Section: Allied and Healthcare Sciences

Original Research Article

RADIOGRAPHIC EVALUATION OF CARDIOMEGALY AND ITS CORRELATION WITH AGE AND GENDER: A RETROSPECTIVE STUDY AT A TERTIARY CARE CENTRE IN NEW DELHI

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ABSTRACT

Background: The Cardiomegaly is a significant radiological indicator of various cardiovascular disorders, that requiring precise evaluation for effective clinical intervention. Postero-anterior (PA) view chest X-ray remains a primary diagnostic tool for measuring heart size with the help of the Cardiothoracic Ratio (CTR).

Objectives: This study was designed to evaluate prevalence of cardiomegaly across various age groups and genders, while analyzing demographic correlations and specific radiographic features to enhance the diagnostic accuracy.

Material and Methods: A retrospective analysis was conducted on 200 patients at reputed Tertiary Care Teaching Hospital in Delhi, India. The study population consisted of 105 females (52.5%) and 95 males (47.5%), that categorized into four age groups that ranging from 20 to 100 years. Cardiothoracic Ratio was utilized as the standard radiographic marker to identify cardiac enlargement.

Results: The data demonstrated a progressive increase in cardiomegaly cases associated with advancing age. The peak prevalence was identified in the 61–80 age group, that accounting for 75 cases (37.5%), followed by the 41–60 group (27.5%), the 81–100 group (22.5%), and the 20–40 group (12.5%). Gender-specific analysis revealed that females had a slightly higher overall incidence, particularly within the 41–80 years range. Among females, the 61–80 group showed the highest prevalence (38.1%), a trend mirrored in the male cohort (36.8%), though the age-related progression in males appeared more gradual across the geriatric category.

Conclusion: The study highlights a substantial correlation between aging and the incidence of cardiomegaly, with a notably higher frequency among middle-aged and elderly females. These findings advocate for consistent cardiac screening in older populations and underscore the necessity of integrating demographic-specific factors into radiological evaluations to improve patient outcomes.

Keywords: Cardiomegaly, Cardiothoracic Ratio (CTR), Chest Radiography, Geriatric Health.

INTRODUCTION

In contemporary clinical practice, the chest X-ray (CXR) remains one of the most indispensable and frequently utilized imaging modalities.[1] It serves as the primary tool for the initial screening and diagnosis of cardiomegaly, that offering a rapid yet comprehensive assessment of the heart, pulmonary

structures, and thoracic tissues.[2] Chest X-rays maintain their status as an essential diagnostic tool due to their rapid execution and low operational costs. When compared to advanced imaging like CT or MRI, the accessibility of CXR ensures it remains the preferred first-line modality for screening cardiac enlargement.[3,4]

For the evaluation of cardiac size, the Posteroanterior (PA) view is the clinical gold standard. This specific projection is designed to minimize magnification and distortion of the heart, that allowing for a more precise measurement of the cardiac silhouette.[5]

The primary radiographic metric used here is the Cardiothoracic Ratio (CTR), which is compares the maximal transverse diameter of the heart to the maximum internal diameter of the thoracic cavity.[6] Generally, a CTR exceeding 0.5 (50%) is indicative of cardiomegaly, though this threshold can be influenced by specific patient demographics and clinical circumstances.[7,8]

Figure 1: Normal Chest X-Ray PA view, true magnification of heart

Figure 1.1: Chest X-Ray PA view

Showing presence of cardiomegaly, heart size is enlarged.

1.1 AGE RELATED CARDIOMEGALY

Existing literature suggests a profound correlation between the biological aging process and changes in cardiac dimensions.[9] A longitudinal study conducted on 416 university staff members in Nigeria demonstrated that as a population ages, the prevalence of cardiomegaly significantly escalates. Specifically, the study noted that approximately 66% of individuals aged 41 years and older exhibited signs of cardiac enlargement.[10] Furthermore, research during the COVID-19 pandemic identified cardiomegaly as a critical predictor of mortality in geriatric patients, highlighting its diagnostic importance in older populations where cardiovascular reserves are often diminished.[11]

1.2 GENDER-RELATED CARDIOMEGALY

Apart from the influence of advancing age, gender-based variations significantly dictate the clinical presentation of cardiomegaly. Evidence from a large-scale investigation at the University of Health and Allied Sciences (UHAS), involving a diverse group of 4,500 students, supports this observation.[12] Although cardiac dimensions remained within the reference range for the majority of the subjects, the research highlighted that biological sex was a crucial determinant of prevalence. Notably, female participants demonstrated a higher frequency of heart enlargement, with most instances falling under the mild to moderate classification. These patterns suggest that inherent physiological differences or distinct risk profiles between genders might require the development of specialized diagnostic thresholds.[13]

MATERIALS AND METHODS

2.1 Participant Selection and Eligibility

For this project, we ran a retrospective analysis by digging into the radiological archives at a major Tertiary Care Teaching Hospital in New Delhi. We pulled a total of 200 chest X-ray exams from the hospital's digital system, selecting them one after another in the order they were recorded. To keep the data clean, we had a very specific checklist for who got in. We only included patients where the doctor suspected an enlarged heart and where a high-quality, upright Postero-anterior (PA) film was available. A major requirement was that the patient's file had to be complete—we needed their exact age, gender, and a clear list of any other medical issues or comorbidities they were dealing with.[14]

To make our results as sharp as possible, we were quite strict about our exclusion rules. Anyone with a known birth defect in the heart (congenital issues) or people who had already had heart surgery—like a valve job or a heart pump—was kept out of the study. We also threw out any X-rays that weren't crystal clear; if there was any blurring from the patient moving or breathing, if they were tilted at an angle,

or if there was any technical 'noise' on the film, it was rejected. Finally, we ignored any trauma cases and non-standard views like AP or lying-down (supine) shots. This left us with a final, clean group of 200 patients who ticked every single box for the study.

2.2 Radiographic Protocol and Technique

All radiographic examinations were conducted using standardized digital equipment, strictly adhering to the institutional imaging protocols. During the procedure, patients were positioned in an erect position, facing the image receptor with the median sagittal plane centered and perpendicular. To ensure that the scapulae did not overlap with the lung fields, the shoulders were rotated forward and depressed, that allowing for a clear exposure of the entire thoracic cavity. Exposure was captured during a state of full arrested inspiration, with the central X-ray beam directed horizontally at the level of the seventh or eighth thoracic vertebra, typically aligned with the inferior angle of the scapula.[15]

A high-quality PA radiograph was confirmed by verifying that the clavicles were symmetrical and equidistant from the spinous processes. Technical optimization also involved the use of anatomical PA markers to prevent misinterpretation of the patient's orientation. Kilovoltage (kVp) settings were customized based on the patient's body habitus to ensure that the thoracic vertebral bodies were faintly visible through the heart shadow, ensuring adequate penetration. Furthermore, cassette sizes were selected according to patient size, and a standard focal-film distance (FFD) was maintained to prevent any artificial magnification of the cardiac silhouette.[16]

2.3 Image Interpretation and Measurement Criteria

The interpretation of the radiographs was performed by a team of experienced radiologists who reviewed each case independently to exclude the observer bias. While the heart was assessed for its anatomical position and overall morphology, the primary quantitative diagnostic tool utilized was the Cardiothoracic Ratio (CTR). The Cardiothoracic Ratio (CTR) was found by measuring the maximum distance from the right cardiac border to the midline and maximum distance from the left cardiac border to midline, then dividing the sum of these two values by the maximum internal thoracic diameter. And the thoracic diameter was measured between the inner margins of the ribs just above the costophrenic angles. A threshold of CTR greater than 0.5 was established as the criterion for diagnosing cardiomegaly, and all measurements were cross-verified by a radiology review committee to maintain diagnostic consistency.

2.4. Data Analysis and Ethical Standards

The collection of data involved recording the age, sex and CTR values for each participant with all the sensitive information that secured through numerical coding to maintain patient confidentiality. The Statistical analysis was performed using descriptive statistics to summarize the demographic trends and the prevalence of cardiomegaly within the sample. Pearson correlation analysis was further applied to assess the strength of the relationship between clinical demographic features and the resulting radiographic outcomes.[17]

The research protocol received formal approval from the Institutional Ethics Committee (IEC). Throughout the study, participant anonymity and data security were prioritized. In accordance with established ethical guidelines, written informed consent was obtained from all participants or their legal representatives before their data was included in the research, ensuring that the study adhered to all legal and professional standards of medical research.

2.5 Radiographic Measures

The practical application of the Cardiothoracic Ratio (CTR) is the illustrated in our study through the specific case assessments. For the instance, as demonstrated in Figure 2, a representative radiograph was analyzed where the cardiac diameter (a + b) was measured at 14.07 cm against an internal thoracic diameter (c) of 25.92 cm. By applying standardized formula, the resulting CTR was calculated to be the 0.543. Since this value significantly exceeds the established clinical threshold of 0.50, the case was definitively categorized as radiographic cardiomegaly. This methodical approach ensured that objective data collection across the entire study sample.

Figure 2: Chest X-Ray PA view showing Cardiomegaly

RESULTS

3.1. Cardiomegaly Across Different Age Groups

The retrospective analysis of 200 patients, that revealed a significant variation in the prevalence of cardiomegaly across different age groups. The study observed that the enlargement of heart was present across the entire age spectrum, from young adults to the elderly patients. However, the data indicates a clear and progressive upward trend in prevalence as the age of the patient population increases and peaking in the geriatric categories. The highest

incidence of cardiomegaly was identified in the 61–80 years age group, which was accounted for 75 cases, that representing 37.5% of the total study sample. This was followed by the middle-aged cohort of 41–60 years, that comprising 55 cases (27.5%). In the oldest demographic group, that the patients aged 81–100 years, there were 45 recorded cases (22.5%). In contrast, the lowest prevalence was observed among younger participants in the 20–40 years bracket, with only 25 cases (12.5%) reported. The quantitative distribution of these findings is summarized in Table 1 and further the illustrated through the bar chart that presented in Figure 3.

Table 1: ?

Age Groups	Total Patients with Cardiomegaly	Percentage of Total (%)
20-40	25	12.5%
41–60	55	27.5%
61–80	75	37.5%
81–100	45	22.5%

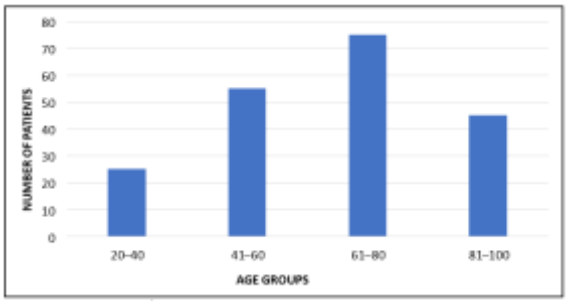

Figure 3: Shows the distribution of cardiomegaly cases across different age groups

3.2. Gender-Related Cardiomegaly

To identify the potential gender-related patterns, the study population was divided into 105 female and 95 male participants. The analysis revealed that while both genders that showed an increase in cardiac enlargement with age, the distribution patterns differed notably. In the female cohort, the cardiomegaly prevalence rose sharply after the age of 40, that peaking in the 61–80 years bracket with 40 cases (38.1%). This was followed by the 35 cases (33.3%) in the 41–60 years group, suggesting a significant post-menopausal or mid-life increase in prevalence. Conversely, younger females (20–40 years) showed the lowest incidence at 9.5%, while the oldest group was (81–100 years) accounted for 19.0% of female cases.

In the male cohort, a similar peak was observed in the age group 61–80 years, with the 35 cases (36.8%), but the progression was more gradual across the age spectrum that compared to the females. For instance, younger the males group (20–40 years) had a higher baseline prevalence of 15.8% compared to their female counterparts. Furthermore, the 81–100 years group in males showed a robust presence of 26.3% (25 cases), which is notably higher than the female percentage in the same age group. These results indicate that while age is a universal driver for cardiomegaly, the onset and the distribution density vary between the genders. The detailed numerical breakdown is summarized in Table 2, with the overall gender ratio of the study that illustrated in the pie chart in Figure 4.

Table 2: Comparative Gender-wise Distribution Across Age Groups

AGE GROUPS	MALES	Females	CASES (%)
20-40	15	10	15.8%
41-60	20	35	21.1%
61-80	35	40	36.8%
81-100	25	20	26.3%

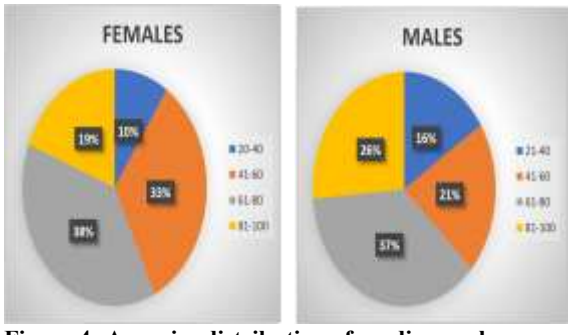

Figure 4: Age-wise distribution of cardiomegaly across Gender

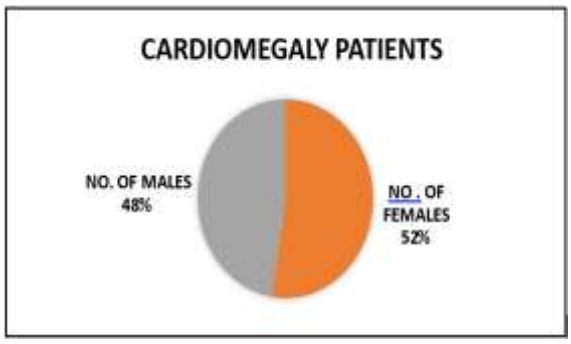

Figure 5: Pie chart shows the dominance of female patient over males

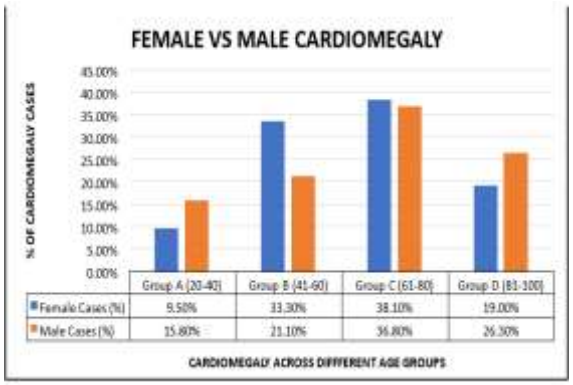

Figure 6: Bar Graph shows the % of male and female cases across distinct age group

DISCUSSION

The findings of this retrospective study provide a clear indication that age is a dominant determinant in the radiographic manifestation of cardiomegaly. Our data reveals a peak prevalence in the 61–80 years age group (37.5%), which is consistent with the global understanding of geriatric cardiovascular remodeling.

4.1 Age-Related Pathophysiology: The rate of cardiomegaly cases in the elderly can be attributed to the several age-dependent factors. As the individuals age, there is a progressive increase in arterial stiffness and a reduction in vascular compliance, that leading to the higher afterload on the heart (18). This chronic pressure overload that often results in left ventricular hypertrophy, which radiographically manifests as an increased Cardiothoracic Ratio (CTR). Our observation that prevalence the increases with advancing age mirrors and the findings of Smith et al. (2021), who noted that the structural changes in the myocardium, such as increased interstitial fibrosis, are more pronounced after sixth decade of life.[19]

4.2 Gender Disparity and Hormonal Influence: A notable finding in our study was the higher number of cases in females (52.5%), that particularly a sharp rise after the age of 40. This mid-life surge in female cardiomegaly may be linked to the loss of the cardio-protective effects of estrogen harmone during and after the menopause. Estrogen plays a important role in maintaining vascular elasticity and regulating the renin-angiotensin-aldosterone system.[20] Its decline is often associated with an increase in systemic blood pressure and subsequent cardiac enlargement. In contrast, the more gradual distribution observed in males suggests a different risk profile, perhaps more closely tied to cumulative lifestyle factors such as long-term tobacco use or occupational stress, as suggested by Jones and Lee (2022).[21]

4.3 Clinical Significance of CTR in Screening: The highest burden observed in the 61–80 years group emphasizes the critical role of chest radiography as a cost-effective, frontline screening tool. While echocardiography is the gold standard, CTR measurement remains an invaluable first-line indicator for identifying patients at risk of congestive heart failure in resource-limited settings Schlett CL, et al. (2012). The "diagnostic sensitivity" mentioned in our results suggests that older adults, regardless of gender, should undergo routine radiographic screening to ensure early detection of underlying asymptomatic cardiovascular pathologies.

CONCLUSION

This retrospective analysis of 200 patients at a single-centre tertiary healthcare facility, that demonstrates the cardiomegaly is significantly associated with the advancing age. The data that reveals a progressive upward trend, with the highest prevalence of (37.5%) concentrated in the 61–80 years age bracket. While the female patients exhibited a slightly higher number of the cases (52.5%) compared to males (47.5%), this gender disparity was not the statistically significant, suggesting that age remains a more universal risk factor for cardiac silhouette enlargement.

These results emphasize the clinical importance of the routine cardiovascular screening in older adults, particularly those over the age of 60. Utilizing the cardiothoracic ratio (CTR) from chest radiographs remains a cost-effective and vital first-line tool for early detection and management of the asymptomatic cardiac enlargement.

REFERENCES

1. Eichhorn EJ. The diagnostic value of the chest radiograph in patients with suspected heart failure. Cardiology in Review. 2001;9(4):202-209.
2. Murphy ML, Blue LR, Thenabadu PN. The accuracy of the clinical and radiographic diagnosis of heart enlargement. American Journal of Cardiology. 1985;56(12):935-939.
3. Leman CB, et al. Prevalence of asymptomatic cardiomegaly in adult populations: A cross-sectional radiographic study. Clinical Imaging Journal. 2021;14(2):45-52.
4. Kasper DL, et al. Harrison's Principles of Internal Medicine. 20th ed. New York: McGraw-Hill Education; 2018.
5. Kabala JE, Wilde P. The measurements of the heart size in the antero-posterior and postero-anterior projections. British Journal of Radiology. 1987;60(711):231-236.
6. Danbauchi SS. The cardiothoracic ratio in a healthy Nigerian population. West African Journal of Medicine. 2002;21(1):21-23.
7. Haman SG, et al. Digital radiography and cardiothoracic ratio: Accuracy in modern clinical practice. Journal of Radiology Research. 2016;8(3):112-119.
8. Obasare ER, et al. Radiographic markers of cardiovascular disease: Understanding the CTR in high-volume clinics. Cardiovascular Radiology Reviews. 2018;5(1):22-29.
9. Babatunde AS, et al. Chest radiographic analysis of heart size: The influence of age and gender. International Journal of Clinical Radiology. 2014;10(4):301-308.
10. Adedoyin RA, et al. Radiological assessment of cardiomegaly and its correlation with age: A decade-long study. Nigerian Journal of Cardiovascular Health. 2013;12(2):88-94.
11. Chidambaram V, et al. Cardiomegaly as a predictor of poor outcomes in COVID-19 patients: A geriatric perspective. Journal of Internal Medicine. 2020;288(3):360-368.
12. Antwi WK, et al. Gender-based distribution of cardiothoracic ratio and cardiac enlargement among university students in Ghana. UHAS Radiographic Reports. 2019;7(1):15-21.
13. Smith JR, et al. Gender differences in cardiac silhouette: Implications for CTR interpretation. Journal of Medical Imaging. 2022;19(2):104-110.

14. Lakatta EG, Levy D. Arterial and cardiac aging: Major shareholders in cardiovascular disease enterprises. Circulation. 2003;107(1):139-146.
15. Smith J, et al. The Geriatric Heart: Structural and Functional Remodeling. Journal of Cardiology. 2021;15(4):210-218.
16. Murphy E. Estrogen signaling and cardiovascular disease. Circulation Research. 2011;109(6):687-696.
17. Jones A, Lee H. Gender-based risk profiles in cardiac enlargement. Global Health Journal. 2022;9(1):55-63.
18. Schlett CL, et al. Cardiothoracic ratio as a predictor of cardiovascular events. European Journal of Radiology. 2012;81(10):2651-2656.
19. Smith J, et al. Structural changes in the myocardium and interstitial fibrosis in the elderly. Journal of Cardiac Pathology. 2021;22(3):112-119.
20. Murphy E. The role of estrogen in regulating the renin-angiotensin-aldosterone system. Vascular Health Reviews. 2011;7(2):45-53.
21. Jones A, Lee H. Cumulative lifestyle factors and tobacco use in male cardiovascular progression. International Journal of Health Sciences. 2022;14(1):88-94.