age, height and weight. The BSA was calculated from Du Bois' formula. LVM was calculated by Echocardiography machine by using ASE corrected cube formula. LVMI was calculated by dividing LVM by BSA [15-22]. Out of 120 subjects 62 were male and 58 were female (Table 1).

Table 1: Summary statistics of study parameters of all subjects

Parameter	Number	Mean	Median	SD	SEM	95% C.I.	
Age (Yrs)	120	48.72	49	7.87	0.72	47.29	50.14
Height (cm)	120	160.35	160	6.49	0.59	159.18	161.53
Weight(kg)	120	61.58	62	7.88	0.72	60.16	63.01
BSA (m^2)	120	1.64	1.65	0.12	0.01	1.62	1.66
Systolic BP (mmHg)	120	128.77	130	7.79	0.71	127.36	130.18
Diastolic BP (mmHg)	120	80.58	82	5.57	0.51	79.58	81.59
IVSd (mm)	120	8.60	8	1.44	0.13	8.34	8.86
PWId (mm)	120	8.49	9	1.47	0.13	8.22	8.76
LVID (mm)	120	48.09	49	4.16	0.38	47.34	48.85
LVM (g)	120	143.38	143.12	31.69	2.89	137.65	149.10
LVMI (g/m^2)	120	86.82	87.12	15.86	1.45	83.95	89.69

Table 2: Summary statistics of study parameters of Male subjects

Parameter	Number	Mean	Median	SD	SEM	95% C.I.	
Age (Yrs)	62	48.77	49	7.89	1.00	46.77	50.78
Height (cm)	62	163.21	1.65	5.7	0.73	161.76	164.66
Weight(kg)	62	62.89	64.5	9.24	1.17	60.54	65.23
BSA (m^2)	62	1.68	1.71	0.13	0.02	1.64	1.71
Systolic BP (mmHg)	62	129.16	130	8.05	1.02	127.12	131.21
Diastolic BP (mmHg)	62	80.39	82	6.04	0.77	78.85	81.92
IVSd (mm)	62	9.02	9	1.75	0.22	8.57	9.46
PWId (mm)	62	8.74	9	1.77	0.23	8.29	9.19
LVID (mm)	62	48.44	49	4.57	0.58	47.27	49.60
LVM (g)	62	152.53	152.47	35.52	4.51	143.51	161.55
LVMI (g/m^2)	62	90.44	90.16	18.54	4.51	86.50	94.39

Table 3: Summary statistics of study parameters of Female subjects

Parameter	Number	Mean	Median	SD	SEM	95% C.I.	
Age (Yrs)	58.00	48.66	50	7.93	1.04	46.57	50.74
Height (cm)	58.00	157.30	1.59	5.89	0.77	155.75	158.85
Weight (kg)	58.00	60.19	62	5.87	0.77	58.65	61.73

BSA (m^2)	58.00	1.60	1.63	0.11	0.01	1.58	1.63
Systolic BP (mmHg)	58.00	128.34	130	7.55	0.99	126.36	130.33
Diastolic BP (mmHg)	58.00	80.79	80	5.505	0.66	79.46	82.12
IVSd (mm)	58.00	8.16	8	0.81	0.11	7.94	8.37
PWId (mm)	58.00	8.22	8	1.02	0.13	7.95	8.49
LVID (mm)	58.00	47.72	49.5	3.68	0.48	46.76	48.69
LVM (g)	58.00	133.59	139.19	23.62	3.10	127.37	139.80
LVMI (g/m^2)	58.00	82.76	86.07	11.18	1.47	79.82	85.70

These subjects were having BSA in the range of 1.2979m^2 to 1.9637m^2. LVM was in the range of 66.4685g to 248.6732g. When BSA of all the subjects were compared with observed LVM, we found that there is a highly significant association between BSA and LVM (r=0.6797, p<0.0001) indicating that as the BSA increased LVM also increased. Normal limits of LVM were calculated by using LVMI for both the genders. For male it was between 86.50 to 94.39 g/m^2 and for female it was between 79.82 to 85.70 g/m^2 (Table 2 and Table 3).

Discussion

The present study was aimed to study normal limits of LVM using LVMI. The subjects were in the age group of 35 to 65 yrs. The methodology was set taking into the consideration the influence of other factors on LVM viz. Age, weight, height, and B.P. The subjects with normal B.P. (Mean Systolic B.P. 128.77 mmHg and Mean Diastolic B.P. 80.58 mmHg) were selected so as to avoid the influence of hypertension on LVM.[7,16,20,23-25]

The BSA of this group was in the range of 1.2979m^2 to 1.9637m^2. The mean BSA was 1.64 m^2. In the present study the mean value of LVM was 143.38g. The values of BSA of all subjects were correlated with LVM. It was seen that the BSA had a strong positive correlation with LVM (r=0.827, p<0.0001). The result of our study was consistent with findings of various studies of Howard P. et al,[26] Richard B. Devreux,[15] Daniel Levy et al,[18] J.C. Mohan et al,[21] I W Hammond et al[(16)], Stephen Daniel et al[19] and Daniel Savage et al.[20]

The probable reason for increase in LVM with increase in BSA is that between birth and adulthood BSA increases by nine fold (from about 0.2 to 1.8m^2).[26] Cardiac measurements increase as an exponential function of surface area, for linear measurements such as left ventricular end diastolic diameter is mainly affected. The result of our study showed that it was LVIDd that increased with increase in BSA. This result was consistent with the results of Lester et al,[27] Henry et al,[28] Devreux et al,[6] Graham[29] and Lange.[30]

Normal limits of LVM

The LVM is influenced by various factors like age, sex, race, body habitus, blood pressure and many others. It is very difficult to draw normal limits of LVM. It is then necessary to incorporate into the definition the normal characteristics of subjects that correlate strongly with LVM and helps in reducing variance among normal subjects. That Characteristic is BSA. By this approach we have determined that indexation of LVM for BSA is valuable. Indexation of LVM for BSA is termed as Left Ventricular Mass Index (LVMI). It is expressed as g/m^2. In our study mean value of LVM was 143.38g and mean value of BSA was 1.64 m^2. Using these two parameters mean LVMI for both genders came as 86.82 g/m^2, for males as 90.44 g/m^2 and for females as 82.76 g/m^2.

From the observations and result of our study, we can conclude that the normal limits of LVM in our study using LVMI for both genders are between 83.95 to 89.69g/m^2, for males it was between 86.50 to 94.39 g/m^2 and for females it was between 79.82 to 85.70 g/m^2. Taking these findings into consideration we suggest similar experimental studies with large sample size for getting accurate values of LVM in normal healthy population which can enable us to diagnose left ventricular hypertrophy at the earliest to prevent its complications.

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