



Association between smoking habits and lung function among adult smokers: A cross-sectional study in public health

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ABSTRACT

Background: Smoking is a major risk factor for impaired lung function. Continuous exposure to cigarette smoke in adulthood contributes to a progressive decline in lung capacity, which may lead to chronic respiratory diseases and other serious health complications. While previous studies have used indirect tools such as smokelyzers, limited research has applied spirometry to directly evaluate lung function among smokers in community health settings.

Objective: This study aimed to analyze the relationship between smoking habits and lung function, measured using spirometry, among adult smokers.

Methods: A cross-sectional design was conducted in a public health center. Smoking behavior was assessed using the Glover-Nilsson Smoking Behavioral Questionnaire (GN-SBQ), while lung function was measured with spirometry. Data were analyzed using the Spearman rank correlation test.

Results: The study included 50 adult respondents with a mean age of 40.8 ± 11.1 years. Most participants demonstrated strong smoking behavior, with 41 respondents (69.5%) categorized as very strong and 24 respondents (40.7%) categorized as moderate. Spirometry results indicated a significant negative correlation between smoking behavior and lung function ($p = 0.010$; $r = -0.360$). These findings suggest that greater smoking intensity is associated with reduced lung capacity, reflecting the harmful cumulative effects of tobacco exposure.

Conclusion: Smoking habits were significantly associated with decreased lung function among adult smokers. This highlights the need for preventive efforts, including health education, routine lung function screening, and smoking cessation programs in public health settings to mitigate long-term respiratory complications.

Keywords: smoking; lung function; lung compliance; smokers

INTRODUCTION

Smoking remains a major global health concern, with harmful effects on nearly every organ of the human body. It is one of the leading causes of preventable death and a significant contributor to the global burden of disease. The World Health Organization (WHO) reports that smoking accounts for more than 8 million

Nursing and Healthcare Practices

- Nurses and healthcare providers should advocate for the integration of spirometry as a routine screening tool in community health centers to detect early lung function decline, particularly among active smokers.
- Nursing practice should prioritize the development and implementation of tailored smoking cessation interventions that consider the intensity of smoking behavior, as identified through tools like the GN-SBQ questionnaire.
- Nurses should lead community outreach and education programs focused on the risks of smoking and its impact on lung health, emphasizing behavioral change strategies and the importance of early detection.

deaths annually worldwide, with millions more living with smoking-related illnesses, including cancer, chronic respiratory disease, and cardiovascular conditions (World Health Organization, 2023). In Indonesia, smoking is not only a public health issue but also a deeply ingrained cultural habit, particularly among adult males. The Global Adult Tobacco Survey (GATS) in 2021 found that 34.5% of Indonesian adults are active smokers, ranking the country among the top three globally for smoking prevalence (Kemenkes RI, 2021).

Lung function, an essential determinant of respiratory health, is significantly compromised by smoking. Cigarette smoke contains thousands of toxic and carcinogenic chemicals that cause chronic inflammation and structural damage to lung tissue, leading to a gradual decline in pulmonary function (Oelsner et al., 2020). The most common smoking-related respiratory diseases include chronic obstructive pulmonary disease (COPD), emphysema, and chronic bronchitis, which are characterized by airflow obstruction, impaired gas exchange, reduced quality of life, and increased mortality risk.

Spirometry is a simple, non-invasive, and widely recommended tool for assessing lung function. It measures parameters such as

Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1), and the FEV_1 /FVC ratio, which are critical for diagnosing and monitoring respiratory diseases (Mozun et al., 2022). Early detection of lung function decline through spirometry can inform timely interventions, including smoking cessation programs. However, spirometry remains underutilized in Indonesia's primary healthcare system due to limited equipment and trained personnel.

Previous studies have consistently demonstrated a strong association between smoking and impaired lung function as measured by spirometry. For example, Oelsner et al. (2020) reported progressive reductions in FEV_1 and FVC among smokers, while Toghiani and Sadeghi (2022) showed that smoking intensity was significantly correlated with the severity of lung function impairment. Similarly, Sharma and Gupta (2022) highlighted that even passive exposure adversely affects lung capacity. Despite this evidence, research employing spirometry to directly assess smoking-related lung function decline in Indonesia is limited. Therefore, this study was conducted to analyze the association between smoking habits and lung function among active adult smokers using spirometry.

METHODS

Design

This study employed an analytic survey design with a correlational cross-sectional approach to examine the relationship between smoking habits and lung function among active adult smokers. The research was conducted at a public health center in Banyuwangi, Indonesia. Smoking behavior was assessed using the Glover-Nilsson Smoking Behavioral Questionnaire (GN-SBQ), while lung function was measured using spirometry. Data collection was performed on adult patients who visited the health center, with the aim of determining the correlation between smoking habits and lung function.

Sample and setting

The study population consisted of adult patients aged 18 years and older who visited a public health center in Banyuwangi, Indonesia. A total of 50 active adult smokers were recruited between May and June 2024. Inclusion criteria were adults aged 18–59 years

who were active smokers, had a smoking history of at least two years, and presented with respiratory complaints. Exclusion criteria included individuals with diagnosed mental disorders, chronic diseases such as cancer, tuberculosis, or pneumothorax, as well as those who withdrew from the study. Participants were selected using purposive sampling, targeting individuals who met the study criteria and were considered representative of the research population.

Variable

The independent variable in this research was smoking habits and the dependent variable was lung function.

Instrument

This study employed two instruments for data collection. Smoking behavior was assessed using the Glover-Nilsson Smoking Behavioral Questionnaire (GN-SBQ), a validated tool designed to evaluate behavioral aspects of smoking and nicotine dependence. The instrument consists of 15 items addressing smoking frequency, duration, intensity, and dependence-related habits. Each item is scored on a Likert scale, with total scores categorized into four levels of behavioral dependence: mild (<12), moderate (12–22), strong (23–33), and very strong (>33). Higher scores indicate stronger smoking behavior and greater dependence on nicotine. The GN-SBQ has demonstrated good internal consistency, with a reported Cronbach's alpha of 0.82, supporting its reliability in measuring smoking dependence.

Lung function was evaluated using standardized spirometry. Key parameters measured included Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), and the FEV₁/FVC ratio, which are essential indicators for assessing respiratory capacity and identifying obstructive or restrictive impairments. All spirometry tests were performed by trained health personnel using calibrated equipment and following standardized protocols to ensure accuracy and reliability of measurements.

Data collection

Data collection was carried out in two structured stages while adhering to ethical research principles. Prior to participation, each respondent was provided with a comprehensive

explanation regarding the purpose of the study, the procedures to be undertaken, as well as potential risks and benefits. Respondents who voluntarily agreed to participate were asked to sign an informed consent form, ensuring their participation was fully informed and voluntary. In the first stage, smoking behavior was assessed using the Glover-Nilsson Smoking Behavioral Questionnaire (GN-SBQ). The questionnaire was administered through face-to-face interviews to ensure clarity and completeness of responses, particularly since some items required careful explanation of behavioral patterns. The interviews were conducted directly by the researchers, assisted by trained health personnel who were familiar with the instrument. This approach minimized misinterpretation, improved data quality, and helped maintain consistency in administration across all respondents.

In the second stage, participants underwent lung function testing using spirometry. Each test was performed by trained health staff with specific expertise in pulmonary function assessment. To maintain measurement accuracy and reliability, standardized procedures were strictly followed, including calibration of the spirometry device before each testing session. Spirometry was conducted in a controlled clinical setting to reduce variability caused by environmental factors. Key parameters recorded included Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), and the FEV₁/FVC ratio. During testing, respondents were instructed and guided carefully to ensure optimal performance of inhalation and exhalation maneuvers.

All collected data, including questionnaire results and spirometry parameters, were documented immediately after each assessment to avoid recall bias or data entry errors. To maintain confidentiality, respondents were identified using codes rather than personal identifiers. The combination of behavioral assessment and objective lung function measurement provided a comprehensive dataset for subsequent analysis of the relationship between smoking habits and pulmonary function.

Data analysis

The collected data were analyzed using Spearman's rank correlation test to determine the relationship between smoking habits and lung function. A significance level of $p < 0.05$ was set to indicate statistical relevance.

The correlation coefficient (r) was used to assess both the strength and direction of the relationship, with negative values interpreted as inverse associations, meaning that higher smoking intensity corresponded with lower lung function.

Lung function data obtained from spirometry were classified according to internationally accepted criteria. Respondents with an $FEV_1 \geq 80\%$ predicted and an $FEV_1/FVC \geq 0.70$ were categorized as having normal lung function. An obstructive pattern was identified when $FEV_1 < 80\%$ predicted and $FEV_1/FVC < 0.70$, while a restrictive pattern was defined as $FVC < 80\%$ predicted and $FEV_1/FVC \geq 0.70$. A mixed pattern was classified when both $FEV_1 < 80\%$ predicted and $FVC < 80\%$ predicted, with $FEV_1/FVC < 0.70$.

In this study, three primary spirometric parameters were analyzed: Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1), and the FEV_1/FVC ratio. These measurements were used not only to quantify lung function but also to categorize participants into normal, obstructive, restrictive, or mixed patterns of impairment. By combining the GN-SBQ scores with spirometry classifications, the analysis provided an integrated understanding of how smoking behavior correlates with pulmonary function decline among adult smokers.

Ethical consideration

Ethical approval for this study was obtained from the Ethics Committee (Approval No. 365/01/KEPK-STIKESBWI/IX/2024). Written informed consent was obtained from all participants prior to data collection. Confidentiality of participant data was strictly maintained, and the information collected was used solely for research purposes. Participation was entirely voluntary, and respondents retained the right to withdraw from the study at any stage without penalty.

RESULTS

The results of this study aim to describe the characteristics of respondents regarding their smoking habits and lung function status based on spirometry test outcomes. Data were collected through the GN-SBQ questionnaire to assess the intensity of smoking behavior and spirometry testing to evaluate pulmonary function. The demographic characteristics of respondents ($n = 50$) showed that most were

middle adults (52.0%), predominantly male (98.3%), with the largest proportion working as self-employed (32.2%) or private employees (27.1%), and the majority had completed senior high school education (52.5%). These characteristics provide an overview of the respondents' background. The following tables present the distribution of respondents by smoking habit category, total GN-SBQ classification, spirometry test results, and the correlation analysis between smoking habits and lung function.

The [table 1](#) shows the distribution of respondents based on the intensity of their smoking habits. Among the 50 respondents, the majority were classified as moderate cigarette smokers, comprising 44% of the total. This was followed by strong smokers at 34%, light smokers at 18%, and a small portion 4% falling into the very strong category. These results suggest that most individuals in the study population engage in moderate to strong smoking behavior, which may pose significant risks to their lung health. The relatively low percentage of very strong smokers may reflect either underreporting or a smaller subgroup with extremely high smoking intensity.

[Table 2](#) presents the classification of respondents smoking habits based on the total scores from the GN-SBQ questionnaire. The majority of respondents, totaling 41 individuals or 82% were categorized as having very strong smoking habits. Meanwhile, 9 respondents accounting for 18% were classified in the strong category. These findings indicate that the overwhelming majority of the study participants exhibit high levels of smoking behavior, which may significantly contribute to the decline in their lung function and increase their risk for respiratory complications.

The [table 3](#) illustrates the distribution of lung function impairment among respondents as measured by the spirometry test. Out of 50 respondents, 24 individuals (48%) experienced restrictive lung disorders, making it the most prevalent type of impairment. 15 respondents (30%) had mixed impairments, indicating both obstructive and restrictive patterns, while 11 respondents (22%) showed signs of obstructive lung disorders. These results suggest that restrictive and mixed patterns of lung dysfunction are more common in this population, likely influenced by their smoking habits. The presence of mixed impairments also highlights the potential for complex and overlapping lung pathologies in heavy smokers.

Table 1. Distribution of Respondents by Smoking Habits

Smoking Habit	n	%
Light Cigarette	9	18
Moderate Cigarette	22	44
Strong Cigarette	17	34
Very Strong Cigarette	2	4

Table 2. Characteristics of respondents based on Smoking Habits with GN-SBQ Questionnaire

Total GN-SBQ Questioner	n	%
Strong	9	18
Very Strong	41	82

Table 3. Characteristics of respondents based on Spirometry Test

Result Spirometry	n	%
Obstruction	11	22
Restriction	24	48
Mixed	15	30
Total	50	100

Table 4. Result of Data Analysis Corelation between Smoking Habits and Lung Function with Spirometry Test

Variable	Correlation Coefficient (r)	P-value
Smoking Habit Score (GN-SBQ) and Lung Function (Spirometry)	-0.360	0.010

DISCUSSION

The findings of this study provide compelling evidence of a significant relationship between smoking habits and lung function in adults, as assessed through the GN-SBQ questionnaire and spirometry testing. Smoking remains one of the leading causes of preventable morbidity worldwide, with its effects on respiratory function well established in clinical and epidemiological research (Wu et al., 2021). The majority of respondents were categorized as moderate to strong smokers, with a substantial portion identified as very strong smokers. This pattern reflects a high-risk group, considering that chronic exposure to cigarette smoke contributes to a progressive decline in respiratory capacity due to the accumulation of harmful substances such as nicotine, tar, and carbon monoxide (Kumar et al., 2022). These toxic agents induce chronic airway inflammation, damage epithelial cells, and reduce ciliary function, leading to long-term structural alterations in the lungs (Aljamali et al., 2022). Prolonged smoking is strongly

associated with chronic airway inflammation. Repeated irritation induces infiltration of neutrophils and macrophages, promoting oxidative stress that damages epithelial integrity and accelerates tissue remodeling (Thomson et al., 2022). This inflammatory cascade also results in the destruction of ciliated epithelial cells, reducing mucociliary clearance. Impaired clearance increases vulnerability to infections and chronic bronchitis, further compromising lung capacity (Vartiainen et al., 2023).

Spirometry results revealed that restrictive patterns were the most prevalent, followed by mixed and obstructive impairments. Restrictive disorders are often caused by reduced lung compliance due to parenchymal fibrosis, which may result from prolonged smoke-induced inflammation (Zhao et al., 2023). The presence of mixed impairments in a significant proportion of respondents suggests both airway and alveolar involvement, a hallmark of more advanced pulmonary deterioration. Similar findings have been reported by (Toghyani & Sadeghi, 2022), who observed that chronic

smokers frequently present with complex lung function impairments involving multiple respiratory mechanisms. The presence of obstructive patterns in other respondents underscores the heterogeneity of smoking-related lung disease. Obstructive deficits, characterized by reduced expiratory flow, typically arise from airway narrowing caused by chronic bronchitis or emphysema (Regan et al., 2019). Comparative studies have shown that smokers frequently present with multiple overlapping pulmonary pathologies, making accurate diagnosis via spirometry essential for effective management (Tony et al., 2022).

The Spearman rank correlation test in this study identified a moderate but statistically significant negative correlation ($r = -0.360$, $p = 0.010$) between smoking habits and spirometry results, indicating that increased smoking intensity is associated with reduced lung function. The negative association was observed consistently across all three spirometry parameters (FVC, FEV1, and the FEV1/FVC ratio), with the strongest effect detected in FEV1. This suggests that smoking habits primarily impair the ability to exhale forcefully within the first second, which is a sensitive marker of smoking-related airway obstruction (Chu et al., 2021). This result aligns with prior studies showing inverse correlations between smoking exposure and spirometric parameters such as FVC, FEV1, and FEV1/FVC ratios (Sharma & Gupta, 2022). Even among individuals who smoke fewer than five cigarettes per day, lung damage can be substantial and comparable to heavier smokers, emphasizing that no level of smoking is safe (Pujiono, 2023).

Beyond physiological consequences, the public health implications of these findings are profound. High rates of strong and very strong smoking behaviors suggest inadequate enforcement of tobacco control policies and limited access to cessation programs. Emphasized the importance of integrating spirometry testing into routine health services, which could facilitate early detection and counselling (Rodriguez-Alvarez et al., 2022). Additionally, community level interventions such as smoking bans in public spaces, school-based prevention programs, and anti-smoking media campaigns have been found to reduce smoking initiation and increase quit rates (Puteri et al., 2023).

Another key barrier to cessation is nicotine dependence, which involves not only

physiological addiction but also behavioral and social reinforcement. Therefore, effective smoking cessation strategies must include pharmacological aids (e.g., nicotine replacement therapy), behavioral counseling, and ongoing support systems (Han et al., 2023). Educational efforts alone are often insufficient unless coupled with structural interventions such as taxation and legislation, which have proven successful in reducing population-wide tobacco consumption (Dutt et al., 2021).

Clinically, accurate classification of lung function impairments through spirometry is essential for guiding treatment. Obstructive disorders typically respond to bronchodilators, while restrictive impairments may require management of underlying fibrotic changes. Mixed patterns, which involve multiple pathophysiological pathways, may necessitate a multidisciplinary approach, including pulmonary rehabilitation and long-term monitoring (Kshatri et al., 2022).

In addition to smokers themselves, passive exposure is also a concern. Studies have shown that passive smoking particularly in enclosed households can lead to measurable declines in lung capacity among nonsmokers, especially women and children (Hashemi-Aghdam et al., 2022). This highlights the need for broader public awareness and protective policies aimed at safeguarding vulnerable populations.

CONCLUSIONS

This study demonstrates a significant negative correlation between smoking intensity and lung function, as measured by spirometry, among adult respondents. The findings underscore the urgent need for early lung function screening and effective smoking cessation interventions, particularly in high-risk communities. Spirometry proved to be a valuable tool for objectively assessing pulmonary health and should be integrated into primary healthcare services to support public health strategies and reduce the burden of smoking-related respiratory diseases.

Declaration of Interest

The authors declare that there is no conflict of interest related to the publication of this research.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. All data have been anonymized to protect participant confidentiality.

REFERENCES

- Abdelaziz, S. H. H., & Mohammed, H. E. (2014). Aljamali, N. M., Al-Qraawy, W. K. N., & Helal, T. A. (2022). Review on carcinogens materials in chemical laboratories. *International Journal of Molecular Biology and Biochemistry*, 4(1). <https://doi.org/10.33545/26646501.2022.v4.i1a.26>
- Chu, S., Ma, L., Wei, J., Wang, J., Xu, Q., Chen, M., Jiang, M., Luo, M., Wu, J., Mai, L., Tang, G., & Mo, B. (2021). Smoking Status Modifies the Relationship between Th2 Biomarkers and Small Airway Obstruction in Asthma. *Canadian Respiratory Journal*, 2021. <https://doi.org/10.1155/2021/1918518>
- Dutt, S., Gogia, T., & Gupta, M. (2021). A comparative study on pulmonary function tests in smokers & nonsmokers. *Indian Journal of Clinical Anatomy and Physiology*, 8(1). <https://doi.org/10.18231/j.ijcap.2021.012>
- Han, M., Fu, Y., Ji, Q., Deng, X., & Fang, X. (2023). The effectiveness of theory-based smoking cessation interventions in patients with chronic obstructive pulmonary disease: a meta-analysis. *BMC Public Health*, 23(1). <https://doi.org/10.1186/s12889-023-16441-w>
- Hashemi-Aghdam, M. R., Shafiee, G., Ebrahimi, M., Ejtahed, H. S., Yaseri, M., Motlagh, M. E., Qorbani, M., Heshmat, R., & Kelishadi, R. (2022). Trend of passive smoking and associated factors in Iranian children and adolescents: the CASPIAN studies. *BMC Public Health*, 22(1). <https://doi.org/10.1186/s12889-022-13045-8>
- Kemenkes RI. (2021). Laporan Kinerja Kementerian Kesehatan 2021. Kementrian Kesehatan RI.
- Kshatri, J. S., Satpathy, P., Sharma, S., Bhoi, T., Mishra, S. P., & Sahoo, S. S. (2022). Health research in the state of Odisha, India: A decadal bibliometric analysis (2011–2020). *Journal of Family Medicine and Primary Care*, 6(2), 169–170. <https://doi.org/10.4103/jfmipc.jfmipc>
- Kumar, N., Chawla, G., Kansal, A. P., Deokar, K., Niwas, R., Abrol, N., Asfahan, S., Garg, S., & Keena, M. (2022). Air flow limitation in smokers – A cause of concern. *Journal of Family Medicine and Primary Care*, 11(11). https://doi.org/10.4103/jfmipc.jfmipc_1159_20
- Mozun, R., Ardura-Garcia, C., Pedersen, E. S. L., Usemann, J., Singer, F., Latzin, P., Moeller, A., & Kuehni, C. E. (2022). Age and body mass index affect fit of spirometry Global Lung Function Initiative references in schoolchildren. *ERJ Open Research*, 8(2). <https://doi.org/10.1183/23120541.00618-2021>
- Oelsner, E. C., Balte, P. P., Bhatt, S. P., Cassano, P. A., Couper, D., Folsom, A. R., Freedman, N. D., Jacobs, D. R., Kalhan, R., Mathew, A. R., Kronmal, R. A., Loehr, L. R., London, S. J., Newman, A. B., O'Connor, G. T., Schwartz, J. E., Smith, L. J., White, W. B., & Yende, S. (2020). Lung function decline in former smokers and low-intensity current smokers: a secondary data analysis of the NHLBI Pooled Cohorts Study. *The Lancet Respiratory Medicine*, 8(1). [https://doi.org/10.1016/S2213-2600\(19\)30276-0](https://doi.org/10.1016/S2213-2600(19)30276-0)
- Pujiono, P. (2023). Hubungan penggunaan apd, kebiasaan merokok, kebiasaan olahraga, dan kadar debu yang terhirup terhadap terjadinya gangguan fungsi paru pada pekerja. *Jurnal riset kesehatan poltekkes depkes bandung*, 15(1). <https://doi.org/10.34011/juriskesbdg.v15i1.2211>
- Puteri, S. O., Ratnawati, R., & Vikawati, N. E. (2023). Relationship between Age, Exercise Habits, Cigarette Smoke Duration Exposure, and Lung Vital Capacity in Passive Smokers. *Majalah Kedokteran Bandung*, 55(2). <https://doi.org/10.15395/mkb.v55n2.2169>
- Regan, E. A., Lowe, K. E., Make, B. J., Lynch, D. A., Kinney, G. L., Budoff, M. J., Mao,

- S. S., Dyer, D., Curtis, J. L., Bowler, R. P., Han, M. L. K., Beaty, T. H., Hokanson, J. E., Kern, E., Humphries, S., Curran-Everett, D., Van Beek, E. J. R., Silverman, E. K., Crapo, J. D., & Finigan, J. H. (2019). Identifying smoking-related disease on lung cancer screening CT scans: Increasing the value. *Chronic Obstructive Pulmonary Diseases*, 6(3). <https://doi.org/10.15326/jcopdf.6.3.2018.0142>
- Rodriguez-Alvarez, M. del M., Roca-Antonio, J., Martínez-González, S., Vilà-Palau, V., Chacón, C., Ortega-Roca, A., Borrell-Thió, E., Erazo, S., Almirall-Pujol, J., & Torán-Monserrat, P. (2022). Spirometry and Smoking Cessation in Primary Care: The ESPIROTAB STUDY, A Randomized Clinical Trial. *International Journal of Environmental Research and Public Health*, 19(21). <https://doi.org/10.3390/ijerph192114557>
- Sharma, N., & Gupta, V. (2022). Effect of passive smoking on lung function tests in women. *Indian Journal of Clinical Anatomy and Physiology*, 9(1). <https://doi.org/10.18231/j.ijcap.2022.010>
- Thomson, N. C., Polosa, R., & Sin, D. D. (2022). Cigarette Smoking and Asthma. *Journal of Allergy and Clinical Immunology: In Practice*, 10(11). <https://doi.org/10.1016/j.jaip.2022.04.034>
- Toghyani, A., & Sadeghi, S. (2022). Association of demographic variables and smoking habits with the severity of lung function in adult smokers. *Journal of Research in Medical Sciences*, 27(1). https://doi.org/10.4103/jrms.jrms_854_21
- Tony, S. M., Abdelrahman, M. A., Abd Elsalam, M., Shafik, M. S., & Abdelrahim, M. E. (2022). Overview of Spirometry and the Use of Its Parameters for Asthma Monitoring in Children. *Journal of Clinical and Nursing Research*, 6(3). <https://doi.org/10.26689/jcnr.v6i3.3964>
- Vartiainen, V. A., Jousilahti, P., Laatikainen, T., & Vartiainen, E. (2023). Contribution of smoking change to 45-year trend in prevalence of chronic bronchitis in Finland. *Scandinavian Journal of Public Health*, 51(8). <https://doi.org/10.1177/14034948221104351>
- World Health Organization. (2023). *WHO report on the global tobacco epidemic, 2023: protect people from tobacco smoke*. In The MPOWER package.
- Wu, S. M., Sun, W. L., Lee, K. Y., Lin, C. W., Feng, P. H., Chuang, H. C., Ho, S. C., Chen, K. Y., Chen, T. T., Liu, W. Te, Tseng, C. H., & Bamodu, O. A. (2021). Determinants of pulmonary emphysema severity in taiwanese patients with chronic obstructive pulmonary disease: An integrated epigenomic and air pollutant analysis. *Biomedicine*, 9(12). <https://doi.org/10.3390/biomedicine9121833>
- Zhao, X., Song, Q., Wang, Y., Zhang, Q., & Sun, C. (2023). Dexmedetomidine improves lung compliance in patients undergoing lateral decubitus position of shoulder arthroscopy: A randomized controlled trial. *Medicine (United States)*, 102(16). <https://doi.org/10.1097/MD.00000000000033661>