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# Lung Capacity and Health: A Comprehensive Study of Health Polytechnic Students' Respiratory Function

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## ABSTRACT

Optimal lung function is essential for maintaining overall health and enhancing the quality of life. This study aims to evaluate pulmonary function among stu-dents of Surabaya Health Polytechnic using spirometry, a method that measures lung capacity and performance. An observational descriptive research design with a cross-sectional approach was employed, involving 38 participants selected through purposive sampling. Key parameters measured included Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1), with data categorized based on gender, exercise habits, Body Mass Index (BMI), and smoking history. The results indicated that all variables exhibited normal values for FVC and FEV1, suggesting that the lung function of the participants was within healthy ranges. Specifically, the study found that 67% of underweight in-dividuals and 89% of those with normal BMI had normal FVC values, while all obese participants exhibited normal FVC. Additionally, the majority of male par-ticipants showed normal lung function compared to females. This study high-lights the importance of regular pulmonary function assessments in medical edu-cation and the factors influencing lung health, emphasizing the need for ongoing monitoring to prevent respiratory disorders.

**Keywords**: Pulmonary Function; Spirometry; Surabaya Health Polytechnic Students; Forced Vital Capacity (FVC); Body Mass Index (BMI).

## INTRODUCTION

A pulmonary function examination represents a crucial method for the assessment of respiratory health[1]. Optimal lung function is a prerequisite for maintaining good health and contributes to an individual's physical performance and quality of life. Pulmonary function testing constitutes an essential element in the monitoring and prevention of lung diseases and other respiratory disorders[2]. Pulmonary function testing represents a diagnostic method employed for the purpose of evaluating the health of the lungs. The test allows for the measurement of a number of parameters, including vital capacity, airflow velocity and lung volume[1]. It should be noted that a number of factors can influence the results of lung function testing. The aforementioned factors include age, gender, obesity level, exercise habits, environmental factors, body posture (lying, sitting, standing), lung disease (e.g., COPD, pulmonary fibrosis, and asthma), emotional state (e.g., stress, anxiety, and panic), and smoking[3]. The objective of a pulmonary function test examination is to measure the static and dynamic capacity of a person's lungs through a spirometer by placing the measurement device on the lips and asking the subject to hold and exhale as hard as possible for a few seconds. The results of the measurement will be displayed on the spirometer. The results are expressed in terms of a forced vital capacity (FVC) value, representing the volume of gas that can be released with the greatest force and speed following maximum inspiration; a forced expiratory volume in one second (FEV1), indicating the volume of gas released within a one-second interval, measured concurrently with FVC; and the FEV1 ratio[4].

The FVC measurement and the FEV1/FVC ratio provide insight into the percentage of lung air in one second. The resulting percentage number is then converted into a diagnosis of normal, restriction, or obstruction[5].

## RESEARCH METHOD

The study employed a descriptive observational design with a cross-sectional approach to evaluate pulmonary function among students at Surabaya Health Polytechnic. The research was conducted in June 2024 and involved a total of 38 participants who were selected through purposive sampling. The study population consisted of students from the Surabaya Health Polytechnic class of 2021. The sample included 20 males and 18 females, with a focus on their exercise habits, Body Mass Index (BMI), and smoking history. The primary method for assessing lung capacity was spirometry. This technique measures two key parameters: Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1). Participants were instructed to exhale forcefully into a spirometer, which recorded the volume of air expelled and the speed of the exhalation.

The results from the spirometry tests were categorized based on gender, exercise habits, BMI classification, and smoking history. The data were then analyzed to determine the percentage of participants exhibiting normal versus decreased lung function values.

## RESULT AND DISCUSSION

The study population comprised 38 individuals, of whom 20 were male and 18 were female. A total of four participants engages in regular exercise, while 34 do not. In accordance with the national BMI classification system, three participants were identified as having a BMI in the underweight category, 18 individuals were classified as having a normal BMI, and 17 participants were classified as having an obese BMI. Four participants reported a history of smoking, while 34 reported a history of not smoking (see Table 1).

The mean value of percent predicted FVC in men was 100%, while the mean value of percent predicted FEV1 was 99%. In women, the mean value of percent predicted FVC was 100%, while the mean value of percent predicted FEV1 was 97%. The mean FVC prediction percent value was 93% and FEV1 97% for the regular exercise category, while the mean FVC prediction percent value was 99% and FEV1 100% for the non-regular exercise category. In the thin BMI category, the mean predicted percentage value of FVC was 100%, with an average predicted percentage value of FEV1 of 91%. In the normal BMI category, the mean predicted percentage value of FVC was 100%, with an average predicted percentage value of FEV1 of 98%.

**Table 1.** Average Results of Lung Function Tests for Surabaya Health Polytechnic Students Based on Research Variables

| Variable | n | % | FVC | FEV1 |
|---|---|---|---|---|
| **Gender** | | | | |
| Male | 20 | 52% | 100% | 99% |
| Female | 18 | 48% | 100% | 97% |
| **Exercise Habits** | | | | |
| Regular Exercise | 4 | 11% | 93% | 97% |
| No Regular Exercise | 34 | 89% | 99% | 100% |
| **BMI** | | | | |
| <18.5 (Underweight) | 3 | 8% | 100% | 91% |
| 18.5–25 (Normal) | 18 | 47% | 100% | 98% |

In the obese BMI category, the mean predicted percentage value of FVC was 99%, with an average predicted percentage value of FEV1 of 102%. In the smoking category, the mean percent predictive value of FVC was 98%, while the mean percent predictive value of FEV1 was 99%. In the non-smoking category, the mean percent predictive value of FVC was 99%, while the mean percent predictive value of FEV1 was 100%.

**Table 2.** Lung Function Test Results for Surabaya Health Polytechnic Students Based on Gender

| **Lung Function** | **FVC** | **FEV1** |
|---|---|---|
| **Gender** | **Normal (≥80%)** | **Decreased (<80%)** |
| Male (n=20) | 20 (100%) | 0 (0%) |
| Female (n=18) | 15 (83%) | 3 (17%) |

Table 2 indicates that the number of male samples was 22, while the number of female samples was 20. All male subjects exhibited a normal FVC prediction percent value. The majority of the female subjects (83%) exhibited a normal FVC prediction percent value, while 17% demonstrated a decreased FVC prediction percent value. Meanwhile, 91% of the male subjects exhibited a normal FEV1, while 9% demonstrated a decreased FEV1. In the female sample, 78% of individuals exhibited normal FEV1 values, while 22% demonstrated a decreased FEV1 prediction percentage value. It is observed that women exhibit lower percentage predicted FVC and FEV1 values than men. This is evidenced by the fact that approximately 20-25% of women have lower lung capacity. For example, women who have the same anthropometric values as men tend to have lower lung capacity. This is attributed to the narrower airways in women, which result in lower lung diffusion capacity compared to men. The male respiratory system contains a greater number of alveoli per unit area than the female respiratory system. Additionally, the male alveoli are typically larger and more elastic. Sex hormones, sex hormone receptors, and intracellular signalling pathways may also contribute to the observed differences in pulmonary function test results[6].

**Table 3.** Lung Function Test Results for Surabaya Health Polytechnic Students Based on Exercise

| **Lung Function** | **FVC** | **FEV1** |
|---|---|---|
| **Exercise Habits** | **Normal (≥80%)** | **Decreased (<80%)** |
| Regular (n=4) | 4 (100%) | 0 (0%) |
| Not Regular (n=34) | 32 (91%) | 3 (9%) |

Table 3 indicates that four samples engaged in regular exercise, while 34 samples did not. The percentage of predicted FVC values for samples who regularly exercise did not demonstrate a decline. In contrast to the non-exercising group, 91% of the exercising group exhibited a normal FVC prediction percentage value, while 9% demonstrated a decreased FVC percentage. In the case of the percentage of predicted FEV1 in relation to regular exercise, no decrease was observed. A total of 88% of the samples exhibited normal results, while 12% demonstrated a decrease in variables among those who did not regularly exercise. It can be posited that those who engage in regular exercise may exhibit superior lung function. Dugral and Balkanci (2022) found that the FVC and FEV1 values in samples who regularly exercised were significantly higher than in samples who did not regularly exercise (p = 0.002.9). Meanwhile, Hayati et al. (2022) observed an increase in the percentage value of predicted FEV1 and FVC in samples before and after exercising. According to the study, routine exercise activities cause muscles to become stronger[7]. The functionality of the muscles will be enhanced, particularly those responsible for respiration, thereby optimising the efficiency of the respiratory process, particularly during periods of rest.

The pulmonary ventilation of those who engage in regular exercise and those who do not remains unchanged. However, the former group finds it easier to breathe more slowly and deeply. This results in a reduction in the oxygen required by the muscles during the ventilation process, thereby enabling the respiratory muscles of individuals who engage in regular exercise to function effectively with the same oxygen supply[8].

In accordance with the data presented in Table 4, the classification is based on the national BMI classification, which comprises three categories: thin (less than 18.5 kg/m²), normal (18.5-25.0 kg/m²), and obese (greater than 25.0 kg/m²). The data revealed that three samples exhibited IMT values within the underweight category, 18 individuals demonstrated values within the normal range, and 17 individuals exhibited values within the obese category. In the predicted percentage value of FVC with a lean BMI, 67% of samples exhibited a normal FVC percentage value, while 33% demonstrated a decreased FVC percentage value. In the normal BMI category, 89% of the samples yielded normal results, while 11% yielded decreased results.

**Table 4.** Lung Function Test Results for Surabaya Health Polytechnic Students Based on BMI

| Lung Function | FVC | FEV1 |
|---|---|---|
| **BMI** | **Normal (≥80%)** | **Decreased (<80%)** |
| <18.5 (Underweight) | 2 (67%) | 1 (33%) |
| 18.5–25 (Normal) | 16 (89%) | 2 (11%) |
| >25 (Overweight) | 17 (100%) | 0 (0%) |

In the obese IMT category, no subjects exhibited a decreased percentage value of FVC prediction. In the thin BMI category, 67% of samples exhibited a normal FEV1 percentage value, while 33% demonstrated a decreased value[9][10]. In the normal BMI category, 83% of samples exhibited a normal FEV1 prediction percentage value, while 17% displayed a decreased FEV1 percentage value. In the obese IMT category, no decrease was observed in the percentage value of FEV1 prediction. The impact of BMI on pulmonary function test outcomes exhibits considerable variability and inconsistency across studies. An increase in BMI has been demonstrated to influence pulmonary function test results, with a concomitant reduction in pulmonary function test values. Abdominal fat can restrict diaphragm movement, increasing intra-abdominal pressure and impeding diaphragm contraction, which can result in decreased lung function[11]. However, the percentage value of predicted FVC and FEV1 in the obese IMT category is not higher than in the normal IMT category, as evidenced by the data[12][10]. This is consistent with the findings of Ghobain MA, who demonstrated that BMI has no direct impact on the results of pulmonary function tests in healthy adults who do not smoke. Furthermore, a reduction in the predictive value of FVC and FEV1 values in individuals with a normal BMI may be indicative of impaired lung function. A deficiency in muscle mass, particularly in the diaphragm and skeletal muscles, can contribute to diminished respiratory strength and drive.

Table 5 indicates that there were four samples from smokers and 34 samples from non-smokers. In the smoker sample, all FVC values were within the normal range. In the non-smoker sample, 91% of the samples exhibited normal FVC values, while 9% demonstrated decreased FVC. In the FEV1 value of the smoking sample, no samples exhibited a decrease in FEV1. With regard to the non-smoking samples, 88% exhibited normal FEV1 values, while 12% displayed decreased FEV1 values. It has been demonstrated that the act of smoking has a deleterious effect on lung function, including both FEV1 and FVC.

**Table 5.** Lung Function Test Results for Surabaya Health Polytechnic Students

Based on Smoking History

| Lung Function | FVC | FEV1 |
|---|---|---|
| **Smoking History** | **Normal (≥80%)** | **Decreased (<80%)** |
| Smoker (n=4) | 4 (100%) | 0 (0%) |
| Non-Smoker (n=34) | 30 (88%) | 4 (12%) |

The production of phlegm is greater in smokers than in non-smokers, which affects the FEV1 value, which indicates airway obstruction[13]. The respiratory muscles are affected by smoking through the influence of free radicals on the vascular system, which causes a decrease in the blood supply to the respiratory muscles, which has an adverse effect on respiratory function[12]. However, as can be seen in the data obtained, the percentage decrease in FEV1 and FVC values in smokers and non-smokers is not significantly different. This is consistent with the findings of Prihantini NN and Batubara F, who reported no significant correlation in pulmonary function test values between smokers and non-smokers (p-value = 0.31).[17] Similarly, Tantisuwat A and Thaveeratitham P observed that the influence of smoking on FEV1 and FVC values was minimal in their adolescent sample, which lacked a history of respiratory disease and therefore did not exhibit significant lung function impairment[12].

## CONCLUSION

The overall analysis revealed that several factors, including gender, exercise habits, body mass index, and smoking history, had no significant impact on the predicted values of FVC and FEV1. This may be attributed to the limited sample size, which resulted in an imbalance in proportions between variables. Moreover, as the samples comprised students who were still at a young age, the results obtained were largely within the normal range for FVC and FEV1 values .

It is recommended that a larger number of samples be obtained in order to ensure equality between variables and to enable the study population to be adequately represented. Furthermore, additional research can be conducted.

## REFERENCES

[1] Lindsay, *Anatomy & Physiology*, vol. 6, no. 6. 2016.

[2] V. Uif, U. Pg, U. Sfbujwf, and P. Mjdfotf, *Anatomy & Physiology*. .

[3] D. A. N. Pencegahan and A. Bronkial, “No Title,” vol. 6, no. 1, pp. 44–51, 2023.

[4] O. Article, “Edukasi Peningkatan Pengetahuan Tentang Penyakit Asma Berdasarkan data dari World Health saluran napas yang biasanya ditandai penyakit asma sangat diperlukan . pengetahuan tentang asma , penyebab ,” vol. 1, no. 2, pp. 13–18, 2023.

[5] A. S. Listyoko, S. Djajalaksana, N. Putu, P. Putra, and U. A. Setyawan, “Jurnal Pengabdian Empowering Telemedicine As An Effort To Asses Knowledge , Asthma Symptoms Control And Risk Factors Of Asthmatic Patients In The Era Of Covid-19 Pandemic,” vol. 4, no. 2, 2022, doi: 10.20473/jpmk.v4i2.33504.

[6] N. Alam, E. L. Hobbelink, A. J. van Tienhoven, P. M. van de Ven, E. P. Jansma, and P. W. B. Nanayakkara, “The impact of the use of the Early Warning Score (EWS) on patient outcomes: A systematic review,” *Resuscitation*, vol. 85, no. 5, pp. 587–594, 2014, doi: 10.1016/j.resuscitation.2014.01.013.

[7] X. Wang and M. W. Kattan, “Cohort Studies: Design, Analysis, and Reporting,” *Chest*, vol. 158, no. 1, pp. S72–S78, 2020, doi: 10.1016/j.chest.2020.03.014.

[8] Z. Wang and M. Tang, “Research progress on toxicity, function, and mechanism of metal oxide nanoparticles on vascular endothelial cells,” *J. Appl. Toxicol.*, vol. 41, no.

5, pp. 683–700, 2021, doi: 10.1002/jat.4121.

[9] K. Karabekir *et al.*, "Health Nexus," vol. 1, no. 4, pp. 90–98, 2023.

[10] A. A. Alqarni *et al.*, "Heliyon Spirometry profiles of overweight and obese individuals with unexplained dyspnea in Saudi Arabia," *Heliyon*, vol. 10, no. 3, p. e24935, 2024, doi: 10.1016/j.heliyon.2024.e24935.

[11] M. Rosenfeld *et al.*, "Incorporating the perspectives of participants and research coordinators on home spirometry into clinical trial design : The example of the OUTREACH study," vol. 23, no. June, pp. 739–743, 2024, doi: 10.1016/j.jcf.2024.06.014.

[12] R. Wharton *et al.*, "Feasibility of remote spirometry monitoring of asthma in pregnancy," vol. 233, no. August, pp. 7–9, 2024, doi: 10.1016/j.rmed.2024.107782.

[13] I. Yovi, A. Adrianison, and S. T. Syafitra, "Pemeriksaan Paru dengan Spirometri Serta Edukasi Berhenti Merokok pada Warga Desa Titi Akar Rupat Utara," vol. 6, pp. 265–269, 2024.