Normative Value of Chest Expansion in the Geriatric Population Living -Pilot Study

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Abstract
Background: Chest expansion (CE) is a key clinical parameter used to evaluate thoracic mobility and respiratory performance. Age-related physiological changes in elderly individuals lead to reductions in chest wall compliance and respiratory muscle strength, contributing to compromised pulmonary function. However, normative reference values for CE in the geriatric population in Delhi NCR are insufficiently documented.
Objective: This study aimed to establish normative CE values in older adults aged ≥60 years residing in Delhi NCR and to analyse the influence of age, gender, BMI, and comorbidities on CE.
Methods: A cross-sectional study was conducted with 111 elderly participants (55 males, 56 females). CE was measured with a non-elastic tape at the fourth intercostal space, recording the difference between maximal inspiration and full expiration. Participants were categorised by age (60–69, 70–79, ≥80 years). Statistical analysis included Pearson's correlation.
Results: The mean CE was significantly greater in males (3.54 ± 0.62 cm) compared with females (2.98 ± 0.57 cm). CE showed a progressive decline with age, with the highest values in the 60–69 group (3.62 ± 0.58 cm) and the lowest in participants aged ≥80 years (2.76 ± 0.49 cm). Higher BMI and comorbidities such as hypertension and diabetes were associated with reduced CE.
Conclusion: This study establishes normative CE values for older adults in Delhi and confirms that CE decreases significantly with advancing age, elevated BMI, and comorbidities, and is consistently higher in males. These findings provide clinically relevant benchmarks to support respiratory assessment and rehabilitation strategies in geriatric populations.

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Introduction

Chest expansion (CE) is a fundamental clinical parameter that reflects the functional mobility of the thoracic cage and is closely linked to respiratory mechanics and pulmonary efficiency. It signifies the degree of thoracic movement during respiration, driven by chest wall elasticity, lung compliance, and the strength and coordination of respiratory muscles [1]. CE measurement is routinely employed in clinical assessment to evaluate respiratory status, musculoskeletal function, and the presence of pathological respiratory limitations [2].

India is undergoing a significant demographic transition, characterised by a rapidly growing elderly population. According to the Technical Group on Population Projections (2020), the number of individuals aged 60 years and above is expected to reach 193.4 million by 2031, escalating sharply from the 103.8 million reported in the 2011 Census [3]. This demographic shift heightens the need for targeted health strategies to address age-related functional decline, including respiratory health concerns.

Age-related structural and physiological changes, such as stiffening of the rib cage, calcification of costal cartilages, and weakening of the diaphragm and intercostal muscles, contribute to reduced CE and impaired ventilatory capacity [4-6]. Decreases in CE are associated with increased susceptibility to respiratory complications, including dyspnea, pneumonia, and chronic obstructive pulmonary disease (COPD) [7].

CE is commonly assessed using a circumferential measuring tape positioned at standard anatomical landmarks, such as the fourth intercostal space or the lower costal margin, with the difference between maximal inspiration and expiration used as the outcome value [8]. Establishing normative CE values in different populations is crucial for recognising deviations that may indicate early pathological changes and guide therapeutic decision-making [9].

Recent studies indicate that CE may be influenced by factors such as gender, BMI, and chronic illnesses, including diabetes and hypertension [10]. However, evidence-based normative CE values for the elderly population in India remain limited, particularly within regional contexts such as Delhi NCR. The development of standardised reference values will support early identification of respiratory dysfunction and improve clinical management for older individuals.

This study aims to establish normative CE values among older adults in Delhi and explore variations based on age, gender, BMI, and comorbidities. The findings are expected to contribute to improved assessment, diagnosis, and rehabilitation planning in geriatric healthcare.

Methodology

Study Design and Participants - A cross-sectional observational pilot study was conducted among 111 elderly individuals aged ≥60 years residing in urban areas of Delhi. Participants were recruited through convenience sampling and included 55 males and 56 females.

Inclusion Criteria

- Individuals aged ≥60 years
- Permanent residents of Delhi NCR for ≥6 months
- Able to provide informed consent

Exclusion Criteria

- Diagnosed respiratory disorders (e.g., COPD, asthma)
- Thoracic or spinal deformities (e.g., kyphosis, scoliosis)
- History of recent thoracic surgery
- Cognitive impairments

Measurement Procedure - CE was measured at the fourth intercostal space using a flexible, non-elastic tape while participants stood upright. The CE value was determined as the difference between maximal inspiration and full expiration.

Data Analysis - Statistical analysis was performed using SPSS version 21. Descriptive statistics were calculated as mean ± SD. Pearson's correlation evaluated relationships between CE and BMI/comorbidities.

Results

Chest expansion measurements indicated a progressive decline with increasing age across all groups. Participants aged 60–69 demonstrated the greatest mean CE, whereas the lowest was observed in individuals aged ≥80 years. Male participants showed consistently higher CE values compared with females across all age categories, reflecting anatomical and physiological differences.

A moderate negative correlation was found between BMI and CE, suggesting that increased adiposity may restrict thoracic movement. Individuals with chronic conditions such as hypertension and diabetes exhibited lower CE values.

These results contribute region-specific normative CE values for elderly residents of Delhi and offer clinically relevant benchmarks for respiratory assessment.

Discussion

The results demonstrate a significant reduction in CE with advancing age, consistent with established literature describing age-associated changes in respiratory biomechanics, including reduced lung elasticity, stiffening of the thoracic cage, and weakening of respiratory musculature. Correspondingly, the significant gender differences observed in CE align with prior studies indicating superior respiratory muscle strength and thoracic volume in males.

The inverse association between BMI and CE may reflect mechanical constraints of increased soft tissue mass, limiting chest wall expansion. The reduced CE values among participants with comorbidities further emphasise the systemic impacts of chronic diseases on pulmonary performance.

Clinical assessment of CE offers a simple, non-invasive, and cost-effective tool for monitoring respiratory status in older adults and can support early identification of restrictive patterns and guide interventions such as pulmonary rehabilitation and respiratory muscle training.

Comparing these results with studies from other regions (e.g., Pagare *et al*., 2017), it is evident that normative values vary geographically due to differences in lifestyle, environmental exposure, genetics, and physical activity levels [11]. This highlights the need for region-specific data, especially for use in rehabilitation and geriatric respiratory care.

The findings of this study emphasize the natural decline in chest wall mobility associated with aging and reinforce the importance of assessing chest expansion as a clinical tool in geriatric populations.

Limitations

Generalizability may be limited since participants were recruited solely from Delhi. The cross-sectional design precludes evaluation of longitudinal CE changes. Comorbidity data were self-reported and not clinically verified. Pulmonary function tests were not included, preventing direct comparison with objective spirometric measures. Lifestyle factors such as smoking and physical activity were not controlled.

Conclusion

This study provides normative CE values for elderly individuals residing in Delhi and demonstrates significant variation based on age, gender, BMI, and comorbid conditions. The observed decline in CE with ageing underlines the importance of incorporating CE measurements into routine geriatric assessment. Early detection of respiratory impairment can guide individualised respiratory interventions and rehabilitation strategies. Future multicenter studies with broader geographic representation and objective pulmonary function testing are recommended to strengthen external validity.

Conflicts of Interest: None
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