A Study on the Evaluation of the Echocardiographic Measurements in Normal Healthy Adult Population of Saharanpur District

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Abstract
Echocardiography is a widely utilized, non-invasive imaging modality essential for diagnosing and monitoring cardiovascular diseases. Echocardiographic measurements provide detailed structural and functional insights into the heart, aiding clinicians in assessing cardiac anatomy, valve function, and hemodynamics. Key measurements include chamber dimensions, wall thickness, ejection fraction (EF), stroke volume, and diastolic function. Advanced modalities, such as Doppler imaging, enable precise evaluation of blood flow velocities and pressures, offering critical information on valvular regurgitation, stenosis, and pulmonary artery pressures.

Keywords: Echocardiography, Anatomy, Ejection Fraction.

INTRODUCTION

The heart is an amazing muscle. The heart muscle cell is striated and shares the same contractile unit as the skeletal muscle, the sarcomere. The sarcomere contains myosin thick filaments and thin filaments of actin, troponin and tropomyosin. In the presence of calcium, the myosin interactswith actin, which produces a cross-bridge between the filaments enabling contraction (systole) to occur. The relaxed state (diastole) is brought about by a decrease in intracellular calcium and the tropomyosin inhibitory sub-unit prevents myosin from interacting with actin **(Souham *et al* 1997).**
When the LV contracts, two things happen; the long-axis distance between the base and the apex decreases and the short-axis diameter of the ventricular chambers decreases, making the pressure high enough to push the blood around the systemic circuit. When the LV contraction occurs, the inter-ventricular septum bulges into the RV cavity (**Martini *et al* 1997).**
Echocardiography is a well-recognized and utilized method across the globe. During a clinical echocardiographic examination, it is crucial to determine the size of the heart, particularly its ventricles, as larger ventricles are frequently indicative of an underlying condition such as dilated cardiomyopathy,

valvular abnormality, or shunt. The patient's prognosis is correlated with the size of the LV. It has significant therapeutic ramifications and can offer information needed, for example, to establish whether patients with aortic or mitral regurgitation should have heart surgery (**Aurigemma *et al* 2002).** Arrhythmogenic right ventricular dysplasia (ARVD) **(Francés *et al*., 2006)** and primary pulmonary disease are two conditions that can cause a large RV in patients. However, elevated LV filling pressure through the pulmonary circulation can also cause an increase in RV afterload (**Wong *et al*., 2002).** Yet, large ventricles and ventricular hypertrophies are not always a sign of disease; they can also be observed in people who appear fit, like sportsmen **(Lauschke *et al* 2009).**

The anatomy of the right ventricle is sophisticated. It has a crescent-shaped, truncated main body with separate outflow and inflow portions. The trabecular pattern of the RV free wall varies. These elements make it challenging to evaluate the RV's structure, including measuring the cavity size and wall thickness. Accessibility is further complicated by the RV's location, which puts it anterior to the left heart and adjacent to the sternum (**Foale *et al*., 1986).**

The most popular non-invasive imaging method for evaluating the anatomy and function of the heart is echocardiography, which is still the gold standard despite the ongoing development of new technologies and applications for a variety of echocardiographic procedures. Even after additional cardiac imaging modalities have emerged, this is still true (**Vasan *et al* 2000)** (**Lancellotti *et al* 2013).** It is predicted that about 20 billion echocardiography examinations are conducted annually in the United States (**Okhrah *et al* 2010).** Several guidelines and pronouncements have provided normal values for echocardiographic measures. The most recent was a joint recommendation for chamber quantification from the American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging (EACVI) (**Lang *et al*., 2015).** This recommendation had previously been supported by a number of societies, including the Indian Academy, Canadian Society of Echocardiography, and International Alliance Partners of the ASE**.** Echocardiography is also a versatile diagnostic tool used throughout a patient's life, from imaging the heart in utero (fetal echocardiography) to addressing congenital abnormalities in infancy and childhood, as well as diagnosing acquired conditions in adulthood. Its capability to measure flow and pressure gradients has largely supplanted the need for invasive procedures in many hemodynamic assessments. **(Linda and Marcoff *et al* 2024).**

The purpose of this study was to evaluate of the echocardiographic measurements in normal healthy adult population of Saharanpur district.

Aim of the Study

To assess 2D trans-thoracic echocardiographic parameters in normal healthy adult population of SAHARANPUR.

Objectives of the Study

1. To compare the ECG changes in all the patients presenting in cardiac Out Patient Department (OPD).
2. To evaluate the echo measurements in all the age groups of the study population.

MATERIALS AND METHODS

Materials

The present study entitled "To study the evaluation of the echocardiographic measurements in normal healthy adult population of Saharanpur district'' was conducted in the Department of Cardiology in Kiran Heart Centre, Saharanpur, UP, from 01/02/2024 to 31/08/2024 after approval taken from the ethical committee of hospital.

Normal healthy adults without a history of cardiovascular illness were included the participants. Four hundred and forty nine (449) patients of 18-60 age group, of either gender were taken as subjects. A written informed consent had been obtained from all the participants

EXCLUSION CRITERIA

Individuals with any form of cardiovascular disease, such as:

- Valvular Heart Disease (apart from minor regurgitation)
- Congenital Heart Disease.
- Cardiomyopathy (restrictive, dilated, ischemic, hypertrophic, or infiltrative)
- Anomalies of ischemia wall motion, arrhythmias, abnormalities of diastolic function, and abnormalities of systolic LV function
- Patients with a systolic blood pressure of at least 80 mmHg, a diastolic blood pressure of at least 140 mmHg
- A history of medication-treated hypertension
- Patients with diabetes mellitus
- Patients with BMI ≥30 kg/m^2 body mass index

  Patients with creatinine ≥1.3 mg/dL

  Patients with Low-density lipoprotein cholesterol ≥130 mg/dL and total cholesterol ≥240mg/dL.

Methods

The Evaluation of the Subjects was done as following

1. **Detailed clinical history**

a. High blood pressure
b. Diabetes
c. Depression
d. Drug History e Diet History
f. Covid 19 History

2. **Physical Examination was done to check vitals**

a. Pulse (bpm)
b. Systolic Blood Pressure (SBP)mmhg
c. Diastolic Blood Pressure (DBP)mmhg
d. Mean Arterial Pressure (MAP) mmhg
e. SpO2 (%)

3.Cardiovascular Examination

a. Murmur

Following Parameters were also been taken into consideration.

1. **Demographic variables;**

a. Age
b. Residence (Rural/ Urban)
c. Gender (Male/ Female)
d. Occupation
e. Marital Status

2. **Study Variables;**

a. Vitals
- Pulse
- Systolic Blood Pressure (SBP mmhg)
- Diastolic Blood Pressure (DBP mmhg)
- SpO2
- Respiratory Rate (Cpm)

b. Investigation

c. Electrocardiography (ECG)Lipid Profile

Parameters of 2D echocardiography

1. LVIDd (mm)
2. LVIDs (mm)
3. LVEDV (ml)
4. LVESV (ml)
5. IVS (cm)
6. PWT (cm)
7. LV mass (g)
8. LVEF (%)
9. A-Aorta (mm)
10. RA (mm)
11. LA (mm)
12. TAPSE (mm)
13. RA vol (ml)
14. LA vol (ml)
15. E/A
16. RVOT (mm)
17. LVOT (mm)
18. IVC (cm)
19. SV (ml)
20. GLS
21. RV length (mm)
22. E (cm/s)
23. A (cm/s)

RESULTS

Table 1 Shows the age-wise and gender-wise distribution of study population.

Age group (years)	Male	Percentage	Female	Percentage	P value
18-40	150	33.4%	181	40.3%	0.012
41-60	70	15.5%	48	10.6%	0.0300

Table 1 showed that in 18-40 age group there were highest number of individuals with 150 (33.40%) males and 181 (40.30%) of females, p value was 0.012 which is lower than typical significant. This indicates that the difference between the two groups is statistically significant.

In 41- 60 age group there were 70 (15.5%) of males and 48 (10.60%) of females, p value was 0.0300 which is lower than typical significance. This indicates that the difference between the two groups is statistically significant.

Table 2 shows the distribution of study population as per occupation

Occupation	Male	Percentage	Female	Percentage	P value
Employed	98	21.8%	53	11.8%	0.001
Unemployed	109	24.2%	135	30%	0.0512
Work from home	13	2.8%	41	9.1%	0.00006

Table 2 highlights significant gender-based differences in occupation distribution among the study population. Employment was significantly higher in males (21.8%) compared to females (11.8%) (P = 0.001). Conversely, working from home was significantly more common among females (9.1%) than males (2.8%) (P = 0.00006). The difference in unemployment rates,although higher in females (30%) than males (24.2%), was not statistically significant (P = 0.0512).

Table 3 shows the distribution of study population as per marital status

Marital Status	Male	Percentage	Female	Percentage	P value
Married	151	33.6%	182	40.5%	0.0324
Unmarried	92	20.4%	47	10.4%	0.00002

Table 3 reveals significant gender differences in marital status distribution. A higher proportion of females (40.5%) were married compared to males (33.6%) (P = 0.0324), while males had a significantly higher proportion of unmarried individuals (20.4%) compared to females (10.4%) (P = 0.00002).

Table 4 shows the electrocardiographic findings in the study population:

ECG findings	Male	Percentage	Female	Percentage	P value
Normal	151	33.6%	167	37.1%	0.2542
Sinus Tachycardia	40	8.9%	48	10.6%	0.3682
Sinus Bradycardia	29	6.4%	14	3.1%	0.0192

Table 4 presents the electrocardiographic (ECG) findings in the study population. No significant gender differences were observed in normal ECG findings (males 33.6%, females 37.1%, P = 0.2542) or sinus tachycardia (males 8.9%, females 10.6%, P = 0.3682). However,
sinus bradycardia was significantly more prevalent in males (6.4%) than females (3.1%) (P = 0.0192).

Table 5 shows the Lipid Profile of the study population

Cholesterol type	Male (mean ± SD)	Female (mean± SD)	P value
TC mg/dl	140 ± 20.0	155 ±25.0	0.01
LDL mg/dl	65 ±25.1	69 ±26.5	0.12

TG mg/dl	133 ±23.0	137 ±22.5	0.82

Table 5 summarizes the lipid profiles of the study population. Females had significantly higher total cholesterol levels (155 ± 25.0 mg/dl) compared to males (140 ± 20.0 mg/dl) (P = 0.01). However, no significant gender differences were observed in LDL cholesterol levels (males: 65 ± 25.1 mg/dl, females: 69 ± 26.5 mg/dl, P = 0.12) or triglycerides (males: 133 ± 23.0 mg/dl,
females: 137 ± 22.5 mg/dl, P = 0.82).

Table 6 shows measurement of echocardiographic parameters based on gender

Parameters	Male	Female	P Value
LVIDd mm	49.9±4.7	44.9±3.7	<0.0001
LVIDs mm	25.0±4.0	23.0±3.1	<0.0001
LVEDV ml	80.7±19.9	85.7±17.9	0.00005
LVESV ml	28.0±7.1	32.0±6.0	<0.0001
IVS cm	0.84±0.4	0.74±0.1	<0.0001
PWT cm	0.75±0.1	0.85±0.3	<0.0001
LV mass g	129.5±34.2	134.5±33.2	0.0264
LVEF%	63.4±4.7	68.4±5.7	<0.0001
GLS -	19.7±1.8	24.2±2.8	<0.0001
LVOT mm	18.7±2.4	22.7±3.4	<0.0001
SV ml	57.7±16.9	53.7±15.9	0.0062
A-Aorta mm	27.9±2.8	23.9±3.7	<0.0001
RVL mm	69.5±6.4	65.5±5.2	<0.0001
RVOT mm	28.4±3.2	24.4±2.4	<0.0001
TAPSE mm	20.7±1.7	24.7±2.7	<0.0001
LA mm	36.1±4.4	32.1±3.4	<0.0001
LA vol ml	38.9±4.5	34.9±3.1	<0.0001
E-cm/s	79.0±10.6	75.0±9.8	<0.0001
A-cm/s	61.5±5.9	57.2±4.8	<0.0001
E/A	1.7±0.8	1.3±0.2	<0.0001
RA mm	37.1±4.9	34.1±3.7	<0.0001
RA vol mm	39.1±5.3	35.1±4.1	<0.0001
IVC size mm	16.6±2.9	12.9±1.9	0.0001

Table 6 shows significant gender differences in echocardiographic parameters. Males had larger dimensions for LVIDd, LVIDs, LVEDV, LVESV, IVS, LV mass, RVL, RVOT, and RA-related measurements (P < 0.0001 for most). Conversely, females had higher LVEF, GLS, PWT, and TAPSE values (P < 0.0001). Females also exhibited smaller aortic and IVC dimensions and lower E/A ratios compared to males. These results highlight distinct cardiac structural and functional variations between genders.

DISSUSSION

The study revealed significant gender-based differences in demographics, clinical characteristics, and cardiac parameters, emphasizing the importance of considering gender- specific variations in cardiovascular risk assessment and management.

In terms of age distribution, younger females (18–40 years) formed a higher proportion of the population compared to males, while males dominated in the 41–60 age group. This may reflect differences in disease onset, lifestyle factors, or healthcare-seeking behaviour among genders which was in line with other studies. (**Rashid *et al* 2023).**

Occupational differences were evident, with males being significantly more likely to be employed, while females predominantly worked from home. Such disparities may influence physical activity levels, stress, and overall cardiovascular health as also seen by previous studies. **(Gaffar *et al* 2021)**

Marital status analysis showed a higher proportion of married females and unmarried males, potentially indicating gender differences in societal roles or family responsibilities, which may indirectly affect health outcomes also seen previously **(Wong *et al* 2018)**.

Electrocardiographic findings demonstrated no significant gender differences in most parameters, except for sinus bradycardia, which was more prevalent in males. This suggests the need for further exploration of gender-specific electrophysiological variations also seen previously **(Rashid *et al* 2023).**

The lipid profile analysis showed that females had significantly higher total cholesterol levels, while no differences were observed in LDL or triglycerides. This finding highlights the need for gender-focused lipid management strategies, particularly for women these finding was in line with other studies. **(Kou *et al* 2014)**

Echocardiographic parameters revealed notable structural and functional differences. Males exhibited larger cardiac dimensions, including LVIDd, LVIDs, LV mass, and atrial sizes, potentially reflecting gender differences in cardiac remodeling or body size. Conversely, females demonstrated higher LVEF, GLS, PWT, and TAPSE, indicating better systolic function and myocardial strain. same results were seen by (**Mukherji *et al* 2012, Rashid *et al* 2023 and Poh, *et al* 2008).** These findings underscore the importance of using gender-specific reference values for echocardiographic assessments.

Overall, the study highlights significant gender-specific variations across various parameters, which have implications for tailored diagnostic, preventive, and therapeutic approaches. Further research is warranted to explore the underlying mechanisms driving these differences and to develop gender-sensitive cardiovascular management strategies.

CONCLUSION

This study highlights significant gender-specific differences in cardiovascular parameters, including demographics, lipid profiles, and echocardiographic measures. Males showed larger cardiac dimensions, while females demonstrated better systolic function. Gender-adapted diagnostic thresholds and personalized management strategies are essential for improving cardiovascular outcomes.

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