

Correlation between the mobility of the above cage and the below thorax cage toward the elderly lung vital capacity



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ABSTRACT

Background: The elderly will experience changes and decreases in all their body systems; one of them is the respiratory system. The changes that occur are a decrease in respiratory muscle mass and tone, which will affect the reduction of thorax expansion. This can be observed in the elderly lung's vital capacity. This study aims to find out the correlation between the mobility of the thorax cage and the lung's vital capacity.

Methods: A cross-sectional study was conducted involving 20 elderlies consists of 10 males and 10 females. Measurements use the midline to measure the mobility of the thorax cage and a spirometer to measure the capacity of lungs vital. Data were analyzed using SPSS version 20 for Windows.

Results: The research data were normally distributed based on the results of the Shapiro Wilk test. The respondents have an average age of 68.40 ± 5.78 years old, followed by upper expansion of lung (86.25 ± 7.51 cm), lower expansion of lung (79.20 ± 7.24 cm), and lung vital capacity (1.18 ± 4.17 L). Based on the multiple correlation test, it was found that there was a strong positive significant correlation ($r=0.784$; $p=0.000$) between upper and lower thorax cage mobility on the elderly lung vital capacity.

Conclusion: There is a strong correlation between upper and lower thorax cage mobility on the elderly lung vital capacity.

Keywords: Correlation, Thorax Cage Mobility, Lung Vital Capacity, Elderly

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INTRODUCTION

Entering old age will be followed by changes and decreases in all body systems; one of them is the cardiopulmonary system.¹ Pulmonary changes in the elderly include decreased muscle mass and tone, leading to reduced lung expansion and decreased chest wall compliance due to osteoporosis and calcification of costal cartilage.¹ Several morphological changes reduce the respiratory efficiency of the chest wall and diaphragm in the elderly. The cross-sectional area of the intercostal muscles begins to decrease after 50 years old and this reduction is more significant in the expiratory muscles.² Maximum static inspiratory and expiratory pressure decreases with aging, reflecting a decrease in respiratory muscle strength.³

A decrease in the respiratory system's

ability and the strength of the respiratory muscles will affect the ability of the thoracic cage to expand and contract during breathing, which is called thoracic expansion.³ The expansion of both the upper and lower thoracic will experience a decline when a person begins to enter the elderly.^{2,4} The measurement of thoracic expansion can be used as a measure to determine the function of respiration. Thorax expansion measurement was done quantitatively by using the midline. Measurements were made at the peak of inspiration and maximum expiration.^{5,6}

Increasing the expansion of the thorax cage will affect respiratory control, coughing ability, and lung vital capacity.⁷ The vital lung capacity is the maximum volume of air released by the lungs after maximum inspiration.⁸

measurement of vital lung capacity can give important information about the strength of respiratory muscles.^{9,10} Based on those mentioned above, this study aims to evaluate a correlation between the mobility of the thorax cage and the vital capacity of the lungs in the elderly.

METHODS

This cross-sectional study was conducted from 5 up to 6 June 2020 in Sulangai Village, Badung Regency, Bali, Indonesia. The sample of this study was the elderly who were taken from the population in the village by using the purposive sampling technique. The sample criteria are male and female, amounting to 20 people with an age range of 60-75 years, and the sample does not have a history of comorbidities, especially on cardiorespiratory. Data

collection techniques are tests and measurements with the midline instrument to measure the expansion of the upper and lower thorax in units of centimeters (cm), the Spirometer brand of Riester to measure the lung's vital capacity in a liter (L). The measurement of the upper thoracic expansion was carried out in a circle with a point in the third intercostal space on the midclavicular line, while the lower thoracic expansion was at the xiphoid process. Both measurements are taken at the peak of inspiration and maximum expiration. The respondents were asked for maximum inspiration, then maximum expiration and the value that can be achieved on the spirometer will be seen. The data analysis includes a

univariate (age, gender, chest expansion, and lung vital capacity) and multiple correlation test with a significance value of $p < 0.05$. Data were analyzed using SPSS version 20 for windows.

RESULTS

Based on the results of descriptive analysis, the average age was 68.4 ± 5.78 years, that each male and female were 10 people. In the upper thorax expansion data, the mean was 86.25 ± 7.51 cm, while the lower thorax expansion data obtained a mean of 79.20 ± 7.24 cm. In addition, it was also found that the male thorax expansion tended to be greater than the female (Figure 1). The mean vital lung capacity in

the sample was 1.18 ± 4.17 L (Table 1).

Based on the results of multiple correlation analyses of the upper and lower thorax expansion with vital lung capacity in the elderly, the correlation coefficient was 0.784, followed by the r-square value (0.614) and the p-value (0.000) (Table 2).

The R-value is 0.784 shows the strong correlations between upper and lower thorax expansion with the vital lung capacity in the elderly. The simultaneous contribution of upper and lower thorax expansion toward the vital lung capacity was 61.4%, according to the r-square value (Table 2). The p-value of 0.000 ($p < 0.05$) shows a significant correlation between upper and lower thorax expansion with vital lung capacity in the elderly (Table 2).

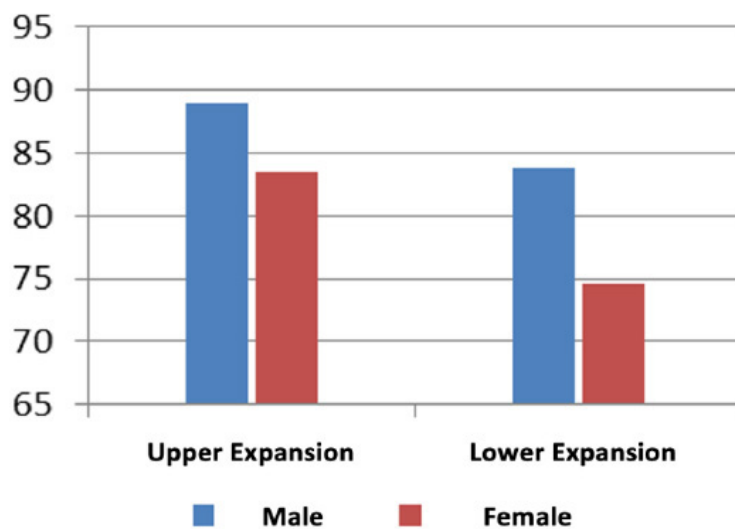


Figure 1. The comparison of male and female thorax expansion

Table 1. Baseline characteristic of respondents

Characteristic	Mean±SD	N (%)
Age (Years)	68.4±5.78	
Gender		
Male		10 (50.00)
Female		10 (50.00)
Upper Expansion (cm)	86.25±7.51	
Lower Expansion (cm)	79.20±7.24	
Lung Vital Capacity (L)	1.18±4.17	

SD: Standard Deviation

Table 2. The multiple correlation test between upper and lower thorax expansion with lung vital capacity

R	R-Square	p
0.784	0.614	0.000

DISCUSSION

The research data shows that the overall average expansion of the upper and lower thorax in the sample of male elderly is higher than female elderly. This is because a previous study conducted by Adedoyin RA et al., stated that men's chest expansion was significantly higher than women's chest expansion.¹¹ This is likely due to differences in the structure of respiration anatomy between men and women.^{12,13} Based on the research data results, it shows that the entire sample has less value on the lung vital capacity. This value continues to decline in line with age and occurs in both male and female samples. The research was conducted by Abdullah S et al., found that lung function changes in line with age addition.¹⁴ A significant decrease in lung function occurs at the age of more than 60 years old.¹⁵ This is due to changes in the airway, possibly followed by weakness in the respiratory muscles.^{14,15}

Research by Lee J et al., shows that lung capacity will decrease with age addition. This is due to changes in the structure of the thorax and weakness of the respiratory muscles.⁴ These changes will cause a decrease in the expansion of the thorax.⁴ According to Park JJ et al., increasing the thorax cage's mobility will affect respiratory control, coughing ability, and lung vital capacity.⁷

This study shows a strong positive significant correlation between the mobility of the thorax cage (upper and lower thorax expansion) and the vital lung

capacity in the elderly. The similar result was also found by a study of Amatya M and Pun DB where the measurement of lung function with a spirometer statistically has a strong correlation to thorax expansion.¹⁶ While the results of Putri IDAJ et al., showed that normal chest development increased thorax expansion, affecting muscle tone.¹⁷ Inspiration and expiration can increase the amount of air in and out of the lungs, so that able to increase the volume and vital capacity of the lung.¹⁷

The research was conducted by Reddy RS et al., showed that measurements of upper and lower thorax expansion have inter-rater and inter-rater reliability and reproducibility in healthy subjects, smokers, and COPD.⁵ Upper and lower thorax expansion correlate with pulmonary function parameters as measured by a spirometer.⁵ The same thing also supported by the research was conducted by Wahyudi TA et al., regarding breathing exercises in divers who state that the results after training can lead to an increase in VO₂ max value, an increase in vital lung capacity, and an increase in thorax expansion.¹⁸ The highest VO₂ max has the best thorax capacity expansion and VO₂ max itself has a close correlation with the lung vital capacity, so indirectly, thorax expansion has an increasing or decreasing effect on the lung vital capacity.¹⁹

Previous studies were also provided similar results where there was a correlation between the vital lung capacity with the mobility of the thorax.^{4,20} If the thorax expansion decreases, the vital lung capacity will also reduce, and so will the contrary.¹⁸⁻²⁰ This is also closely related to the statement that the vital lung capacity is the maximum air total that can be exhaled strongly after maximum inspiration.⁴

CONCLUSION

This study shows a strong positive significant correlation between the mobility of the upper and lower thorax cages with the vital lung capacity in the elderly. In the implementation of this research, the subject was still limited. In future research, it will be necessary to increase research subjects and cover a wider area.

CONFLICT OF INTEREST

There was no conflict of interest in the preparation of this article.

FUNDING

There is no funding from any agency.

ETHICS CONSIDERATION

This study was approved by the ethics committee of Universitas Dhyana Pura. All respondents were accepted as research samples by signing informed consent and following COPE guidelines for publication ethics.

AUTHOR CONTRIBUTION

All authors contributed equally to the completion of this article from the conceptual framework, data acquisition, data analysis until reporting the study results through publication.

REFERENCES

- Roman MA, Rossiter HB, Casaburi R. Exercise, ageing and the lung. *Eur Respir J*. 2016;48(5):1471-1486.
- Kim J, Heise RL, Reynolds AM, Pidaparti RM. Aging effects on airflow dynamics and lung function in human bronchioles. *PLoS One*. 2017;12(8):e0183654.
- Chaunhaiyakul R, Groeller H, Clarke JR, Taylor NA. The impact of aging and habitual physical activity on static respiratory work at rest and during exercise. *Am J Physiol Lung Cell Mol Physiol*. 2004;287(6):L1098-L1106.
- Lee J, Kang T, Yeo Y, Han D. The change of lung capacity in elderly women caused by life span. *J Phys Ther Sci*. 2017;29(4):658-661.
- Reddy RS, Alahmari KA, Silvian PS, Ahmad IA, Kakarparthi VN, Rengaramanujam K. Reliability of Chest Wall Mobility and Its Correlation with Lung Functions in Healthy Nonsmokers, Healthy Smokers, and Patients with COPD. *Can Respir J*. 2019;2019:5175949.
- Lutfi MF. The physiological basis and clinical significance of lung volume measurements. *Multidiscip Respir Med*. 2017;12:3.
- Park JJ, Chon SC. Effect of posterior-anterior mobilization of the thoracic spine on pain, respiratory function, and thoracic circumference in patients with chronic low back pain. *J Phys Ther Korea*. 2018;2(4):37-45.
- Pun DB, Shresta P, Choudhury PR, Amatya M. Correlation Between Vital Capacity and Maximum Chest Expansion among Nepalese Young Adults. *Journal of Kantipur Dental College*. 2020;1(1):20-24.
- Godfrey MS, Jankowich MD. The Vital Capacity Is Vital: Epidemiology and Clinical Significance

- of the Restrictive Spirometry Pattern. *Chest*. 2016;149(1):238-251.
- Padkao T, Boonla O. Relationships between respiratory muscle strength, chest wall expansion, and functional capacity in healthy nonsmokers. *J Exerc Rehabil*. 2020;16(2):189-196.
 - Adedoyin RA, Adeleke OE, Fehintola AO, Erhabor GE, Bisiriyu LA. Reference Values for Chest Expansion among Adult Residents in Ile-Ife. *Journal of Yoga & Physical Therapy*. 2012;2(3):2-5.
 - LoMauro A, Aliverti A. Sex differences in respiratory function. *Breathe (Sheff)*. 2018;14(2):131-140.
 - Ekström M, Sundh J, Schiöler L, Lindberg E, Rosengren A, Bergström G, et al. Absolute lung size and the sex difference in breathlessness in the general population. *PLoS One*. 2018;13(1):e0190876.
 - Abdullah S, Taha JH, Ahmed MH, Abdullah KS. The Influence of Age on Pulmonary Function, A Cross Sectional Study on a Sample of Healthy Iraqi Males and Females Population. *Journal of Physics*. 2019;1178(1):012027.
 - Gao C, Zhang X, Wang D, Wang Z, Li J, Li Z. Reference values for lung function screening in 10- to 81-year-old, healthy, never-smoking residents of Southeast China. *Medicine (Baltimore)*. 2018;97(34):e11904.
 - Amatya M, Pun DB. Correlating Spirometric Parameters with Breath-Holding Time and Maximum Chest Expansion in Healthy Young Adults. *Nepal Med Coll J*. 2019;21(3):230-234.
 - Putri IDAJ, Wibawa A, Primayanti IDAID, Wiryanthini IAD. Deep Breathing Exercise Lebih Efektif daripada Diaphragmatic Breathing Exercise dalam Meningkatkan Kapasitas Vital Paru Lansia di Banjar Kedaton, Desa Tonja, Denpasar Timur. *Majalah Ilmiah Fisioterapi Indonesia*. 2017;5(1):13-15.
 - Wahyudi TA, Indah P, Darmaja IGAP. Latihan Nafas dalam Meningkatkan Daya Tahan Menyelam Dive Master di Pantai Semawang, Sanur, Denpasar [Prosiding SINTESA]. *LP2M-Undhira Bali*. 2018:1-8
 - Turquetto ALR, Canêo LF, Agostinho DR, Oliveira PA, Lopes MICS, Trevizan PF, et al. Impaired Pulmonary Function is an Additional Potential Mechanism for the Reduction of Functional Capacity in Clinically Stable Fontan Patients. *Pediatr Cardiol*. 2017;38(5):981-990.
 - Malaguti C, Rondelli RR, de Souza LM, Domingues M, Dal Corso S. Reliability of chest wall mobility and its correlation with pulmonary function in patients with chronic obstructive pulmonary disease. *Respir Care*. 2009;54(12):1703-11.



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