



The Influence Of Age, Duration Of Work, And Length Of Employment On Pulmonary Function Capacity Among Traders At Medan Deli Market In 2024

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Abstract

The urban workplace environment often encounters environmental issues, one of which is air pollution. This issue is triggered by population growth and high levels of urbanization, leading to increased air pollution, predominantly caused by transportation activities. Traders in markets are frequently exposed to respiratory disorders due to particulate matter (PM) emitted by passing vehicles. This study aims to analyze the influence of age, duration of work, and work tenure on pulmonary function capacity among traders at Medan Deli Market in 2024. This quantitative

study employs an analytic survey approach using a cross-sectional study design. The research was conducted at Medan Deli Market in Medan City from March 2024 to October 2024. The study population consisted of all traders at Medan Deli Market, with a sample size of 55 traders calculated using Lemeshow's formula. The sampling technique used was purposive sampling. Data collection was performed through questionnaire distribution. The data analysis methods included univariate analysis, bivariate analysis using simple linear regression tests, and multivariate analysis using multiple linear regression tests, with a significance level of 95% ($\alpha = 0.05$). The results indicated significant effects of age ($P\text{-value}=0.032$; $\text{Exp.B}=0.016$), duration of work ($P\text{-value}=0.008$; $\text{Exp.B}=0.158$), and work tenure ($P\text{-value}=0.002$; $\text{Exp.B}=0.067$) on pulmonary function capacity among traders at Medan Deli Market. Work tenure was found to have the most dominant influence on pulmonary function capacity ($P\text{-value}=0.007$; $\text{Exp.B}=0.157$). Recommendations for Medan Deli Market traders include adherence to wearing masks while working, particularly for those located near the main road, and routine health check-ups at healthcare centers.

Keywords: Market traders, Pulmonary Function Capacity

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Introduction

The work environment plays a crucial role for workers as it significantly impacts their health (Fuadi et al., 2022). A poor work environment can lead to various health problems among workers (Suwanto, 2018; Primasanti & Herawati, 2022). In urban areas, work environments often face environmental issues such as air pollution, primarily driven by population growth and high levels of urbanization (SN et al., 2024).

The largest Medan City in North Sumatra Province and the fourth-largest city in Indonesia, experiences significant annual population growth. This growth is accompanied by increasing air pollution from domestic, industrial, and other sources, with transportation being a major contributor (Greenstone & Fan, 2019; Panggabean et al., 2019).

Transportation plays a pivotal role as a significant contributor to air pollution, accounting for up to 80% of total air pollution due to incomplete fuel combustion in vehicle engines (Arganata, 2017; Li & Managi, 2021). Air pollution from the transportation sector often includes particulate matter (PM) and gases, with PM_{2.5} and PM₁₀ being the most prevalent forms (Harrison, 2020). Particulate matter (PM) consists of a complex mixture of particles such as dust, dirt, smoke, and liquid droplets suspended in the air. Fine particulate matter (PM_{2.5}) refers to particles smaller than 2.5 µm, which can penetrate deep into the lungs and circulate in the bloodstream, posing significant health risks (Wambebe & Duan, 2020).

The dangers posed by air pollution include a decline in air quality, which can adversely affect health, particularly pulmonary function capacity (Pamurti & Maulana, 2023). Particulate Matter (PM) or particulate dust can lead to a reduction in lung function capacity, thereby limiting the optimal use of respiratory organs for oxygen intake during the respiration process and causing respiratory system disorders (Suwanto, 2018).

Vital Lung Capacity (VLC) refers to the total volume of air that an individual can exhale after a maximal inhalation. The average VLC volume is approximately 4800 ml, with normal values defined as exceeding 80%. VLC measurements can be performed using spirometry with a spirometer. The VLC value is utilized to assess the presence or absence of pulmonary function impairments (Sari et al., 2020).

Pulmonary function disorders can result from the accumulation of materials such as gases and dust. The concentration of airborne dust affects health when inhaled, depending on particle size. Particles hazardous to respiratory health typically range between 0.1 microns and 10 microns. Particles smaller than 5 microns can penetrate the lungs and settle in the alveoli, while particles larger than 5 microns may disrupt the upper respiratory tract and cause irritation (Oktaviani & Prasasti, 2016). Pulmonary function impairment can significantly affect vital lung capacity. Vital lung capacity represents the maximum amount of air an individual can transfer in a single breath



to the lungs. It encompasses inspiratory reserve volume, tidal volume, and expiratory reserve volume (Wiguna, 2021).

Informal sector workers are individuals who work without formal employment relationships, meaning there are no agreements regulating work elements, wages, or authority. One example of informal sector work is market trading. Market traders are frequently exposed to respiratory disorders due to continuous exposure to dust and vehicle emissions. Additionally, respiratory issues among market traders are often influenced by individual factors.

Individual factors are the most dominant determinants affecting pulmonary function capacity, including age, duration of work, and work tenure. Aging is a natural process that results in a decline in human physiological functions, including a reduction in lung capacity as part of the overall decrease in organ functionality (Oviera et al., 2018). Work duration refers to the length of time a worker performs a specific task, from the start of employment to its completion, while work tenure refers to the total time a worker has been engaged in their occupation (Gharini & Hermawati, 2020). These individual factors influence the level of hazard exposure experienced by workers, thereby impacting their pulmonary function capacity (Devy et al., 2024).

Based on a preliminary survey, it was observed that Medan Deli Market operates daily, opening around 3:00 AM, with peak visitor hours occurring between 4:00 AM and 10:00 AM. The market conditions reveal that trading activities take place along the roadside and beneath a flyover, areas intended for motor vehicle traffic, which contributes to air pollution. The market is also situated near a major roadway. Sources of pollution at Medan Deli Market primarily stem from visitor activities and individuals offering services such as pedicabs or online transportation near the market area.

Observations revealed that the proximity between traders and the main road is very close, increasing the risk of particulate exposure. Additionally, many stalls are open-air, further heightening the exposure risk. It was also noted that nearly all market traders do not wear masks.

The declining air quality at Medan Deli Market is attributed to the high traffic volume, which continues to degrade the air quality over time, posing a health risk to traders working in the area. To mitigate potential health issues such as reduced pulmonary function capacity, this study aims to analyze the effects of age, duration of work, and work tenure on pulmonary function capacity among traders at Medan Deli Market in 2024.

Methods

This study is a quantitative research employing an analytic survey design with a cross-sectional study approach. The research was conducted at Medan Deli Market in Medan City from March 2024 to October 2024. The study population comprised all traders at Medan Deli Market,



with a sample size of 55 traders determined using Lemeshow's formula. The sampling technique used was purposive sampling, wherein sample selection from the population was based on specific considerations or criteria (inclusion and exclusion criteria).

The inclusion criteria required participants to meet the following conditions: trading at Medan Deli Market, Medan City, and being directly exposed to PM2.5 within a distance of 1 to 240 meters from the main road. The exclusion criteria involved traders who were suffering from respiratory diseases, whether infectious or non-infectious, during the study period, such as asthma, bronchitis, or pneumonia.

Data collection was carried out through the distribution of questionnaires. The questionnaire instruments measured age, duration of work, and work tenure, while pulmonary function capacity was assessed using the Contec Spirometer Series 10W. The dependent variable was pulmonary function capacity, measured on a ratio scale (numerical data), and the independent variables included age, duration of work, and work tenure, measured on an ordinal scale (numerical data). Data analysis was performed using SPSS software version 25 and included three steps: (1) univariate analysis, (2) bivariate analysis using simple linear regression, and (3) multivariate analysis using multiple linear regression, with a significance level of 95% ($\alpha = 0.05$).

The principal investigator received ethical approval from the Health Research Ethics Committee of Sumatera Utara University (No: 1204/KEPK/USU/2024). Additionally, permission was obtained from academic administrators and relevant authorities prior to data collection. Informed consent was secured from all respondents before distributing the questionnaires.

Results

Characteristics of Traders at Medan Deli Market

The characteristics of traders at Medan Deli Market include age, working hours, and years of service. A descriptive analysis of the characteristics of traders at Medan Deli Market is presented as follows:

Table 1. Descriptive Analysis of Trader Characteristics at Medan Deli Market

Trader Characteristics	Min	Max	Mean	SD	Confidence Interval (95% CI for Mean)
Age (Years)	18	66	38.85	10.22	36.09 – 41,62
Working Hours (Hours)	5	13	9.13	1.27	8.78 – 9.47
Years of Service (Years)	3	20	7.65	3.41	6.73 – 8.58

Based on Table 1, the average age of traders at Medan Deli Market is 38.85 years, with a standard deviation of 10.22 years. The youngest trader is 18 years old, while the oldest is 66



years old. The average working hours of traders at Medan Deli Market are 9.13 hours per day, with a standard deviation of 1.27 hours. The shortest working hours recorded are 5 hours per day, while the longest are 13 hours per day. The average years of service among traders at Medan Deli Market are 7.65 years, with a standard deviation of 3.41 years. The shortest duration of service is 3 years, while the longest is 20 years.

Pulmonary Function Capacity of Traders at Medan Deli Market

A descriptive analysis of the pulmonary function capacity of traders at Medan Deli Market is presented as follows:

Table 2. Descriptive Analysis of Pulmonary Function Capacity of Traders at Medan Deli Market

	Min	Max	Mean	SD	Confidence Interval (95% CI for Mean)
Pulmonary Function Capacity of Traders	2.06	4.60	3.10	0.56	2.94 – 3.25

Based on Table 2, the average pulmonary function capacity of traders at Medan Deli Market is 3.10, with a standard deviation of 0.56. The lowest pulmonary function capacity recorded is 2.06, while the highest is 4.60.

The Effect of Age, Working Hours, and Years of Service on Pulmonary Function Capacity of Traders at Medan Deli Market in 2024

Bivariate analysis using simple linear regression reveals the effects of age, working hours, and years of service on the pulmonary function capacity of traders at Medan Deli Market in 2024. The results are presented in the following table:

Table 3. The Effect of Age, Working Hours, and Years of Service on Pulmonary Function Capacity of Traders at Medan Deli Market in 2024

	β	Exp B	Confidence Interval (95% CI) for Exp B		Pvalue
			Lower	Upper	
Age	-0,290	-0,016	-0,031	-0,001	0,032
Working Hours	-0,356	-0,158	-0,272	-0,044	0,008
Years of Service	-0,406	-0,067	-0,109	-0,026	0,002



Based on the results in Table 3, the influence of traders' age on pulmonary function capacity at Medan Deli Market revealed an Exp(B) value of 0.016. This indicates that age has a 1.6 times effect on pulmonary function capacity among traders at Medan Deli Market. The statistical test yielded a p-value of 0.032, indicating a significant influence of age on pulmonary function capacity.

The influence of working hours on pulmonary function capacity among traders at Medan Deli Market showed an Exp(B) value of 0.158, suggesting that working hours have a 15.8 times effect on pulmonary function capacity. The statistical test resulted in a p-value of 0.008, confirming a significant relationship between working hours and pulmonary function capacity.

The influence of years of service on pulmonary function capacity among traders at Medan Deli Market demonstrated an Exp(B) value of 0.067, indicating that years of service have a 6.7 times effect on pulmonary function capacity. The statistical test yielded a p-value of 0.002, suggesting a significant effect of years of service on pulmonary function capacity.

The Most Influential Factor on Pulmonary Function Capacity among Traders at Medan Deli Market in 2024

Multivariate analysis was employed to examine the effects of age, working hours, and years of service on pulmonary function capacity and to identify the most dominant factor influencing pulmonary function capacity among traders. Multiple linear regression analysis was used, including all variables from the bivariate analysis with a p-value < 0.25. The bivariate results showed that all independent variables had a p-value < 0.25, thus all variables were included in the multivariate selection process.

The results of the variable selection affecting pulmonary function capacity among traders at Medan Deli Market are presented in the following table:

Table 4. Selection of Variables Influencing Pulmonary Function Capacity among Traders at Medan Deli Market

Model	Variabel	β	Exp B	Confidence Interval (95% CI) for Exp B		Pvalue
				Lower	Upper	
I	Constant		4.902	3.816	5.987	0.001
	Age	-0.138	-0.008	-0.023	0.007	0.312
	Working Hours	-0.283	-0.125	-0.235	-0.015	0.026
	Years of Service	-0.284	-0.047	-0.093	-0.001	0.044
II	Constant		4.680	3.686	5.674	0.001
	Working Hours	-0.282	-0.125	-0.235	-0.015	0.027
	Years of Service	-0.346	-0.157	-0.298	-0.016	0.007



Based on Table 4, the final analysis results indicate that two independent variables can predict pulmonary function capacity among traders at Medan Deli Market: working hours and years of service. According to Table 5, years of service is identified as the most dominant variable influencing pulmonary function capacity among traders at Medan Deli Market, as it has the highest beta value of 0.157.

Discussion

A Decline in Pulmonary Function Capacity can lead to various respiratory disorders, where impaired lung function represents a condition in which the lungs, as organs responsible for the respiratory system, undergo abnormal functional changes. These changes may include reduced lung elasticity (necessary for lung expansion) or alterations in respiratory processes that hinder the airflow entering and exiting the lungs.

The findings of this study indicate a significant influence of age on pulmonary function capacity among traders at Medan Deli Market. Advancing age affects the performance of bodily organs, resulting in a gradual decline in functionality, particularly pulmonary function capacity. Age is a key factor that increases the risk of pulmonary function decline, as the aging process of bodily functions, including the lungs, begins after the age of 30. This decline leads to a reduction in physiological pulmonary functions over time.

This study aligns with the research of Premana & Griandhi (2017), which reported that traders aged 41–55 years exhibited a higher prevalence of impaired pulmonary function compared to younger age groups. Approximately 36% of respondents in this age category experienced pulmonary function impairments, likely due to prolonged exposure over many years.

Working Duration refers to the time range required for an individual to work in one day, typically measured in hours. The standard working duration in one day is 7 hours, with a maximum of 8 hours. Exceeding the prescribed working hours increases the risks of fatigue, workplace accidents, and health disorders.

The results of this study indicate a significant effect of working duration on the pulmonary function capacity of traders at Medan Deli Market. The longer the traders work, the greater the decline in their pulmonary function capacity. Working duration is a risk factor for pulmonary function impairment, strongly influenced by the work environment and conditions around the workplace.

Workers with extended working hours will experience a cumulative exposure to harmful particles every day, which can settle in the lungs (Putri, 2020). The longer the exposure, the more pollutants accumulate in the lungs, leading to impaired pulmonary function (Widajati et al., 2023).



According to Indonesian Ministry of Manpower Regulation Number 5 of 2018 regarding permissible chemical exposure limits in the workplace, the recommended working duration is no more than 8 hours per day and 40 hours per week to prevent health disorders (Permenaker RI Nomor 5 Tahun 2018).

This study demonstrates that the longer an individual is exposed to a work environment with poor air quality, the greater the risk of experiencing a decline in pulmonary function. Extended working durations increase the accumulation of exposure to air pollutants, dust, and smoke, which can cause damage to lung tissue.

This study aligns with research conducted by Firmanto et al. (2019), which states that the longer an individual is exposed to areas with high particulate concentrations during the day, the greater the risk of respiratory disorders. The proximity of traders to the main road and their working hours significantly influence the amount of pollutants entering their respiratory system.

Additionally, this study is reinforced by research by Putri et al. (2023), which found that prolonged exposure significantly affects pulmonary function impairment, with a p-value of 0.006. These findings are consistent with the theory that the longer the working duration, the higher the exposure to environmental hazards in the workplace.

Length of Service refers to the duration a trader has been working, measured in years, starting from the initial year of trading at Medan Deli Market until the present. The results of this study indicate a significant effect of the length of service on pulmonary function capacity in traders at Medan Deli Market. The longer the length of service, the more prolonged the exposure to dust and gases, commonly referred to as Particulate Matter (PM), which leads to increased inhalation of pollutants.

Individuals with more than 5 years of work experience face a higher risk, and the effects of exposure become more apparent, making them more likely to experience pulmonary function disorders compared to those with less than 5 years of service. The longer the length of service, the more likely individuals are to experience a decline in pulmonary function due to continuous exposure to pollutants in the workplace. However, this largely depends on the exposure dose and the nature of the pollutants inhaled daily.

The findings of this study are consistent with the research conducted by Heriana et al. (2020), which stated that there is a significant relationship between length of service and the decline in pulmonary function among workers in the lime industry at CV. Sumber Rejeki in Majalengka. This study also aligns with research by Novziransyah et al. (2022), which found a significant relationship between length of service and pulmonary function disorders. According to this study, workers with longer service durations are more likely to develop lung diseases, such as bronchitis and chronic obstructive pulmonary disease (COPD).



Conclusion and Recommendation

The results of this study conclude that pulmonary function capacity in traders at Medan Deli Market is influenced by age (P-value = 0.032; Exp.B = 0.016), length of service (P-value = 0.008; Exp.B = 0.158), and years of service (P-value = 0.002; Exp.B = 0.067). The most dominant factor affecting pulmonary function capacity in traders at Medan Deli Market is years of service (P-value = 0.007; Exp.B = 0.157).

Recommendations for traders at Medan Deli Market include consistent use of masks while trading to minimize exposure to PM_{2.5}, particularly for traders located near main roads, as well as regular health check-ups at local health centers. The Department of Environment and Forestry is encouraged to conduct routine monitoring and supervision of PM_{2.5} concentrations, as well as increase the number of air-purifying plants along the roadsides of Medan Deli Market. Additionally, public awareness campaigns should be implemented to inform traders about the health impacts of PM_{2.5} exposure and the importance of preventive measures such as always wearing masks while trading.



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References

- Arganata, F.Z. (2017). Beberapa faktor penyebab gangguan faal paru pada penjual unggas di Pasar Burung Kupang Surabaya. *The Indonesian Journal of Occupational Safety and Health*, 5(1), 31. <https://doi.org/10.20473/ijosh.v5i1.2016.31-40>
- Devy, A.P., Rachmaniyah, Sari, E., & Khambali. (2024). Analisis risiko pajanan gas karbon monoksida pada petugas parkir di Pusat Perbelanjaan X Surabaya. *Jurnal Kesehatan*, 17(2), 174–181. <https://doi.org/10.32763/6dkac385>
- Firmanto, J., Firdaust, M., & Hikmandari, H. (2019). Pengaruh pajanan particulate matter 10 (pm10) di udara terhadap keluhan sistem pernapasan masyarakat di Sekitar Pabrik Semen X Desa Tipar Kidul Kecamatan Ajibarang Tahun 2018. *Buletin Keslingmas*, 38(2), 234–242. <https://doi.org/10.31983/keslingmas.v38i2.4882>
- Gharini, R. P. iwi E., & Hermawati, E. (2020). Analisis risiko kesehatan pemulung akibat pajanan gas. *Jurnal Nasional Kesehatan Lingkungan Global Analisis*, 1(3), 242–251.
- Greenstone, M., & Fan, Q. (Claire). (2019). Kualitas udara Indonesia yang memburuk dan dampaknya terhadap harapan hidup. *Air Quality Life Index*, 1–10. <https://aqli.epic.uchicago.edu/wp-content/uploads/2019/03/Indonesia.Indonesian.pdf>
- Harrison, R. M. (2020). Airborne particulate matter. *Philosophical Transactions of the Royal Society A*, 378.
- Heriana, C., Ropii, A., & Setiawan, W. (2020). Analisis determinan penurunan fungsi paru pada tenaga kerja industri kapur di CV Sumber Rejeki Kabupaten Majalengka Tahun 2020. *Journal of Public Health Innovation*, 1(1), 13–25. <https://doi.org/10.34305/jphi.v1i1.200>
- Li, C., & Managi, S. (2021). Contribution of on-road transportation to PM2.5. *Scientific Reports*, 11(1), 1–12. <https://doi.org/10.1038/s41598-021-00862-x>
- Mirza Fathan Fuadi, Firmansyah, Y. W., & Fadli R, M. (2022). Sebaran kadar partikulat debu total dan faktor risiko pekerja dengan kejadian ispa di Industri Pembakaran Batu Kapur Kecamatan Margasari Kabupaten Tegal. *Sanitasi: Jurnal Kesehatan Lingkungan*, 15(1), 36–46. <https://doi.org/10.29238/sanitasi.v15i1.1430>
- Novziransyah, N., Veronica, S., & Balatif, F. (2022). Penyuluhan dan pengukuran fungsi paru menggunakan peak flow meter pada buruh pabrik aspal PT.Karya Murni Patumbak Deli Serdang. *Jurnal Pengabdian Masyarakat*, 1(1), 2–8.
- Oktaviani, D. A., & Prasasti, C. I. (2016). The physical and chemical air quality, worker's characteristics, and respiratory symptoms among printing workers in Surabaya. *Jurnal Kesehatan Lingkungan*, 8(2), 195. <https://doi.org/10.20473/jkl.v8i2.2016.195-205>
- Oviera, A., Jayanti, S., & Suroto. (2018). Factors associated with vital lung capacity in wood processing industry workers at PT. X Jepara. *Jurnal Kesehatan Masyarakat*, 4(1), 267–276. <https://ejournal3.undip.ac.id/index.php/jkm/article/view/11824>
- Pamurti, A.A., & Maulana, N. F. (2023). Analisis tingkat pencemaran lingkungan permukiman di Sekitar Pasar Mangkang Kota Semarang. *Metta : Jurnal Ilmu Multidisiplin*, 3(3), 268–276. <https://doi.org/10.37329/metta.v3i3.2719>



- Panggabean, D., Hasairin, A., & Hasruddin. (2019). Mengenal lichens sebagai bioindikator pencemaran udara (KIM 1 Mabar, Taman Beringin dan T-Garden). In *Sustainability (Switzerland)*, 11(1). http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484_SISTEM_PEMBETUNGAN_TERPUSAT_STRATEGI_MELESTARI
- Pemerintah Indonesia. (2018). Tentang Keselamatan dan Kesehatan Kerja Lingkungan Kerja. *Peraturan Menteri Ketenagakerjaan Republik Indonesia No. 5 Tahun 2018*, 5, 11.
- Premana, P. M. I., & Griandhi, I. P. A. (2017). Prevalensi gangguan fungsi paru akibat paparan asap pada pedagang sate di Denpasar. *E-Jurnal Medika*, 6(6), 1–10.
- Primasanti, Y., & Herawati, V. D. (2022). Analisis paparan debu pada departemen pemintalan benang PT. PBTS. *Теплоэнергетика*, 15(8), 14–20. <https://doi.org/10.56304/s0040363622080021>
- Putri, N. S. (2020). Literature Review: Coal Dust Exposure and Pulmonary Physiology Status. *Jurnal Kesehatan Lingkungan*, 12(4), 292–301. <https://doi.org/10.20473/jkl.v12i4.2020.292-301>
- Putri, R. A., Prasetyo, A., & Supriyono, V. (2023). Kejadian ISPA di Sekitar Industri Genteng atau Batu Bata di Desa Bogorejo, Kecamatan Barat Kabupaten Magetan. *JPKM: Jurnal Profesi Kesehatan Masyarakat*, 4(1), 9–16. <https://doi.org/10.47575/jpkm.v4i1.468>
- Sari, J. A., Astuti, R., & Prasetio, D. B. (2020). Kapasitas vital paru pada pekerja tambal ban pinggir jalan. *Higeia Journal Of Public Health Research Adn Development*, 4(22), 223–232. <http://journal.unnes.ac.id/sju/index.php/higeia>
- SN, I. Z., Setyono, P., & Rachmawati, S. (2024). Risiko cemaran particulate matter 2.5 pada pedagang kaki lima di Jalan R.A Kartini, Kota Tegal. *Jurnal Keselamatan Kesehatan Kerja Dan Lingkungan (JK3L)*, 05(2), 165–177.
- Suwanto, Y. E. P. (2018). Analisis faktor fisik lingkungan dan karakteristik pekerja dengan keluhan pernapasan pada pekerja di Industri Panci Aluminium. *Jurnal Kesehatan Lingkungan*, 10(4), 409–416. <https://e-journal.unair.ac.id/JKL/article/download/4906/5822>
- Wambebe, N. M., & Duan, X. (2020). Air quality levels and health risk assessment of particulate matters in abuja municipal area, Nigeria. *Atmosphere*, 11(8), 1–15. <https://doi.org/10.3390/ATMOS11080817>
- Widajati, N., Martiana, T., Utami, T. N., Jalaludin, J., & Hamedon, T. R. (2023). Lung Function Analysis of Marble Home Industry Workers in Tulungagung Regency. *Pertanika Journal of Science and Technology*, 31(2), 947–960. <https://doi.org/10.47836/pjst.31.2.15>
- Wiguna, I. B. (2021). *Teori dan aplikasi latihan kondisi fisik*. PT. RajaGrafindo Persada - Rajawali Pers.