FACTORS RELATED TO PEAK EXPIRATORY FLOW RATE IN PULMONARY TUBERCULOSIS PATIENTS

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ABSTRACT

Patients with pulmonary tuberculosis can be at risk of bronchial obstruction due to secretions or secretions that collect and shallow breathing due to pain, which can cause atelectasis and decreased Peak Expiratory Flow Rate (PEFR) in pulmonary TB patients. The purpose of this study was to determine the relationship between PEFR in pulmonary TB patients at the Kramat Jati Health Center. This type of research uses correlation analytic observation using cross-sectional design and data analysis using Chi Square and Sperman rank methods. The sample in this study were 50 respondents at the TB Poly Kramat Jati Health Center and were collected using total sampling. Conclusion: The results of this study showed that gender was associated with PEFR in pulmonary TB patients with a p value=0.016 p <0.05 and work was associated with PEFR in pulmonary TB patients with a p value=0.007 p <0.05, age was unrelated to PEFR in pulmonary TB patients with a p value=0.412 and so was BMI with a p value=0.509. Suggestion: for more in-depth matters related to PEFR in pulmonary TB patients can be seen in terms of environmental factors or the physical condition of the patient.

Keywords: *Medical Surgical Nursing; Peak Expiratory Flow Rate; Pulmonary Tuberculosis*

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis, primarily affecting the lungs, making pulmonary symptoms the most common manifestation. The bacteria spread through airborne droplets when an infected person coughs, talks, or sneezes, making it highly contagious (Inayah & Wahyono, 2019).

Despite global efforts to control the disease, TB remains a significant public health issue, with a high incidence, especially in developing countries. Indonesia is currently ranked second globally in the number of new pulmonary TB cases, behind India, highlighting the continued need for effective prevention and treatment strategies (Miranda et al., 2019).

In pulmonary TB patients, there is an increased risk of bronchial obstruction due to

the accumulation of secretions, leading to reduced airway patency and shallow breathing, which may result in atelectasis. Atelectasis is the collapse of lung tissue due to obstruction of the airways, which, if untreated, may lead to fibrosis and a permanent decrease in lung elasticity (Wahdi & Dewi Retno Puspitosari, 2021). The diminished capacity of the lungs to function effectively can be measured through Peak Expiratory Flow Rate (PEFR), which evaluates the maximum speed at which a person can exhale air. PEFR is influenced by several factors, including age, gender, weight, height, and environmental conditions (Andriany, 2018).

Decreased lung functional capacity occurs due to damage to lung parenchymal tissue and respiratory tract. The severity of the degree of lung damage can be detected by the functions still performed by the respiratory system. Decreased lung function will reduce the availability of oxygen throughout the body and ultimately have an impact on reducing health status. (Puspasari & Fistra Aryu Brata Dewi, 2020).

Peak Expiratory Flow Rate is the maximum ability to expel air in the lungs from a state of maximum inspiration through the mouth in liters per minute (L/min) and describes air flow that depends on expiratory strength and muscle strength or PEFR is the maximum expiratory air flow by a person within 10 seconds expressed in liters per minute (Andriany, 2018).

PEFR values are related to several factors including measurements of height, weight, age and gender, nutritional status, environment, respiratory tract conditions, and chest cavity deformities. PEF measurement results vary depending on age, gender, height, weight, nutritional status / body mass index (BMI) and breath effort (Andriany, 2018).

Pulmonary TB is at risk of obstruction due to the accumulation of secretions or secretions that collect which results in narrowing of the small breathing space, causing symptoms such as coughing, wheezing, or shortness of breath. Which in turn can cause atelectasis and a decrease in peak expiratory flow rate (PEFR). To determine lung function, it can be measured with a peak folw mater tool which is the maximum ability to expel air in the lungs from the maximum inspiratory state of the mouth. And output the results of the PEFR value. PEFR values are related to several factors including age and gender, occupation, and body mass index.

This study is essential to be conducted in East Jakarta because it is the region with the highest prevalence of pulmonary TB cases in the capital, making it a critical area for focused public health interventions. Despite the widespread availability of TB treatment, the persistent high incidence rates in East Jakarta indicate potential gaps in effective disease management and the need for targeted research to understand contributing factors such as PEFR. By analyzing the specific demographic and environmental factors influencing PEFR in this high-risk area, the study can provide valuable insights that can inform local healthcare strategies and improve patient outcomes.

OBJECTIVE

Analyze the factors related to peak expiratory flow rate in pulmonary tuberculosis patients.

METHOD

This study uses a cross-sectional design where each variable studied or observed is measured only once. Therefore, this study is limited to context knowledge only and cannot explain cause and effect or causal relationships. In this study, the population was pulmonary TB patients who were undergoing outpatient care at the Kramat Jati District Health Center. The sample in this study were pulmonary TB outpatients in the Kramat Jati Subdistrict area aged 20-60 years, namely 50 people.

The Spearman Rank correlation is used to bivariat analyzing, because the data did not meet the assumptions for a parametric test, such as normality. Spearman Rank is

particularly suitable for data that is ordinal or not normally distributed, which was the case in this study. This method allows us to assess the strength and direction of the relationship between two variables without assuming a linear distribution. It was especially helpful in analyzing the relationship between demographic factors (like age, gender, and BMI) and PEFR (Peak Expiratory Flow Rate) in pulmonary TB patients. By using Spearman Rank, we could capture the correlations more accurately, taking into account the non-normal nature of our data, ensuring that the findings reflect the true relationships between these variables.

RESULT

Univariate Analysis

This study was followed by a total of 50 respondents who had an age range of 26-35 and 46-55 who were predominantly male with Private and Other occupations having the highest percentage, and had the most Underweight BMI values, namely 23 people (table 1).

The table shows the highest frequency distribution in yellow PEFR with 21 respondents (Table 2).

Bivariate Analysis

The results of the analysis related to gender with PEFR with 50 respondents, showed that the statistical test results obtained were the value of P = 0.016, meaning p <0.05 so it can be concluded that there is a relationship between gender and pulmonary TB (Table 2).

illustrates the relationship between age and PEFR. Based on the results of Spearman Rank, the significance value or p value is 0.412 because the p value is greater than 0.05, it can be concluded that there is no significant or meaningful relationship between age level and PEFR in pulmonary TB patients at the TB Clinic Kramat Jati Health Center. (Table 2).

Table 2 shows the results of statistical tests obtained the results of p value = 0.007 means p value <0.05. So it means that there are factors related to work with PEFR in pulmonary TB patients at TB Poly Kramat Jati Health Center (Table 2). In that table also illustrates the relationship between BMI and PEFR. Based on the results of Spearman rank, the significance value or p value is 0.509 because the p value is greater than 0.05, it can be concluded that there is no significant or meaningful relationship between BMI and PEFR in pulmonary TB patients at the TB Poly Kramat Jati Health Center (Table 2).

DISCUSSION

Univariate Analysis

The results of the analysis in table 1 show that the majority of respondents in this study were male as many as 27 (54%). These results are similar to research (Hariyono et al., 2021) where the majority of respondents were male with 21 (46%) respondents while female respondents were 2 (4%). The results of this study are in line with research conducted by (Hariyono, 2019) where out of 35 respondents the majority of respondents were male, totaling 23 male respondents and 12 female respondents. According to (Nafisah et al., 2019) respondents based on gender, the average respondent in both groups who had the largest percentage was male, totaling 21 people (46%) this shows that men are more susceptible to developing pulmonary TB caused by smoking habits which is a comorbid factor in pulmonary TB. One of the indicators related to gender to PEFR in the incidence of pulmonary TB is a person's life habits such as smoking habits and alcohol drinking habits which can affect PEFR in pulmonary TB.

Based on the results in table 1, the research analysis obtained results showing that early adulthood and early elderly showed the highest number of results, totaling 14 respondents each (28%). The results of this study are in line with research conducted by (Pangaribuan et al., 2020) in which the majority of respondents aged 34-55 years were 164. As for research conducted by (Sina et al., 2022) respondents aged (15-58 years) were 60 people (63.8%) while those aged 55 years and over were fewer, namely 34 respondents (36.2%).

According to Sina et al., (2022) the age group 14 - 55 years is an age group that is still income productive. It is estimated that an elderly pulmonary TB patient will spend an average of 3 to 4 months working. This has an impact on the loss of annual household income.

Based on the results in table 1 of the univariate analysis, the results showed that private jobs and others such as laborers, public transportation drivers, numbered 17 respondents each. The results of this study are in line with Hamidi et al., (2021) most of the self-employed with 11 respondents (36.7%) which is where most of the pulmonary TB occurs due to work.

According to (Susanti, 2020) the type of work can affect the emergence of disease through environmental factors. Work environment factors can cause a person to be exposed to a disease. A poor work environment supports infection with pulmonary TB. Based on the data obtained, there is a lot of conformity with what is done in this study that the type of work is related to pulmonary TB disease.

Although the work environment is cited as a risk factor for PEFR, its role is less strong than that of cigarette smoke. However, if work environment factors are combined with cigarette smoke, there will be a large synergistic effect (Kusuma, 2019).

One of the indicators that relates PEFR to pulmonary TB is work. Where the environment in work greatly affects the high or low value of PEFR according to smoking habits and air pollution in the work environment.

The univariate results obtained showed that the highest body mass index was underweight, totaling 23 respondents. The results of this study are in line with (Dayu Pralambang et al., 2020) found that people who have an underweight BMI are 13.57 times the incidence of pulmonary TB Nutritional status is a risk factor for the incidence of pulmonary TB, respondents with nutritional status have an underweight BMI value.

According to Fadhalna, (2019) the incidence of pulmonary TB cannot be separated from the lifestyle and nutrition of the community, poor lifestyle can trigger the onset of pulmonary TB disease. In addition, poor nutrition will cause someone who has been exposed to this disease to not recover quickly. From various sources obtained, it can be concluded that most people with less weight can easily develop pulmonary TB disease.

Based on the results in table 2, the results show that the frequency of the yellow zone with a total of 21 respondents (42%). This research is in line with research conducted (Ardiana, 2020) where the yellow zone PEFR category was 30 people (66.8) more than the red zone PEFR value of 16 people (34%). This study is also in line with research (Hans, 2019) where most respondents in the VH community had a yellow PEFR category, namely 31 people (43.1).

This study is also in line with (Nafisah et al., 2019a) which shows that of the 96 patients who had respiratory problems who were tested for PEFR, there were 52 people (54.20%) who had yellow zone results. According to Nafisah et al., (2019a) based on a history of lung disease that has been experienced, it was found that 19.8% of samples had a history of lung disease after PEFR examination, it turned out that there was a decrease in lung function with the highest PEFR value in the yellow zone as many as 52 people, this happened because in samples that did not have a history of lung disease, other related factors were found such as age, gender and smoking history. From the history of research cited in accordance with the research conducted where there are factors related such as age, gender, occupation, and BMI to PEFR in pulmonary TB patients.

Bivariate Analysis

Based on the results in table 2, the study showed a significant correlation between gender and PEFR in pulmonary TB patients at the TB Poly Kramat Jati Health

Center with a p value of 0.016 (<0.05). This study showed that male respondents in the red zone were 10 (37.9%), yellow zone were 15 (55.6%), and green zone were 2 (7.4%) and female respondents in the red zone were 8 (34.8%), yellow zone were 6 (26.1%) and green zone were 9 (39.1%). It can be concluded that the majority of male respondents with 27 respondents and the highest total in the yellow zone with 15 (55.6) so that there is a relationship between gender and PEFR in Pulmonary TB patients at the Kramat Jati Health Center.

The results of the research conducted by the researchers are in accordance with the results of previous researchers conducted by (Nafisah et al., 2019) About Analysis of Peak Expiratory Flow Rate (PEFR) Results in patients with Respiratory Disorders. That gender has an association with the incidence of pulmonary TB because in the male sex there is more decrease in PEFR with a value of 50-80%. This is in line with this study where in male patients with a total of 27 male patient respondents were in the yellow zone as many as 15 (55.6%).

From these data, it is also supported by research (Harahap et al., 2019) that there is a relationship between PEFR and gender, besides that the PEFR value of men is greater and more diverse than women due to the large respiratory muscles supported by a relatively higher level of sports activity. During exercise, there will be an immediate increase in ventilas. A man with a maximum oxygen consumption of 4L/min, his ventilation can increase to 120 L/min. This increase in ventilation is accompanied by increased oxygen uptake and carbon dioxide removal. Large carbon dioxide removal leads to high PEFR values due to the absence of airway patency. PEFR serves to assess expiratory muscle strength and airway patency.

Based on the results in table 2, the study showed no significant correlation between age and PEFR in pulmonary TB patients at the TB Poly of Kramat Jati Health Center with a p value of 0.357 (>0.05). This study shows that early adulthood with a red zone of 8 (57.1%), it can be concluded that the majority of early adult respondents aged 26-35 years with a total of 24 respondents were at a PEFR value in the red zone as many as 8 (57.1%). This proves that early adulthood with age 26-35 is not related to PEFR in pulmonary TB patients at Kramat Jati Health Center.

The results of this study showed that respondents with late adolescence 3 (30%) with red PEFR value, 6(60%) with yellow PEFR value, 1(10%) with green PEFR value, early adulthood 8(57%) with red PEFR value, 3(21%) with yellow PEFR value, 3(21%) with green value, late adulthood 3(33%) 36 with red PEFR value, 2(22%) with yellow PEFR value, 4(44%) with green PEFR value, early elderly 3(21%) with red PEFR value, 8(57%) with yellow PEFR value, 3(21%) with green PEFR value, and late elderly with 1(33%) respondent with red PEFR value, 2(66%) with yellow PEFR value, and 0(0%) with green PEFR value. This shows that there is no significant relationship between age and PEFR in pulmonary TB patients at the Kramat Jati Health Center.

The results of this study are not in accordance with the results of previous research conducted by (Pangaribuan et al., 2020). That age has a relationship with the incidence of pulmonary TB with p of 1.22 and 1.74, which means that age in the range of 15 -34 years has a risk of 1.22 times while 55 years has a risk of 1.74 times. Which means that age has a factor related to pulmonary TB. As for research conducted by (Sina et al., 2022) that age has no relationship with pulmonary TB where the p value is obtained = 0.131 with a significant level <0.05 so it can be concluded that there is no relationship between age and pulmonary tuberculosis.

The most vulnerable age for pulmonary TB is those aged 15-65 years. However, the most advanced age is more than 55 years old because the immune system of a person of that age can decrease so that it is very vulnerable to a pulmonary TB disease. In general, decreased lung volume and capacity

are associated with increased airway resistance and decreased airway reactance. Increased airway resistance is mainly due to damage and remodeling of the peripheral airways during TB infection, the treatment period, and post-treatment depending on pathogen-host interactions (Shanmugasundaram et al., 2022).

Based on research conducted by Kusuma (2019) that the decrease in PEFR in patients with pulmonary TB is also very diverse, this is related to the radiological picture of plain chest photos, where the more extensive the radiological lesion, the lower the percentage value of PEFR in that patient.

Based on the assumptions of researchers and references obtained, in this study respondents who had moderate or low PEFR values were not only related to the pathophysiological burden of pulmonary TB disease, but could also be related to demographic factors such as gender, and occupation.

The results of bivariate analysis have been carried out and show a significant correlation between occupation and PEFR in pulmonary TB patients at the Kramat Jati Health Center with a p value of 0.007 (<0.05) in this study showing that the majority of respondents have other jobs with a total of 17 respondents in the red zone as many as 8 (47.1%). This proves that work can be related to PEFR values due to different activities or activities carried out. The results in this study also showed that respondents with ASN jobs with a total of 3 respondents were not in the red zone, 1 (33.3%) was in the yellow zone, and 2 (66.7%) were in the green zone. Meanwhile, there were 17 respondents with private jobs with 3 (17.6%) respondents in the red zone, 9 (52.9%) respondents in the yellow zone, and 5 (29.4%) respondents in the green zone. In addition, respondents with entrepreneurial jobs were 13 respondents with a red zone of 7 (53.8%) respondents, a yellow zone of 3 (23.1%) respondents, and those in the green zone were 3 (23.1%). Meanwhile, respondents with other types of employment have a total of 17 respondents with PEFR values in the red zone as many as 8 (47.1%), yellow zone as many as 8 (47.1%), and green zone 1 (5.9%) respondents. While respondents with other types of jobs, which are usually laborers, motorcycle taxis, and hawkers, the majority of PEFR values are in the red zone as many as 8 (47.1%) and yellow zone as many as 8 (47.1%). This shows that there is an occupational relationship with PEFR in Pulmonary TB patients at the Kramat Jati Health Center.

The results of this study are in accordance with the results of previous research by (Hans, 2019). That work has a relationship with PEFR in pulmonary TB patients, this is supported by data on the p value of 0.36 (smaller than 0.05) which means that there is a significant relationship. The research conducted by (Collaborative Science et al., 2022). based on the results of bivariate analysis with the chi square test between work and PEFR in pulmonary tuberculosis obtained a p value = 0.031 with a significant level <0.05 so it can be concluded that there is a relationship between work and pulmonary tuberculosis.

Patients with pulmonary tuberculosis may be at risk of bronchial obstruction due to accumulated secretions or secretions that can cause atelectasis and a decrease in Peak Expiratory Flow Rate (PEFR). In addition, decreased lung function or decreased PEFR can also be caused by several demographic factors such as gender and smoking history.

Based on the things that have been done by researchers, in this study respondents who have PEFR values in the red zone, yellow zone, and green zone are not only related to the pathophysiological burden of pulmonary TB disease, but can also be related to demographic factors such as age, gender, and occupation. This is in line with the results of the study, where the majority of respondents with other jobs/labor were found to be in the red zone and yellow zone PEFR values.

The results of bivariate analysis have been carried out and show no significant correlation between IMT and PEFR in pulmonary TB patients at the Kramat Jati

Health Center with a p value of 0.509 (>0.05) in this study showed that the majority of respondents had underwight and normal IMT with a total of 23 respondents and 22 respondents were in the red zone as many as 9 (39.1%) and 7 (31.8%). This proves that BMI can be unrelated to PEFR value.

The results of this study showed that respondents with underwight BMI were 23 respondents with PEFR values in the red zone 9 (39.1) respondents, yellow zone 13 (43.5%) respondents, and green zone as many as 4 (17.4%) respondents. Whereas at normal BMI, PEFR values in the red zone were 7 (31.8%) respondents, yellow zone were 10 (45.5%) respondents, and green zone were 5 (22.7%) respondents. Whereas at IMT overwight PEFR value in the red zone as many as 2 (40.0%) respondents, yellow zone 1 (20.0%) respondents, and green zone 2 (40.0) respondents. While respondents with normal BMI with PEFR values were mostly in the yellow zone as many as 10 (45.5%). This shows that there is no significant relationship between BMI and PEFR in pulmonary TB patients at the Kramat Jati Health Center.

The results of this study are in accordance with the results of previous research conducted by (Sina et al., 2023) that there are no factors associated with BMI with PEFR in pulmonary TB patients. This data is supported based on the test results with a p value of 0.75 (more than 0.05) from the results of this study obtained a negative correlation trend between body mass index and PEFR (r = 0.186).

From these data it can be concluded that there is a difference in the p value of research and previous research, it is because the amount of data obtained by previous researchers with a Skinny BMI value while in the researcher's research respondents with an average BMI value are thin and normal almost have the same value and get a value of P = 0.760 where these results exceed the significant value of P => 0.05 which means there is no significant relationship between BMI and PEFR in pulmonary TB patients. The results of research conducted by (Alimmattabrina et al., 2020) show that there is no significant relationship between BMI and PEFR values with a p value of 0.621, which means that the p value is more than 0.05.

BMI results depend on height and weight (Guyton, 2019). This happens because the body mass index in Pulmonary TB patients at the Kramat Jati Health Center is at normal weight and underweight where 22 respondents with normal weight and underweight are at lift 23 while in the number of obese there are 5 respondents with PEFR in the red zone, this proves that the higher the body mass index, the lower the peak expiratory flow.

CONCLUSION

This study found significant relationships between gender and occupation with PEFR in pulmonary TB patients, while age and BMI were not significantly associated. These findings highlight the importance of demographic factors in influencing lung function among TB patients. Future research should consider a broader range of factors and larger populations to better understand the complexities of PEFR in TB management.

For future research, it is recommended to expand the scope of this study by including a larger sample size from various regions, not just East Jakarta, to enhance the generalizability of the findings. Additionally, considering other environmental and lifestyle factors, such as smoking habits, air quality, and socioeconomic conditions, may provide a more comprehensive understanding of the factors influencing PEFR in pulmonary TB patients. Furthermore, longitudinal studies would be beneficial to observe changes in PEFR over time and to determine the long-term impact of TB treatment on lung function. Implementing these suggestions can help develop more effective interventions to improve respiratory outcomes in TB patients.

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Table 1. Frequency Distribution of Demographic Characteristics of Respondents

Demographic Data	F	%
Age		
20 – 25 (late adolecence)	10	20
26 – 35 (early adulthood)	14	28
36 – 45 (late adulthood)	9	18
46 – 55 (early elderly)	14	28
56 – 60 (late elderly)	3	6
Total	50	100
Gender		
Male	27	54
Female	23	46
Total	50	100
Occupation		
Government Employee (ASN)	3	6
Private Employee	17	34
Enterpreneur	13	26
Others	17	34
Total	50	100
BMI		
Underweight (<18.5)	23	46
Normal (18.5-22.9)	22	44
Overweight (23-24.9)	5	10
Total	50	100

Table 2. Relationship between Demographic Variables and PEFR in Pulmonary TB Patient

Variable	Category	PEFR			P-value
		Red Zone (%)	Yellow Zone (%)	Green Zone (%)	
Gender	Male	10 (37.9%)	15 (55.6%)	2 (7.4%)	0.016
	Female	8 (34.8%)	6 (26.1%)	9 (39.1%)	
Age	Late Adolescence	3 (30%)	6 (60%)	1 (10%)	0.412
	Early Adulthood	8 (57%)	3 (21%)	3 (21%)	
	Late Adulthood	3 (33%)	2 (22%)	4 (44%)	
	Early Elderly	3 (21%)	8 (57%)	3 (21%)	
	Late Elderly	1 (33%)	2 (66%)	0 (0%)	
Occupation	Govt. Employee	0 (0%)	1 (33.3%)	2 (66.7%)	0.007
	Private Employee	3 (17.6%)	9 (52.9%)	5 (29.4%)	
	Enterpreneur	7 (53.8%)	3 (23.1%)	3 (23.1%)	
	Others	8 (47.1%)	8 (47.1%)	1 (5.9%)	
BMI	Underweight	9 (39.1%)	10 (43.5%)	4 (17.4%)	0.509
	Normal	7 (31.8%)	10 (45.5%)	5 (22.7%)	
	Overweight	2 (40%)	1 (20%)	2 (40%)	