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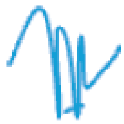

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Table 1. Distribution of Respondent Characteristics (n=57)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	32	56.1
Female	25	43.9
Body Mass Index (BMI)		
Underweight (<18.5 kg/m²)	7	12.3
Normal (18.5-22.9 kg/m²)	14	24.6
Overweight (23.0-24.9 kg/m²)	9	15.8
Obesity I (25.0-29.9 kg/m²)	18	31.6
Obesity II (≥30.0 kg/m²)	9	15.8
Physical Activity		
Low	42	73.7
Moderate	14	24.5
High	1	1.7
Peak Expiratory Flow (PEF)		
Low (<79% Predicted)	34	59.6
Normal (≥79% Predicted)	23	40.4

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Relationship Between Physical Activity and Body Mass Index with Peak Expiratory Flow in Adults

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A B S T R A C T

Peak expiratory flow (PEF) is a crucial parameter for assessing large airway function and lung ventilation capacity. PEF values are influenced by various factors, including physical activity levels and nutritional status as measured through body mass index (BMI). This study aims to investigate the relationship between physical activity and BMI with PEF in the adult population within an academic work environment. An analytical observational study with a cross-sectional design was conducted at the Faculty of Computer Science, Kuningan University, from September to October 2025. A total of 57 respondents met the inclusion criteria. Physical activity was measured using the IPAQ-Short Form, BMI was measured using weight and height measurements, and PEF was measured using a Peak Flow Meter. Data analysis was performed using the Chi-Square test and analyzed using SPSS version 25. Most respondents had low physical activity (73.7%) and low PEF (59.6%). No significant relationship was found between physical activity and PEF (p = 0.611). In contrast, BMI showed a significant relationship with PEF (p = 0.026). There is a relationship between BMI and PEF, but no significant relationship was found between physical activity level and PEF in these research respondents

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INTRODUCTION

Peak expiratory flow (PEF) is a simple yet important parameter for assessing large airway function and lung ventilation capacity. PEF values are widely used in clinical practice and community settings as an early indicator of pulmonary function impairment because the measurement is easy, quick, and non-invasive. A decrease in PEF values can reflect airway obstruction or reduced respiratory muscle strength, which can potentially impact the quality of life of socially and professionally active adults. (Feher, 2017)

Various factors are known to influence PEF values, including age, gender, height, nutritional status, and physical activity level. Physical activity plays a role in increasing cardiopulmonary capacity and respiratory muscle strength through physiological adaptations to increased workload. Meanwhile, body mass index (BMI) has a complex relationship with lung function. In obesity, increased fat mass can cause mechanical restriction of the chest wall and diaphragm, whereas in individuals with low BMI, respiratory muscle weakness can decrease lung ventilation performance. However, previous research has shown inconsistent findings regarding the relationship between physical activity and BMI with PEF, especially in healthy adult populations. (Feher, 2017; Ji et al., 2021)

Most previous studies were conducted on specific age groups, such as adolescents, elderly individuals, or people with lung disease, so data on healthy adult populations in academic work environments remains limited. The academic environment is an interesting sample because it is characterized by sedentary workload, relatively good health literacy, and diverse variations in physical activity and nutritional status. This condition provides an opportunity to evaluate the relationship between physical activity and BMI with PEF in an adult population that is relatively homogeneous in terms of occupation but heterogeneous in terms of lifestyle. Based on this background, this research was conducted to analyze the relationship between physical activity level and BMI with PEF in adult populations in academic work environments, as a contribution to enriching scientific evidence regarding factors that affect lung function in adults.

LITERATURE REVIEW

PEF represents the maximum airflow value that can be achieved during rapid and forceful expiration after maximal inspiration. PEF reflects large airway function, lung elasticity, and respiratory muscle strength, making it widely used as a simple indicator of lung function at clinical and community levels. (Powers & Dhamoon, 2023; Feher, 2017) PEF values are influenced by various physiological factors such as age, gender, height, nutritional status, and physical activity level. A decrease in PEF indicates increased airway resistance or decreased lung ventilation capacity. (Feher, 2017)

Physical activity is defined as any body movement produced by skeletal muscles that requires energy expenditure. Regular physical activity can increase cardiorespiratory capacity through physiological adaptations, including increased lung ventilation, tidal volume, and respiratory muscle strength. (Ji et al., 2021)

Several studies show that physical activity is positively related to lung function and PEF values. An intervention study by Imanita et al. reported significant increases in PEF values after a high-intensity training program in young adults (Dong et al., 2024). Longitudinal research also shows that regular physical activity plays a role in maintaining lung function and slowing the decline in ventilation capacity with age. (Wahyu & Mourisa, 2017; Arslan et al., 2024)

However, different results were reported by Marangoz et al., who found that although physical exercise increased vital lung capacity, there was no significant difference in PEF values between active and sedentary individuals (Ji et al., 2021). A large population study in Europe also showed that the relationship between physical activity and lung function was weak in healthy adult populations. (Marangoz et al., 2016)

BMI is a nutritional status indicator calculated from the ratio of body weight to height. BMI affects lung function through mechanical and physiological mechanisms. In individuals with high BMI, fat accumulation in the chest wall and abdomen can decrease lung compliance and limit diaphragm movement, thereby reducing ventilation capacity and expiratory airflow. (Charoensittisup et al., 2024)

On the other hand, several studies show that in non-obese overweight groups, higher BMI is actually associated with better lung function, which is thought to be related to greater muscle mass, including respiratory muscles. (Shah & Kaltsakas, 2023; DeVrieze et al., 2024) Other research has also reported a U-shaped or inverted U-shaped relationship between BMI and lung function, where both too low and too high BMI are associated with decreased PEF values. (Shah & Kaltsakas, 2023; Vanzeller et al., 2019) These findings show that the relationship between BMI and PEF is complex and depends on population characteristics.

METHODS

This study used a quantitative analytical design with a cross-sectional approach to assess the relationship between physical activity level and body mass index (BMI) with peak expiratory flow (PEF) values in adult populations, where all variables were measured simultaneously at one time point. The research was conducted at the Faculty of Computer Science, Informatics Engineering Department, Kuningan University in September–October 2025. The target population was all active lecturers and staff at the Faculty of Computer Science, with the accessible population being healthy lecturers and staff aged 18–59 years.

Research respondents were selected based on inclusion criteria that included: (1) active lecturers and staff, (2) no history of lung disease (asthma, COPD, or tuberculosis), (3) not currently experiencing acute respiratory tract infections, and (4) willing to participate in the study by signing informed consent. Exclusion criteria included: (1) individuals with a history of chest wall trauma affecting breathing (2) pregnant women.

Sample size was calculated using the infinite population formula and adjusted to the finite population with a prevalence of 50% (0.5) because precise prevalence data regarding the relationship between physical activity and body mass index with peak expiratory flow in lecturer and staff populations was not yet available, resulting in a minimum requirement of 50 respondents which was then increased by 10% to anticipate drop-outs, making a total of 55 respondents. A total of 57 respondents were successfully recruited in this study.

Physical activity was measured using the International Physical Activity Questionnaire–Short Form (IPAQ-SF) consisting of seven questions about respondents' physical activity over the last 7 days. Each type of activity was converted into a MET (Metabolic Equivalent of Task) score and categorized as low (<600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and high (>3000 MET-minutes/week). (Ko et al., 2021) BMI was calculated from body weight measurements using a GEA digital scale and height using a stadiometer using the standard BMI formula = body weight (kg) / [height (m)]^2, then classified according to Asia Pacific criteria (Okawa et al., 2025). PEF values were measured using a calibrated peak flow meter in a standing position, performed three times with the highest value as the final result, then compared with predicted values based on age, height, and gender to obtain PEF percentage, which was then categorized as normal (≥79%) and low (<79%) based on cut-off. (Su et al. 2024)

Data analysis was performed using SPSS version 25, including univariate analysis to describe data distribution using measures of central tendency and dispersion, as well as bivariate analysis using Chi-Square test or Fisher's Exact Test if requirements were not met, with a significance level of 95% (α = 0.05). This research has received ethical approval from the Research Ethics Commission of the Faculty of Medicine, Trisakti University with number 010/KER/FK/08/2025.

RESULTS

Based on Table 1, the majority of respondents were male, totaling 32 people (56.1%). In the nutritional status category, the distribution of respondents was quite diverse, with most respondents in the obesity I category (31.6%).

Table 1. Distribution of Respondent Characteristics (n=57)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	32	56.1
Female	25	43.9
Body Mass Index (BMI)		
Underweight (<18.5 kg/m^2)	7	12.3
Normal (18.5-22.9 kg/m^2)	14	24.6
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Low	42	73.7
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High	1	1.7
Peak Expiratory Flow (PEF)		
Low (<79% Predicted)	34	59.6
Normal (≥79% Predicted)	23	40.4

However, when combined, respondents with normal and underweight BMI reached 36.9%, while respondents with overweight and obesity reached 63.1%, showing a high proportion of overweight in this population. In terms of physical activity level, the majority of respondents had low physical activity levels, totaling 42 people (73.7%). Meanwhile, PEF measurement results showed that more than half of the respondents had low PEF values (< 79% predicted value), totaling 34 people (59.6%).

Relationship Between Physical Activity and Peak Expiratory Flow

In the bivariate analysis using chi-square test between physical activity and peak expiratory flow, the expected cell value <5 was more than 20%. The researcher combined the physical activity variable into 2 categories, namely low and moderate-high, so it could be tested using Fisher's Exact Test. Based on Table 2, respondents with low physical activity who had low PEF values totaled 25 people (59.5%), while respondents with moderate-high physical activity who had low PEF values totaled 9 people (57.1%). The proportion of low PEF in both physical activity groups showed minimal differences, with a difference of only 2.4%. Fisher's Exact Test results showed a p value = 0.611 ($p > 0.05$), indicating that there was no significant relationship between physical activity level and peak expiratory flow (PEF) values in respondents in this study.

Table 2. Relationship between Physical Activity and Peak Expiratory Flow (n=57)

Physical Activity	Peak Expiratory Flow		p-value
	Low (%)	Normal (%)	
Low	25 (59.5)	17 (40.5)	0.611#
Moderate-High	9 (57.1)	6 (42.9)	

#= Fisher's Exact Test

Relationship Between BMI and Peak Expiratory Flow

The researcher combined the BMI variable into 2 categories: underweight-normal and overweight-obese to meet statistical test requirements. Based on Table 3, there was a striking difference in proportions where respondents with underweight-normal BMI who had low PEF (73.3%) were far more numerous than respondents with overweight-obese BMI who had low PEF (44.4%). Chi Square Test statistical test results obtained a p value = 0.026 ($p < 0.05$), indicating that there was a significant relationship between BMI and peak expiratory flow (PEF) values. This finding shows that the overweight-obese BMI group had a higher proportion of normal PEF (55.6%) compared to the underweight-normal BMI group (26.7%).

Table 3. Relationship between Body Mass Index and Peak Expiratory Flow (n=57)

Body Mass Index	Peak Expiratory Flow		p-value
	Low (%)	Normal (%)	
Underweight-Normal	22 (73.3)	8 (26.7)	0.026*
Overweight-Obese	12 (44.4)	15 (55.6)	

*= Chi-Square Test ($p<0.05$)

DISCUSSION

The results of this study show that most respondents had low physical activity levels (73.7%) and more than half of respondents (59.6%) had peak expiratory flow (PEF) values below predicted values. This finding describes the dominant sedentary lifestyle pattern in academic adult populations, which has the potential to impact lung ventilation function even though clinically respondents did not show clear respiratory symptoms. The high proportion of low PEF in productive and relatively young age groups indicates a subclinical decrease in ventilation capacity (Ji et al., 2021).

This condition is in line with reports stating that PEF is influenced by various non-pathological factors, including physical activity level and body composition. However, the prevalence of low PEF in this study appears higher than the general population which is only around 3-4%, strengthening the assumption that computer-based work environments with long sitting durations contribute to decreased lung function performance (Powers & Dhamoon, 2023). The sedentary work pattern in this lecturer and staff population causes respiratory muscles not to be optimally trained, which ultimately impacts decreased lung function capacity (Burgard & Sonnega, 2018).

The distribution of respondent characteristics dominated by males (56.1%) is likely related to the demographic characteristics of teaching staff and employees in technology and computer faculty environments. International literature shows that in computer science/STEM fields, female representation in faculty and research is quite low, with only about 15% of tenure-track lecturers in Computer Science at many universities being female (Way et al., 2016). Although the majority of respondents had BMI in the normal-underweight category (36.9%), the proportion of respondents with overweight-obese was very high (63.1%), indicating that almost two-thirds of the population was overweight.

The combination of high overweight-obese proportions and lack of physical activity becomes an indicator of unhealthy lifestyles, which is then reflected in lung function results: more than half of respondents showed low PEF values. Low levels of physical activity can occur due to high academic workload, demands for completing computer-based work, and modern lifestyle changes that tend to reduce daily physical activity. Prolonged sitting habits, minimal leisure time for exercise, and priority on academic activities and passive entertainment contribute to the formation of sedentary lifestyle patterns that physiologically decrease cardiorespiratory fitness capacity (Collaud et al., 2024).

Relationship Between Physical Activity and Lung Function

The results of the analysis of the relationship between physical activity level and peak expiratory flow (PEF) showed that there was no statistically significant relationship between the two variables ($p = 0.611$). This finding shows that differences in physical activity categories based on IPAQ-SF were not followed by statistically significant differences in the proportion of low or normal PEF. The proportion of low PEF in the low physical activity group (59.5%) and the moderate-high physical activity group (57.1%) showed very minimal differences, only about 2.4%, indicating no clear relationship pattern between these two variables.

These results are in line with research by Marangoz et al. (2016) and Arslan et al. (2024), which reported that regular physical activity does not always correlate strongly with PEF parameters, especially in young adult populations without lung disease. (Marangoz et al., 2016; Arslan et al., 2024) Several studies show that physical activity is more consistently related to static lung function parameters such as FVC or FEV_1 compared to PEF, which is highly dependent on maximum momentary effort. The absence of a significant relationship can be explained by several factors. First, the relatively small sample size ($n = 57$) and very unbalanced distribution between physical activity groups, especially in the high physical activity group which was only represented by 1 person (1.7%), caused low test power to detect real differences. (Skender et al., 2016)

Measurement of physical activity based on MET-minutes/week is generally obtained from questionnaire instruments that are subjective in nature, making them prone to recall bias and misclassification. (Collaud et al., 2024) Emphasized that subjective measurement of physical activity tends to experience overestimation or underestimation, so the intensity of reported activity does not necessarily reflect adequate aerobic load to cause physiological adaptation in the respiratory system. This can cause incorrect grouping between low, moderate, and high physical activity. On the other hand, PEF measurement is also greatly influenced by examination techniques, subject motivation when blowing the peak flow meter, and diurnal variation in lung function, all of which have the potential to increase data variability. (Vanzeller et al., 2019)

From a physiological perspective, regular physical activity can increase respiratory muscle strength, vital lung capacity, and alveolar ventilation. However, these effects are generally more evident in structured and long-term aerobic exercise. (Fuertes et al., 2018) In general populations with heterogeneous physical activity variations and without exercise intensity control, the protective effect on lung function may not appear statistically. Moreover, PEF more reflects the strength and coordination of expiratory muscles compared to total ventilation capacity.

Therefore, physical activity with light to moderate intensity that dominates in respondents is likely not sufficient to significantly increase PEF performance. This finding emphasizes the importance of not only increasing the duration of physical activity, but also the intensity and type of exercise performed to have a positive impact on lung function. (Imanita et al., 2022)

Relationship Between BMI and Lung Function

In contrast to physical activity, this study found a significant relationship between BMI and PEF values ($p = 0.026$; $p < 0.05$), with an interesting direction of relationship to examine further. Respondents in the overweight-obese category had a higher proportion of normal PEF (55.6%) compared to respondents with underweight-normal BMI (26.7%). This result presents a direct contradiction to the general hypothesis that increased body mass is always negatively associated with lung function, and differs from most literature showing that being overweight increases the mechanical burden on the respiratory system. (Shah & Kaltsakas, 2023)

This finding is consistent with research results by Jordan et al. (2023) and Sembel et al. (2024), which reported that in student and young adult populations, increased BMI up to the overweight category is often correlated with better lung function values. This phenomenon can be explained through the muscle mass hypothesis, where weight gain at a young age does not always reflect increased adiposity, but also increased muscle mass. Greater muscle mass, especially in the thoracic and abdominal muscles, contributes to increased respiratory muscle strength, including the diaphragm and intercostal muscles. This allows individuals to generate higher expiratory pressure during PEF maneuvers, so the PEF value obtained becomes better (Jordan et al., 2023; Sembel et al., 2024; Elsaidy et al., 2024).

The normal BMI category in this study may include individuals who are at the lower limit of normal or who have lower muscle and fat mass composition compared to the overweight group. Conversely, underweight-normal BMI values dominated by low PEF may reflect the presence of sarcopenia or normal weight obesity, where although body weight appears normal, body fat composition is high while muscle mass is low—a condition that can significantly weaken respiratory muscles and decrease PEF. Thus, the findings of this study emphasize that in the context of lung function, BMI alone may be a less sensitive predictor compared to more specific body composition measurements, such as waist circumference or body fat percentage. (Jordan et al., 2023)

This condition differs from central obesity or severe obesity which actually decreases lung function through mechanical restriction effects on the chest wall and diaphragm. Literature shows that obesity increases the mechanical load on the chest wall, raises the diaphragm, and increases airway resistance, thereby reducing lung volume and vital capacity. (Sun et al., 2024) However, in the mild overweight range without excessive abdominal obesity as in this study population, the lung restriction effect has not yet occurred, and instead the advantage of greater body mass (muscle strength) is more dominant.

The positive relationship between BMI and PEF in this study needs to be understood in the context of respondent characteristics who are mostly productive adults without severe obesity. This result confirms that the impact of BMI on lung function is non-linear and is greatly influenced by body composition and body mass distribution. (Tang et al., 2022)

Clinical Implications and Research Limitations

The high prevalence of low PEF (59.6%) among respondents indicates the need for routine lung health screening programs in office worker environments, regardless of weight status. Peak expiratory flow reflects the maximum speed of air that can be expelled after maximal inspiration and is influenced by respiratory muscle strength, lung elasticity, airway caliber, and voluntary effort. PEF is a functional indicator that is easy to measure and has been linked to various health outcomes, including risk of cognitive deficit, motoric cognitive risk (MCR) in the elderly, frailty, sarcopenia, and mortality. (Dong et al., 2024; Xu et al., 2024)

In this study, the proportion of respondents with low PEF was quite high, showing the presence of peak ventilation problems that need serious attention. This finding indicates the need for routine lung function screening, respiratory education, and healthy lifestyle interventions in academic environments. Other studies show that increasing regular physical activity can slow the decline in lung function in asthma patients, and significant weight loss can increase ventilation and decrease airway resistance. (Brumpton et al., 2016) Therefore, promotion of physical activity and ideal weight management remains important, even though in this study the statistical impact on PEF was not visible.

This study has several limitations that need to be considered in interpreting the results. Limitations in BMI measurement, where BMI measurement alone without measuring body composition (fat vs muscle percentage) or waist circumference. This makes it difficult to ensure whether the positive correlation between BMI and PEF is caused by muscle mass or other factors. Other variables that have a strong influence on lung function such as smoking history, pollution exposure, and history of respiratory tract infections were not statistically controlled in this study. (Benadjaoud et al., 2019)

CONCLUSIONS

Based on research results conducted on adult populations in academic work environments, it can be concluded that physical activity level has no significant relationship with PEF values. Conversely, BMI showed a significant relationship with PEF values.

RECOMMENDATIONS

For future research, it is recommended to use longitudinal designs and objective measurement tools (such as accelerometers for physical activity and complete spirometry) and include muscle mass variables to clarify the mechanism of positive relationship between body weight and lung function. The use of objective physical activity measurement methods such as accelerometers can reduce questionnaire subjectivity bias and provide more accurate data regarding intensity, frequency, and duration of physical activity. (Collaud et al., 2024) In addition, body composition measurement using Bioelectrical Impedance Analysis (BIA) or DEXA scan can help precisely differentiate whether the positive BMI-PEF relationship is caused by muscle or fat, thereby providing a more comprehensive understanding of the physiological mechanisms underlying this finding. (Elsaidy et al., 2024)

FURTHER STUDY

This study still has limitations, so further research on Relationship Between Physical Activity and Body Mass Index With Peak Expiratory Flow in Adults is needed to refine this study and enhance the insights of readers and the authors.

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Relationship Between Physical Activity and Body Mass Index With Peak Expiratory Flow in Adults

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ABSTRACT

Peak expiratory flow (PEF) is a crucial parameter for assessing large airway function and lung ventilation capacity. PEF values are influenced by various factors, including physical activity levels and nutritional status as measured through body mass index (BMI). This study aims to investigate the relationship between physical activity and BMI with PEF in the adult population within an academic work environment. An analytical observational study with a cross-sectional design was conducted at the Faculty of Computer Science, Kuningan University, from September to October 2025. A total of 57 respondents met the inclusion criteria. Physical activity was measured using the IPAQ-Short Form, BMI was measured using weight and height measurements, and PEF was measured using a Peak Flow Meter. Data analysis was performed using the Chi-Square test and analyzed using SPSS version 25. Most respondents had low physical activity (73.7%) and low PEF (59.6%). No significant relationship was found between physical activity and PEF (p = 0.611). In contrast, BMI showed a significant relationship with PEF (p = 0.026). There is a relationship between BMI and PEF, but no significant relationship was found between physical activity level and PEF in these research respondents.

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INTRODUCTION

Peak expiratory flow (PEF) is a simple yet important parameter for assessing large airway function and lung ventilation capacity. PEF values are widely used in clinical practice and community settings as an early indicator of pulmonary function impairment because the measurement is easy, quick, and non-invasive. A decrease in PEF values can reflect airway obstruction or reduced respiratory muscle strength, which can potentially impact the quality of life of socially and professionally active adults. (Feher, 2017)

Various factors are known to influence PEF values, including age, gender, height, nutritional status, and physical activity level. Physical activity plays a role in increasing cardiopulmonary capacity and respiratory muscle strength through physiological adaptations to increased workload. Meanwhile, body mass index (BMI) has a complex relationship with lung function. In obesity, increased fat mass can cause mechanical restriction of the chest wall and diaphragm, whereas in individuals with low BMI, respiratory muscle weakness can decrease lung ventilation performance. However, previous research has shown inconsistent findings regarding the relationship between physical activity and BMI with PEF, especially in healthy adult populations. (Feher, 2017; Ji et al., 2021)

Most previous studies were conducted on specific age groups, such as adolescents, elderly individuals, or people with lung disease, so data on healthy adult populations in academic work environments remains limited. The academic environment is an interesting sample because it is characterized by sedentary workload, relatively good health literacy, and diverse variations in physical activity and nutritional status. This condition provides an opportunity to evaluate the relationship between physical activity and BMI with PEF in an adult population that is relatively homogeneous in terms of occupation but heterogeneous in terms of lifestyle. Based on this background, this research was conducted to analyze the relationship between physical activity level and BMI with PEF in adult populations in academic work environments, as a contribution to enriching scientific evidence regarding factors that affect lung function in adults.

LITERATURE REVIEW

PEF represents the maximum airflow value that can be achieved during rapid and forceful expiration after maximal inspiration. PEF reflects large airway function, lung elasticity, and respiratory muscle strength, making it widely used as a simple indicator of lung function at clinical and community levels. (Powers & Dhamoon, 2023; Feher, 2017) PEF values are influenced by various physiological factors such as age, gender, height, nutritional status, and physical activity level. A decrease in PEF indicates increased airway resistance or decreased lung ventilation capacity. (Feher, 2017)

Physical activity is defined as any body movement produced by skeletal muscles that requires energy expenditure. Regular physical activity can increase cardiorespiratory capacity through physiological adaptations, including increased lung ventilation, tidal volume, and respiratory muscle strength. (Ji et al., 2021)

Several studies show that physical activity is positively related to lung function and PEF values. An intervention study by Imanita et al. reported significant increases in PEF values after a high-intensity training program in young adults (Dong et al., 2024). Longitudinal research also shows that regular physical activity plays a role in maintaining lung function and slowing the decline in ventilation capacity with age. (Wahyu & Mourisa, 2017; Arslan et al., 2024)

However, different results were reported by Marangoz et al., who found that although physical exercise increased vital lung capacity, there was no significant difference in PEF values between active and sedentary individuals (Ji et al., 2021). A large population study in Europe also showed that the relationship between physical activity and lung function was weak in healthy adult populations. (Marangoz et al., 2016)

BMI is a nutritional status indicator calculated from the ratio of body weight to height. BMI affects lung function through mechanical and physiological mechanisms. In individuals with high BMI, fat accumulation in the chest wall and abdomen can decrease lung compliance and limit diaphragm movement, thereby reducing ventilation capacity and expiratory airflow. (Charoensittisup et al., 2024)

On the other hand, several studies show that in non-obese overweight groups, higher BMI is actually associated with better lung function, which is thought to be related to greater muscle mass, including respiratory muscles. (Shah & Kaltsakas, 2023; DeVrieze et al., 2024) Other research has also reported a U-shaped or inverted U-shaped relationship between BMI and lung function, where both too low and too high BMI are associated with decreased PEF values. (Shah & Kaltsakas, 2023; Vanzeller et al., 2019) These findings show that the relationship between BMI and PEF is complex and depends on population characteristics.

METHODS

This study used a quantitative analytical design with a cross-sectional approach to assess the relationship between physical activity level and body mass index (BMI) with peak expiratory flow (PEF) values in adult populations, where all variables were measured simultaneously at one time point. The research was conducted at the Faculty of Computer Science, Informatics Engineering Department, Kuningan University in September–October 2025. The target population was all active lecturers and staff at the Faculty of Computer Science, with the accessible population being healthy lecturers and staff aged 18–59 years.

Research respondents were selected based on inclusion criteria that included: (1) active lecturers and staff, (2) no history of lung disease (asthma, COPD, or tuberculosis), (3) not currently experiencing acute respiratory tract infections, and (4) willing to participate in the study by signing informed consent. Exclusion criteria included: (1) individuals with a history of chest wall trauma affecting breathing (2) pregnant women. Sample size was calculated using the infinite population formula and adjusted to the finite population with a prevalence of 50% (0.5) because precise prevalence data regarding the relationship between physical activity and body mass index with peak expiratory flow in lecturer and staff populations was not yet available, resulting in a minimum requirement of 50 respondents which was then increased by 10% to anticipate drop-outs, making a total of 55 respondents. A total of 57 respondents were successfully recruited in this study.

Physical activity was measured using the International Physical Activity Questionnaire–Short Form (IPAQ-SF) consisting of seven questions about respondents' physical activity over the last 7 days. Each type of activity was converted into a MET (Metabolic Equivalent of Task) score and categorized as low (<600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and high (>3000 MET-minutes/week). (Ko et al., 2021) BMI was calculated from body weight measurements using a GEA digital scale and height using a stadiometer using the standard BMI formula = body weight (kg) / [height (m)]^2, then classified according to Asia Pacific criteria (Okawa et al., 2025). PEF values were measured using a calibrated peak flow meter in a standing position, performed three times with the highest value as the final result, then compared with predicted values based on age, height, and gender to obtain PEF percentage, which was then categorized as normal (≥79%) and low (<79%) based on cut-off. (Su et al. 2024)

Data analysis was performed using SPSS version 25, including univariate analysis to describe data distribution using measures of central tendency and dispersion, as well as bivariate analysis using Chi-Square test or Fisher's Exact Test if requirements were not met, with a significance level of 95% (α = 0.05). This research has received ethical approval from the Research Ethics Commission of the Faculty of Medicine, Trisakti University with number 010/KER/FK/08/2025.

RESULTS

Based on Table 1, the majority of respondents were male, totaling 32 people (56.1%). In the nutritional status category, the distribution of respondents was quite diverse, with most respondents in the obesity I category (31.6%).

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Table 1. Distribution of Respondent Characteristics (n=57)

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	32	56.1
Female	25	43.9
Body Mass Index (BMI)		
Underweight (<18.5 kg/m²)	7	12.3
Normal (18.5-22.9 kg/m²)	14	24.6
Overweight (23.0-24.9 kg/m²)	9	15.8
Obesity I (25.0-29.9 kg/m²)	18	31.6
Obesity II (≥30.0 kg/m²)	9	15.8
Physical Activity		
Low	42	73.7
Moderate	14	24.5
High	1	1.7
Peak Expiratory Flow (PEF)		
Low (<79% Predicted)	34	59.6
Normal (≥79% Predicted)	23	40.4

However, when combined, respondents with normal and underweight BMI reached 36.9%, while respondents with overweight and obesity reached 63.1%, showing a high proportion of overweight in this population. In terms of physical activity level, the majority of respondents had low physical activity levels, totaling 42 people (73.7%). Meanwhile, PEF measurement results showed that more than half of the respondents had low PEF values (< 79% predicted value), totaling 34 people (59.6%).

Relationship Between Physical Activity and Peak Expiratory Flow

In the bivariate analysis using chi-square test between physical activity and peak expiratory flow, the expected cell value <5 was more than 20%. The researcher combined the physical activity variable into 2 categories, namely low and moderate-high, so it could be tested using Fisher's Exact Test. Based on Table 2, respondents with low physical activity who had low PEF values totaled 25 people (59.5%), while respondents with moderate-high physical activity who had low PEF values totaled 9 people (57.1%). The proportion of low PEF in both physical activity groups showed minimal differences, with a difference of only 2.4%. Fisher's Exact Test results showed a p value = 0.611 ($p > 0.05$), indicating that there was no significant relationship between physical activity level and peak expiratory flow (PEF) values in respondents in this study.

5 **Table 2. Relationship Between Physical Activity and Peak Expiratory Flow (n=57)**

Physical Activity	Peak Expiratory Flow		p-value
	Low (%)	Normal (%)	
Low	25 (59.5)	17 (40.5)	0.611#
Moderate-High	9 (57.1)	6 (42.9)	

#= Fisher's Exact Test

Relationship Between BMI and Peak Expiratory Flow

The researcher combined the BMI variable into 2 categories: underweight-normal and overweight-obese to meet statistical test requirements. Based on Table 3, there was a striking difference in proportions where respondents with underweight-normal BMI who had low PEF (73.3%) were far more numerous than respondents with overweight-obese BMI who had low PEF (44.4%). Chi
1 Square Test statistical test results obtained a p value = 0.026 ($p < 0.05$), indicating that there was a significant relationship between BMI and peak expiratory flow
42 (PEF) values. This finding shows that the overweight-obese BMI group had a
5 higher proportion of normal PEF (55.6%) compared to the underweight-normal BMI group (26.7%).

1 **Table 3. Relationship Between Body Mass Index and Peak Expiratory Flow (n=57)**

Body Mass Index	Peak Expiratory Flow		p-value
	Low (%)	Normal (%)	
Underweight-Normal	22 (73.3)	8 (26.7)	0.026*
Overweight-Obese	12 (44.4)	15 (55.6)	

*= Chi-Square Test ($p<0.05$)

DISCUSSION

7 The results of this study show that most respondents had low physical activity levels (73.7%) and more than half of respondents (59.6%) had peak expiratory flow (PEF) values below predicted values. This finding describes the dominant sedentary lifestyle pattern in academic adult populations, which has the potential to impact lung ventilation function even though clinically respondents did not show clear respiratory symptoms. The high proportion of low PEF in productive and relatively young age groups indicates a subclinical decrease in ventilation capacity (Ji et al., 2021).

This condition is in line with reports stating that PEF is influenced by various non-pathological factors, including physical activity level and body composition. However, the prevalence of low PEF in this study appears higher than the general population which is only around 3-4%, strengthening the assumption that computer-based work environments with long sitting durations contribute to decreased lung function performance (Powers & Dhamoon, 2023). The sedentary work pattern in this lecturer and staff population causes

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respiratory muscles not to be optimally trained, which ultimately impacts decreased lung function capacity (Burgard & Sonnega, 2018).

The distribution of respondent characteristics dominated by males (56.1%) is likely related to the demographic characteristics of teaching staff and employees in technology and computer faculty environments. International literature shows that in computer science/STEM fields, female representation in faculty and research is quite low, with only about 15% of tenure-track lecturers in Computer Science at many universities being female (Way et al., 2016). Although the majority of respondents had BMI in the normal-underweight category (36.9%), the proportion of respondents with overweight-obese was very high (63.1%), indicating that almost two-thirds of the population was overweight.

The combination of high overweight-obese proportions and lack of physical activity becomes an indicator of unhealthy lifestyles, which is then reflected in lung function results: more than half of respondents showed low PEF values. Low levels of physical activity can occur due to high academic workload, demands for completing computer-based work, and modern lifestyle changes that tend to reduce daily physical activity. Prolonged sitting habits, minimal leisure time for exercise, and priority on academic activities and passive entertainment contribute to the formation of sedentary lifestyle patterns that physiologically decrease cardiorespiratory fitness capacity (Collaud et al., 2024).

Relationship Between Physical Activity and Lung Function

The results of the analysis of the relationship between physical activity level and peak expiratory flow (PEF) showed that there was no statistically significant relationship between the two variables ($p = 0.611$). This finding shows that differences in physical activity categories based on IPAQ-SF were not followed by statistically significant differences in the proportion of low or normal PEF. The proportion of low PEF in the low physical activity group (59.5%) and the moderate-high physical activity group (57.1%) showed very minimal differences, only about 2.4%, indicating no clear relationship pattern between these two variables. These results are in line with research by Marangoz et al. (2016) and Arslan et al. (2024), which reported that regular physical activity does not always correlate strongly with PEF parameters, especially in young adult populations without lung disease. (Marangoz et al., 2016; Arslan et al., 2024) Several studies show that physical activity is more consistently related to static lung function parameters such as FVC or FEV_1 compared to PEF, which is highly dependent on maximum momentary effort. The absence of a significant relationship can be explained by several factors. First, the relatively small sample size ($n = 57$) and very unbalanced distribution between physical activity groups, especially in the high physical activity group which was only represented by 1 person (1.7%), caused low test power to detect real differences. (Skender et al., 2016)

Measurement of physical activity based on MET-minutes/week is generally obtained from questionnaire instruments that are subjective in nature, making them prone to recall bias and misclassification. (Collaud et al., 2024) Emphasized that subjective measurement of physical activity tends to experience overestimation or underestimation, so the intensity of reported activity does not necessarily reflect adequate aerobic load to cause physiological adaptation in the respiratory system. This can cause incorrect grouping between low, moderate, and high physical activity. On the other hand, PEF measurement is also greatly influenced by examination techniques, subject motivation when blowing the peak flow meter, and diurnal variation in lung function, all of which have the potential to increase data variability. (Vanzeller et al., 2019)

From a physiological perspective, regular physical activity can increase respiratory muscle strength, vital lung capacity, and alveolar ventilation. However, these effects are generally more evident in structured and long-term aerobic exercise. (Fuertes et al., 2018) In general populations with heterogeneous physical activity variations and without exercise intensity control, the protective effect on lung function may not appear statistically. Moreover, PEF more reflects the strength and coordination of expiratory muscles compared to total ventilation capacity. Therefore, physical activity with light to moderate intensity that dominates in respondents is likely not sufficient to significantly increase PEF performance. This finding emphasizes the importance of not only increasing the duration of physical activity, but also the intensity and type of exercise performed to have a positive impact on lung function. (Imanita et al., 2022)

Relationship Between BMI and Lung Function

In contrast to physical activity, this study found a significant relationship between BMI and PEF values ($p = 0.026$; $p < 0.05$), with an interesting direction of relationship to examine further. Respondents in the overweight-obese category had a higher proportion of normal PEF (55.6%) compared to respondents with underweight-normal BMI (26.7%). This result presents a direct contradiction to the general hypothesis that increased body mass is always negatively associated with lung function, and differs from most literature showing that being overweight increases the mechanical burden on the respiratory system. (Shah & Kaltsakas, 2023) This finding is consistent with research results by Jordan et al. (2023) and Sembel et al. (2024), which reported that in student and young adult populations, increased BMI up to the overweight category is often correlated with better lung function values. This phenomenon can be explained through the muscle mass hypothesis, where weight gain at a young age does not always reflect increased adiposity, but also increased muscle mass. Greater muscle mass, especially in the thoracic and abdominal muscles, contributes to increased respiratory muscle strength, including the diaphragm and intercostal muscles. This allows individuals to generate higher expiratory pressure during PEF maneuvers, so the PEF value obtained becomes better (Jordan et al., 2023; Sembel et al., 2024; Elsaidy et al., 2024).

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The normal BMI category in this study may include individuals who are at the lower limit of normal or who have lower muscle and fat mass composition compared to the overweight group. Conversely, underweight-normal BMI values dominated by low PEF may reflect the presence of sarcopenia or normal weight obesity, where although body weight appears normal, body fat composition is high while muscle mass is low—a condition that can significantly weaken respiratory muscles and decrease PEF. Thus, the findings of this study emphasize that in the context of lung function, BMI alone may be a less sensitive predictor compared to more specific body composition measurements, such as waist circumference or body fat percentage. (Jordan et al., 2023)

This condition differs from central obesity or severe obesity which actually decreases lung function through mechanical restriction effects on the chest wall and diaphragm. Literature shows that obesity increases the mechanical load on the chest wall, raises the diaphragm, and increases airway resistance, thereby reducing lung volume and vital capacity. (Sun et al., 2024) However, in the mild overweight range without excessive abdominal obesity as in this study population, the lung restriction effect has not yet occurred, and instead the advantage of greater body mass (muscle strength) is more dominant. The positive relationship between BMI and PEF in this study needs to be understood in the context of respondent characteristics who are mostly productive adults without severe obesity. This result confirms that the impact of BMI on lung function is non-linear and is greatly influenced by body composition and body mass distribution. (Tang et al., 2022)

Clinical Implications and Research Limitations

The high prevalence of low PEF (59.6%) among respondents indicates the need for routine lung health screening programs in office worker environments, regardless of weight status. Peak expiratory flow reflects the maximum speed of air that can be expelled after maximal inspiration and is influenced by respiratory muscle strength, lung elasticity, airway caliber, and voluntary effort. PEF is a functional indicator that is easy to measure and has been linked to various health outcomes, including risk of cognitive deficit, motoric cognitive risk (MCR) in the elderly, frailty, sarcopenia, and mortality. (Dong et al., 2024; Xu et al., 2024)

In this study, the proportion of respondents with low PEF was quite high, showing the presence of peak ventilation problems that need serious attention. This finding indicates the need for routine lung function screening, respiratory education, and healthy lifestyle interventions in academic environments. Other studies show that increasing regular physical activity can slow the decline in lung function in asthma patients, and significant weight loss can increase ventilation and decrease airway resistance. (Brumpton et al., 2016) Therefore, promotion of physical activity and ideal weight management remains important, even though in this study the statistical impact on PEF was not visible.

This study has several limitations that need to be considered in interpreting the results. Limitations in BMI measurement, where BMI measurement alone without measuring body composition (fat vs muscle percentage) or waist circumference. This makes it difficult to ensure whether the positive correlation between BMI and PEF is caused by muscle mass or other factors. Other variables that have a strong influence on lung function such as smoking history, pollution exposure, and history of respiratory tract infections were not statistically controlled in this study. (Benadjaoud et al., 2019)

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on research results conducted on adult populations in academic work environments, it can be concluded that physical activity level has no significant relationship with PEF values. Conversely, BMI showed a significant relationship with PEF values.

Recommendations

For future research, it is recommended to use longitudinal designs and objective measurement tools (such as accelerometers for physical activity and complete spirometry) and include muscle mass variables to clarify the mechanism of positive relationship between body weight and lung function. The use of objective physical activity measurement methods such as accelerometers can reduce questionnaire subjectivity bias and provide more accurate data regarding intensity, frequency, and duration of physical activity. (Collaud et al., 2024) In addition, body composition measurement using Bioelectrical Impedance Analysis (BIA) or DEXA scan can help precisely differentiate whether the positive BMI-PEF relationship is caused by muscle or fat, thereby providing a more comprehensive understanding of the physiological mechanisms underlying this finding. (Elsaidy et al., 2024)

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