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Research

Do Demographic Factors Influence the Forced Vital Capacity Value of Lung Function in Covid-19 Survivors?

Harizza Pertiwi[1], Shenda Maulina Wulandari[2], Apriana Rahmawati[3], Ulfa Nur Rohmah[4]

[1,2,3]*Universitas Binawan, Jakarta, Indonesia*

[4]*Nursing Program, Institute of Health Science Husada Hospital Jakarta*

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CORRESPONDING AUTHOR

Harizza Pertiwi

E-mail: harizza@binawan.ac.id

Jl. Dewi Sartika No.25-30, Kalibata, Kec. Kramat jati, Kota Jakarta Timur, Daerah Khusus Ibukota Jakarta 13630

A B S T R A K

Background: Aging can cause increased work of breathing and decreased respiratory muscle strength. Furthermore, males and females have different measures of lung function. This alone can become a reason for decreased lung function, especially if there is a history of Covid-19 infection which can cause further damage to the lungs.
Purpose: This study investigates the correlation between age and sex differences in the Forced Vital Capacity value of Covid-19 survivors.
Method: Using a cross-sectional design with a survey and observational method, this study involved 46 participants that were selected purposively based on their history of being positively diagnosed Covid. Data was collected using a questionnaire and observational form to collect data from the spirometer, then analyzed with the Pearson test and Independent Sample T-test.
Result: The result shows that age (mean = 40,89) does have a significant correlation to FVC (mean = 2.3602), with p-value = 0,017 (< 0,05). On the contrary, sex difference does not have a significant correlation with FVC value, with p-value = 0,109 (>0,05).
Conclusion: This study reveals that aging can further affect the lung function of Covid-19 survivors, especially when comorbid factors are involved. Moreover, both males and females have the same risk of decreased lung function after being infected by the Covid-19 virus. However, other factors may influence the lung function of Covid-19 survivors. Further research needs to be conducted to scrutinize those other factors.

INTRODUCTION

Covid-19 has hit the whole world since 2019 until now, which has infected 6,737,606 people, with a recovery prevalence of 6,573,749 people in Indonesia as of 7 March 2023 [1]. In the respiratory system, Covid-19 virus can infect upper and lower respiratory tract until it reaches to alveoli [2]. This may affect the oxygen and carbon dioxide gas exchange which causes shortness of breath. In severe cases, pneumonia, acute respiratory distress syndrome, and sepsis may emerge which leads to mortality. After the disease is healed, there is a chance that lung injury caused by the infection still remains and may take months or years before it disappears [3].

Based on the data from National Disaster Relief Agency, it is discovered that the mortality rate caused by Covid-19 infection is mostly filled by people aged 30-59 years old [4]. Following the first age group, people aged 60-79 years old become the second highest. These age groups indicate that older people tend to have a higher risk of severity if exposed to the Covid-19 virus. Moreover, the Centers for Disease Control and Prevention also analyzed that people aged 30 to 39 years old have a 3.5

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times higher death rate if compared to 18 to 29 years old, and 350 times higher for people aged 85 years and older [5]. Other than age, sex can also influence the severity of Covid-19 infection. Females have lower odds of in-hospital mortality, mechanical ventilation, Intensive Care Unit (ICU) admission, and all-cause mortality [6]. Thus, males have a higher risk of worse outcomes and death [7]. These findings suggested that Covid-19 infection can cause different effects on males and females.

Data from the Indonesian Covid-19 Task Force shows around 92% of people infected with Covid can recover. Most people who have recovered from Covid-19 still feel sequelae or commonly called "Long Covid" [8]. Some of the sequelae felt by Covid survivors include anxiety (10.4-42%), depression (1.3-31%), PTSD (11-35%), fatigue (25.3-87%), cognitive deficits (2.6-23%), shortness of breath (2.6-71%), impaired mobility (18-30%), problems in fulfilling daily activities (2-36.8%), insomnia (23.2- 40%) and memory impairment (6.1-28.9%) [9]. One of the sequelae that is often found in Covid survivors is shortness of breath [9], which can occur due to Covid virus infection causing fibrosis in the lungs of Covid survivors [10]. This condition can have an impact on reducing a person's quality of life [11]. Both age and sex factors result in the various outcomes of Covid-19 infection. However, there has been no literature that studies the contribution of these factors to lung function after the infection subsided. The specific aim of this study is to identify the lung function of Covid survivors based on their age and sex. This study is feasible because there are more and more Covid survivors in Indonesia. Moreover, most of those with severe symptoms have comorbid diseases that can further reduce lung and respiratory function. Therefore, there is a need for scientific evidence regarding the contribution of age and sex to the lung function of Covid-19 survivors.

METHOD

This study is a cross-sectional-designed research that was conducted on October 2022. The population is all Covid survivors in Kecamatan Kramat Jati, East Jakarta. The sampling technique used in this study was non-probability sampling using convenience sampling where populations that met the criteria were included as respondents. The calculation of the number of target samples in the research is to use Sugiyono's theory that the number of samples for experimental research is 10 to 20 respondents (Sugiyono, 2017). To avoid dropping out, a 10% correction will be made so that the size of the sample and control groups is 22 respondents each.

The inclusion criteria in this study were Covid survivors in Kecamatan Kramat Jati, Jakarta who had complaints of shortness of breath/difficulty of breathing, and were willing to become respondents by signing a consent form to become respondents. While the exclusion criteria in this study were respondents who experienced a decrease in consciousness, and respondents who withdrew during the research. The instrument used was a questionnaire which consists of demographic data and an observational form which consists of the respondent number and FVC results. Demographic data include age and sex.

Questionnaires were distributed manually to Covid survivors who were checking their health in the community health center. After they fill them out, the researcher gave the FVC test by using a spirometer with an individual mouthpiece. Then, data was collected and analyzed using statistical tests. Since age is numerical data, normality was firstly tested with Kolmogorov-Smirnov with a result of p-value = 0.088 which is more than 0.05. This result implies that data is distributed normally ($p > 0.05$). Thus, the Pearson test was used to determine the correlation between age and FVC value, whereas the correlation between sex and FVC value was analyzed using independent t-test.

This study was ethically approved by the Health Research Ethics Committee, State Polytechnic of Health Malang, Indonesia (Reg No: 668/KEPK-POLKESMA/2022). Information regarding the objective of this study, the rights of participants, and the informed consent form are written on the first page of the questionnaire and explained before respondents fill out the questionnaire. Covid survivors have the right to decide whether they agree or disagree on becoming participants in this study.

RESULT DAN DISCUSSION

Results of this study are presented into two tables which show the correlation between age and sex with Forced Vital Capicity (FVC) value.

Table 1 Correlation Between Age and FVC value

Age (years)	FVC (L)	p value*
Mean	40.89	2.36	
Std. Deviation	6.69	0.65	
Minimum	27	0.97	0.017
Maximum	58	4.23	

* p value < 0.05

Table 2 Correlation Between Sex and FVC value

Sex	N (%)	FVC (L)		p value*
Male	16 (35)	Mean	2.36	
Female	30 (65)	Std. Deviation	0.65	
		Minimum	0.97	0.109
Total	46 (100)	Maximum	4.23	

* p value < 0.05

Based on the results of the data analysis above, it is known that the average age of the respondents is 41 years and the average FVC value is 2.36 liters. With a p-value of 0.017, it can be interpreted that there is a significant relationship between age and the FVC value. Then, it was also known that most of the respondents were female and there was no significant difference between male and female FVC values. Age is a biological identity that can be used as a benchmark in assessing a person's health status. As we get older, the physiological changes of a human also occur. The physiological condition of the human body from birth is always changing, since in the process of development, then reaching optimal conditions, to experiencing a decline in function. We often refer to this decline in bodily functions as aging.

Aging is something that definitely happens to a human being. All systems in the human body are affected by aging, including the respiratory system. Aging that occurs in the respiratory system includes changes in anatomy, physiology, and immunology [12]. In terms of anatomy, there are changes in the chest wall and spine, resulting in a decrease in overall lung function in storing air which leads to an increase in the effort to breathe. Respiratory muscle strength also decreases, thus affecting the ability to cough which can help clear the airways. From a physiological perspective, the number of damaged alveoli will increase with age, so the amount of oxygen absorbed will decrease. Then, the level of sensitivity to dyspnoea is also reduced which can cause the response to hypoxia to slow down. When viewed from objective lung function measurements, the values of Forced Expiratory Volume in 1 second (FEV1), FVC, and Peak Expiratory Flow Rate (PEFR) decrease with age even in the absence of disease in the respiratory system [13].

The function of the respiratory system, which decreases with aging, will experience a further decline in function if infected by the Covid-19 virus. The covid virus that enters the airways infects the tissues and causes an inflammatory reaction [2]. Furthermore, a critical condition can occur if the alveoli are infected causing mucus production or fluid collection which can block oxygen exchange into the blood. This is what can trigger death in a patient with Covid-19. Older people also tend to have comorbid factors that can exacerbate the condition of the respiratory system when infected with Covid-19. A study shows that diseases affecting the cardiovascular, respiratory, urinary, and nervous systems, as well as cancer and diabetes are contributors to the high mortality rate in the elderly population [14]. These disorders and diseases can suppress a person's immunity so it will

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be difficult to fight the infecting virus. As a result, lung function will be increasingly disrupted and the recovery process will be hampered.

From the explanation above, it can be concluded that physiologically, aging can have a negative effect on the condition of a person's respiratory system. When combined with the negative effects of Covid-19, the lung function of elderly survivors will be more disrupted than survivors who tend to be young. This is also one of the things that cause most of the deaths from Covid to occur in elderly people [15]. Thus, it can be said that the lung function of elderly Covid-19 survivors is impaired more than that of young sufferers. In contrast to age, which has a significant relationship with lung function, gender apparently has no effect on the lung function of a Covid-19 survivor. When compared to gender, the size of the organs in a person's respiratory system has more influence on lung function [16], [17]. Females have smaller airway diameter, lung volume, maximum expiratory flow, and diffusion surface area than males. Other studies have shown that females with body sizes that are almost the same as males have lung function that is similar to theirs [18]. However, when exercising, females have a higher risk of experiencing expiratory flow limitation, arterial hypoxemia, and increased metabolic energy to breathe [18].

Sex is not a determinant of the prevalence of Covid or decreased lung function caused by the virus. However, studies show that females are less likely to die from Covid, treated in Intensive Care Unit (ICU), and using mechanical ventilators [6]. This is reinforced by the results of research from Jin et al. [7] which states that males and females have the same prevalence regarding positive diagnoses of Covid-19 infection, even though males have a higher risk of death. There are various ways to measure lung function, one of which is spirometry. There are also several types of spirometry measurement results besides FVC, including FEV1, FEV1/FVC Ratio, Flow/Volume Graph, and Duration. In this study, the only indicator used to measure lung function is FVC, so there is still a possibility that the results will be different when measured with other indicators. Based on the explanation above, it can be concluded that women and men have the same risk of changes in lung function if infected with the Covid-19 virus. However, women have a lower death rate from Covid and a lower risk of complications from Covid when compared to men. Further research that can analyze why this can happen needs to be done in order to reduce the risk of complications and mortality from infectious diseases that attack the respiratory system in the future.

CONCLUSION

The respondents who participated in this study had an average age of 41 years, and the statistical analysis shows that age has a significant relationship with the lung function of Covid-19 survivors. On the contrary, this research also indicates that sex difference does not associate with FVC value, thus males and females of Covid-19 survivors have similar lung functions. These results show that physiological changes caused by aging can worsen the negative effect of virus infection both in males and females. Therefore, promotive and preventive efforts to minimize the effect of viral infection could become the best option to reduce unwanted negative after-effects. The result of this study provides an overview of the contribution of demographic data, especially age and sex, to the lung function of Covid-19 survivors. However, it can only represent a specific sample since this research is conducted at one subdistrict. Additionally, how respondents blew the spirometer could influence result. There was a chance for them to not blow properly. This brings an investment to future research in investigating other factors influencing lung function on a larger sample in a controlled procedure and situation.

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REFERENCE

[1] Satuan Tugas Penanganan COVID-19, "Data Sebaran Covid-19," 2022.

[2] WebMD, "Coronavirus in the Lungs: What Does COVID-19 Really Do to Your Lungs?," 2020. https://www.webmd.com/lung/what-does-covid-do-to-your-lungs#1 (accessed Dec. 01, 2022).

[3] P. Galiatsatos, "COVID-19 Lung Damage | Johns Hopkins Medicine," *John Hopkins Medicine*, Feb. 28, 2022. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/what-coronavirus-does-to-the-lungs (accessed Dec. 01, 2022).

[4] Badan Nasional Penanggulangan Bencana, "Kasus Meninggal Akibat COVID-19 Paling Banyak Usia 30-59 Tahun - BNPB," Apr. 29, 2020. https://bnpb.go.id/berita/kasus-meninggal-akibat-covid19-paling-banyak-usia-3059-tahun- (accessed Mar. 08, 2023).

[5] Centers for Disease Control and Prevention, "Risk for COVID-19 Infection, Hospitalization, and Death By Age Group | CDC," Feb. 06, 2023. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-age.html (accessed Mar. 08, 2023).

[6] A. Tejpal *et al.*, "Sex-Based Differences in COVID-19 Outcomes," *J. Women's Heal.*, vol. 30, no. 4, p. 492, Apr. 2021, doi: 10.1089/JWH.2020.8974.

[7] J. M. Jin *et al.*, "Gender Differences in Patients With COVID-19: Focus on Severity and Mortality," *Front. Public Heal.*, vol. 8, p. 152, Apr. 2020, doi: 10.3389/FPUBH.2020.00152.

[8] A. V. Raveendran, R. Jayadevan, and S. Sashidharan, "Long COVID: An overview," *Diabetes Metab. Syndr. Clin. Res. Rev.*, vol. 15, no. 3, pp. 869–875, May 2021, doi: 10.1016/J.DSX.2021.04.007.

[9] A. M. Kholilah and A. Y. S. Hamid, "Gejala Sisa Penyintas Covid-19: Literatur Review," *J. Ilmu Keperawatan Jiwa*, vol. 4, no. 3, pp. 501–516, Aug. 2021, Accessed: Feb. 18, 2022. [Online]. Available: http://journal.ppnijateng.org/index.php/jikj/article/view/993.

[10] T. H. Setiadi and T. Y. Dzahabiyyah, "Penyuluhan Kesehatan Rehabilitasi Medik Pasca COVID 19," *Pros. SENAPENMAS*, vol. 0, no. 0, pp. 647–654, Nov. 2021, doi: 10.24912/PSENAPENMAS.V0I0.15071.

[11] A. Suci Dewi, I. Laras Satiti, and I. Mulyani, "Penyuluhan untuk Peningkatan Kualitas Hidup Penyintas Covid-19 di Wilayah Kerja Puskesmas Rejosari Pekanbaru," *JATI EMAS (Jurnal Apl. Tek. dan Pengabdi. Masyarakat)*, vol. 6, no. 1, pp. 1–6, Dec. 2021, doi: 10.36339/JE.V6I1.519.

[12] G. Sharma and J. Goodwin, "Effect of aging on respiratory system physiology and immunology," *Clin. Interv. Aging*, vol. 1, no. 3, p. 253, 2006, doi: 10.2147/CIIA.2006.1.3.253.

[13] E. T. Thomas, M. Guppy, S. E. Straus, K. J. L. Bell, and P. Glasziou, "Rate of normal lung function decline in ageing adults: a systematic review of prospective cohort studies," *BMJ Open*, vol. 9, no. 6, p. e028150, Jun. 2019, doi: 10.1136/BMJOPEN-2018-028150.

[14] A. Péterfi *et al.*, "Comorbidities and increased mortality of COVID-19 among the elderly: A systematic review," *Physiol. Int.*, vol. 109, no. 2, pp. 163–176, May 2022, doi: 10.1556/2060.2022.00206.

[15] J. P. A. Ioannidis, C. Axfors, and D. G. Contopoulos-Ioannidis, "Population-level COVID-19 mortality risk for non-elderly individuals overall and for non-elderly individuals without underlying diseases in pandemic epicenters," *Environ. Res.*, vol. 188, Sep. 2020, doi: 10.1016/J.ENVRES.2020.109890.

[16] D. García-Martínez, N. Torres-Tamayo, I. Torres-Sanchez, F. García-Río, and M. Bastir, "Morphological and functional implications of sexual dimorphism in the human skeletal thorax," *Am. J. Phys. Anthropol.*, vol. 161, no. 3, pp. 467–477, Nov. 2016, doi: 10.1002/AJPA.23051.

[17] A. Lomauro and A. Aliverti, "Sex differences in respiratory function," *Breathe*, vol. 14, no. 2, p. 131, Jun. 2018, doi: 10.1183/20734735.000318.

[18] A. W. Sheel, P. B. Dominelli, and Y. Molgat-Seon, "Revisiting dysanapsis: sex-based differences in airways and the mechanics of breathing during exercise," *Exp. Physiol.*, vol. 101, no. 2, pp. 213–218, Feb. 2016, doi: 10.1113/EP085366.