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Original Research

Effect of Slow Deep Breathing on Lung Function Among Individuals with Multi-Drug-Resistant Tuberculosis (MDR-TB) at a Regional General Hospital in Indonesia

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ABSTRACT

Introduction: Multi Drug Resistant Tuberculosis (MDR-TB) sufferers experience decreased lung function. Non-pharmacological therapy such as slow deep breathing has been widely applied to improve lung function of individuals with Tuberculosis. However, the results were inconsistant. The aim of this research is to analyze the effect of slow deep breathing on lung function pf individuals with multi-drug resistant (MDR-TB) at the MDR-TB Polyclinic Ibnu Sina General Hospital Gresik, Indonesia.

Method: This study employed a quasi-experimental design with a pre-test and post-test. The population consisted of 294. A total of 35 participants were selected using purposive sampling based on inclusion and exclusion criteria. Data collection involved a Standard Operating Procedure (SOP)-guided intervention in slow deep breathing exercises as the independent variable. Lung function, the dependent variable, was measured using a calibrated spirometry device before and after the intervention. An accidental sampling method was applied, focusing on the availability and willing to participate.

Results: The results showed of 19 (54.3%) and almost half of participants had abnormal lung function, 16 (45.7%) people. After being given intervention, the majority of particupants presented normal lung function, 21 (65.7%) of them and almost half of them had abnormal lung function, 12 (34.3%) of them. Mc Nemar test to determine the effect of slow deep breathing on lung function was p-value of 0.125 > 0.05.

Conclusion: This study documented that slow deep breathing exercises had no significant effect on lung function in individuals with MDR-TB. This likely attributable to other contributing factors, such as routine pharmacological treatment, consistent physical activity, and improved adherence to therapy. These confounding variables may have played a more substantial role in the observed changes. Further research with rigorous experimental designs, involved larger sample sizes, and longer duration of intervention is needed.

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1. INTRODUCTION

Pulmonary tuberculosis (TB) remains a major public health concern in many developing countries, including Indonesia. It is a contagious respiratory disease caused by *Mycobacterium tuberculosis*, which primarily affects the lungs but can also spread to other parts of the body, such as the skin, lymph nodes, bones, and meninges (Afni Anggraeny, 2021).The transmission of TB occurs through the inhalation of airborne droplets released when an infected person coughs, sneezes, or talks. One of the unique

characteristics of the TB bacterium is its ability to enter a dormant state, allowing it to remain inactive within the body's tissues for years. Under certain conditions, such as a weakened immune system, these dormant bacteria can reactivate and cause active tuberculosis. Additionally, *Mycobacterium tuberculosis* is an aerobic organism, meaning it requires oxygen to grow. This explains its preference for the upper lobes of the lungs, where oxygen concentration is higher, making these areas more susceptible to infection.

Due to the nature of TB infection, it can easily spread among close contacts, especially within households and communities. *Mycobacterium Bacillus* enter the lung tissue by the respiratory tract (infectious droplets) into the alveoli. This leads to primary contamination (ghon), which can extend to the lymph nodes and form a primary complex (ring). They are called primary TB, and most people experience a cure. Primary pulmonary tuberculosis is contamination before the body develops a characteristic strength against mycobacteria, while primary tuberculosis (reinfection) is pneumonia caused by reinfection of the body when specific immunity to the bacilli is formed (Afni Anggraeny, 2021).Preventing tuberculosis also involves promoting behavioral changes that help reduce transmission to others (Sari et al., 2022) Therefore, interventions that improve lung function and support respiratory health—such as slow deep breathing therapy—may contribute positively to the management and recovery of individuals with TB, particularly those with multi-drug resistant tuberculosis (MDR-TB).

According to the World Health Organization, there are an estimated 10.6 million TB diagnoses in the world in 2021, a jump of around 600,000 cases weighed against an estimated 10 million TB cases in 2020. Of the 10.6 million cases, 6.4 million (60.3%) of them suffer from tuberculosis. It has been reported and through treatment, then 4.2 million (39.7%) have not been found or complained. Since 10.6 million cases in 2021, at least 6 million are adult males, followed by 3.4 million adult females, and the rest of the TB cases are children or 1.2 million cases (World Health Organization, 2021). Meanwhile, in the context of a study setting, Indonesia has been acknowledged as the country with the second-largest biggest of TB cases globally, after India, followed by China in the third position. In 2020, Indonesia had the third highest number of incidences, so the total number of TB cases in Indonesia in 2021 is estimated to reach 969,000. The value is 17 per cent higher than in 2020, or 824,000 cases. Tuberculosis cases in Indonesia are 354 cases per 100,000 people, meaning that from each 100,000 people in Indonesia, 354 people suffer from tuberculosis. This condition is the dominant obstacle in achieving the goal of clearing tuberculosis by 2030. The success rate of tuberculosis treatment is below the optimal number of 85 per cent, below the global target of 90 per cent of treatment achievement. Meanwhile, the total number of tuberculosis cases detected was subsequently reported to the tuberculosis information system (SITB) in 2022 as many as 717,941 cases, and the detection rate of tuberculosis was 74% (target: 85%). However, the success rate of tuberculosis therapy is 86%. Although still below the global target set by WHO (90%), the success rate of TB treatment in Indonesia is increasing every year. This problem makes Indonesia hope to stop tuberculosis. In addition, individuals with TB who have not found the source of transmission in the community can be a big challenge to the TB control program in Indonesia to defeat TBC (Badan Pusat Statistik Provinsi Jawa Timur, 2024).

Particularly, in East Jawa provinnce where was the cinical setting of this study conducted, the number of TB case presented a significant increase. It was 53,289 in 2021 and rised to 81,753 in 2022. This figure makes East Jawa as the second most affected after West Java (Pratama, n.d.). According to the Central Statistics Agency of East Java Province, the incidence of pulmonary tuberculosis in Gresik Regency was 1,760 in 2021, and mortality of individuals with TB in Gresik Regency as many as 88 people in 2022 (BPS Indonesia, 2023). Pulmonary tuberculosis can be treated and prevented with comprehensive therapy. 85% of individuals with TB were successfully treated within six months by taking medication regularly and other therapies to reduce the side effects of infection. Drugs used to treat pulmonary tuberculosis are drug therapy and non-drug therapy. Pharmacological therapy is a therapy that uses anti-tuberculosis drugs (OTA) in the form of drugs such as bronchodilators and corticosteroids, while non-pharmacological therapy is a form of physical therapy in the form of nebulizers and breathing exercises. Different interventions can be performed in individuals with TB according to the existing complaints. One of the interventions that can be used in the management of individuals with TB to control or reduce dyspnea is exercise therapy in the form of Slow Deep Breathing (Sumartini & Miranti, 2019).

Treatment of tuberculosis also depends on age, health status, response to treatment, type of tuberculosis, and the site of infection in the body. One of the measures to prevent tuberculosis is through the BCG (Bacillus Calmette-Guerin) vaccine. In Indonesia, this vaccine is included in the list of vaccinations that must be distributed before the child is 2 months old. For those who have not had time to get it, it is recommended to get it if there is a family member who has contracted tuberculosis. Many of individuals with TB did not receive complete treatment, so they are still young enough to infect their family members or loved ones. Public health activities are defined as several direct and indirect activities, while these activities include disease prevention (preventive), health improvement (promotion), therapy including physical, mental and social (curative activities) and health recovery (rehabilitation activities). The main

goal of treating tuberculosis cases is to break the chain of transmission and prevent the recurrence of the disease.

One complementary intervention that may support individuals with TB, particularly those with MDR-TB, is Slow Deep Breathing Therapy. This therapy involves controlled breathing while in a conscious and relaxed state, with attention to the rhythm and depth of breath to elicit a calming effect on the body (Azwaldi et al., 2023). During this relaxation process, muscle fibres elongate, neural impulse transmission to the brain decreases, and activity in various parts of the body slows down. Signs of deep breathing relaxation include reductions in heart rate, respiratory rate, and blood pressure. Given these physiological effects, Slow Deep Breathing (SDB) therapy is hypothesized to assist in improving lung function by enhancing oxygen exchange and promoting respiratory efficiency. However, despite its theoretical benefits, there is limited empirical evidence supporting its direct effect on lung function in individuals with TB. Therefore, this study was conducted to examine the effect of SDB Therapy on lung function in individuals with Multi-Drug-Resistant Tuberculosis at the MDR-TB Polyclinic of Ibnu Sina Gresik Regional Hospital.

2. METHODS

2.1 Design

Experimental research method can be defined as a method used to evaluate the effect of a specific treatment or intervention on an outcome under controlled conditions. In this study, the research design employed is a pre-experimental design, specifically using the One-Group Pretest-Post-test Design model. This design involves measuring the dependent variable. variable (lung function) before and after the intervention SDB therapy within a single group, allowing researchers to assess any changes that occur as a result of the treatment.

2.2 Population, Sample and Sampling

Population is an ordinary area that consists of objects or objects with a special number and personality shown by the research to be studied and after that conclusions are drawn. The target population of this study is all individuals diagnoses with TB at Ibnu Sina Gresik Hospital. The number of people with pulmonary tuberculosis (TB) during the last 6 months from January to June 2023 was 294 people. The sample in this study was 35 individuals diagnoses with TB and reported MDR-TB. The sampling method was obtained in accordance realistically with the overall research object (Notoatmodjo, 2012). The sample collection process of this study uses the Accidental sampling technique.

2.3 Variable

The independent variable in this study was SDB. The dependent variable in this study was the Lung Function of Pulmonary Tuberculosis (TB) or individuals diagnosed with TB.

2.4 Instruments

The instruments needed for this research include: observation sheets for the application of Slow Deep Breathing and Spirometry.

2.5 Procedure

During the study conducted, particupants practiced SDB for a period of one month. Each respondent was instructed to perform the breathing exercise three times daily, with each session lasting for 15 minutes. The sessions were scheduled at 05:00 AM 01:00 PM, and 09:PM, ensuring an 8-hour interval between each session. During each breathing session, respondents were guided to silently repeat affirmations such as “I relax” or “I am calm” to enhance the relaxation response. This approach aimed to support respiratory muscle function, promote relaxation, and optimize pulmonary performance. After the 1-month intervention, an evaluation of lung function was conducted using a spirometry device, measuring parameters such as Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 Second (FEV_1). The collected data were organized, analyzed statistically, and presented in tabular format to illustrate changes in lung function before and after the intervention. Conclusions were then drawn based on the analysis of the research findings.

2.6 Data Analysis

The analysis was carried out on two variables that were allegedly related (Notoatmodjo, 2012). This is done through hypothesis experiments and evidence formation. The collected data is directly processed, which includes research cases. To see the effect between two variables whether relevant or not by means 0.05 by requiring a test Mc Nemar with SPSS software version 22.0, using normal distribution conditions. Values of significance from the test statistic Mc Nemar, where ($p<0.005$) then there is an influence of giving SDB on Lung Function of individuals with TB at the Pulmonary Polyclinic of Ibnu Sina Gresik Hospital. If ($p>0.05$) then there is no effect of giving SDB on Pulmonary Function at Polyclinic MDR-TB Ibnu Sina Gresik Hospital.

2.7 Ethical Clearance

This study was ethically approved by the Hospital Ethics Committee of KOMKORDIK Ibnu Sina Gresik Hospital, with ethical clearance certificate number: 071/078/437.76/2023, issued on October 31, 2023. All participants provided informed consent before participation. Confidentiality and anonymity of participant data were maintained throughout the study.

3. RESULTS

Based on figure 1, it is explained that most of participants before being given SDB therapy have normal lung function as many as 19 (54.3%) people and almost half have abnormal lung function as many as 16 (45.7%) people.

Based on figure 2, it shows that most participants after being given SDB therapy have normal lung function as many as 23 (65.7%) people and almost half have abnormal lung function as many as 12 (34.3%) people.

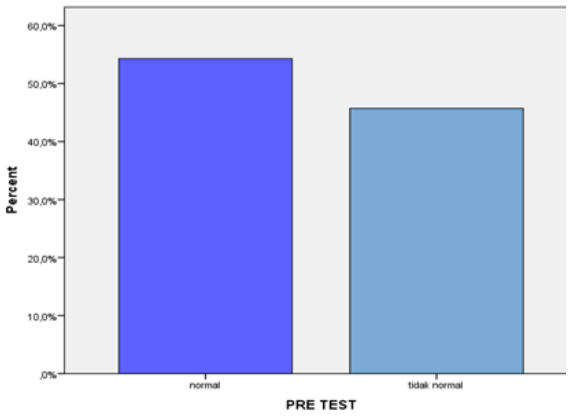

Figure 1. Frequency of Pulmonary Function Disruption Before Giving Slow Deep Breathing Therapy in individuals with MDR-TB at the MDR-TB Polyclinic Ibnu Sina Gresik Hospital 2023

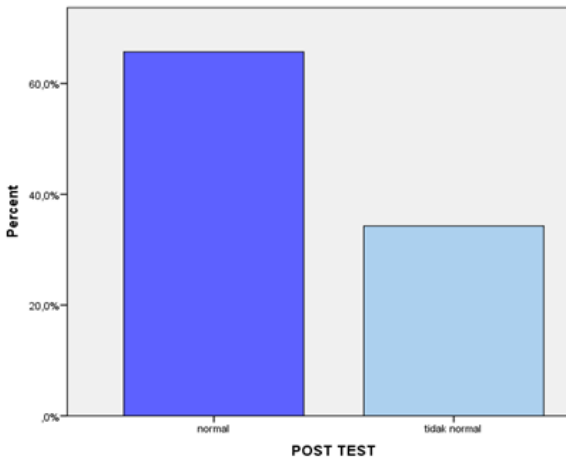

Figure 2. Frequency of Pulmonary Function Disruption After Slow Deep Breathing Therapy in Individuals with MDR-TB at the MDR-TB Polyclinic of Ibnu Sina Gresik Hospital 2023

Table 1. Effect of Slow Deep Breathing on Lung Function in Multidrug Resistant Tuberculosis in Individuals with MDR-TB at the MDR-TB Polyclinic of Ibnu Sina Gresik Hospital 2023

Variable	N	P.Value
Pre dan Post	30	0.125

Based on the results of bivariate analysis, it is known that the variables of lung function before and after SDB are abnormally distributed, so the hypothesis in this study uses Mc Nemar's u ji with a significance value of p-value < 0.05. The results of hypothesis testing can be seen in the following table. Based on table 1, the results are obtained P value 0.125 > 0.05, meaning no therapeutic effect SDB on lung function in individuals with MDR-TB at Polyclinic MDR-TB Rasud IBNU Sina Grasik.

4. DISCUSSION

The aim of this research is to analyze the effect of SDB therapy on lung function in individuals with MDR-TB who are undergoing treatment at the MDR-TB Polyclinic of a regional general hospital in Indonesia. This study seeks to determine whether the incorporation of SDB exercises contributes to measurable improvements in lung function, as assessed through spirometric evaluation, in conjunction with standard MDR-TB treatment protocols.

Lung function of individuals with MDR-TB before being given Slow Deep Breathing Therapy

Based on figure 1. the results were obtained that most of the study participants before being given SDB therapy on lung function of all individuals with MDR-TB at the MDR-TB Poly of Ibnu Sina Gresik Hospital had normal lung function as many as 19 (54.3%) people and almost half had abnormal lung function as many as 16 (45.7%) people. The lungs are respiratory organs paired on the right and left sides. The role of the respiratory tract is to receive oxygen and channel it to the blood vessels to be distributed throughout the body (Utoyo & Nugroho, 2021). Most of study partucupants have normal lung function with a > value of 80% as many as 19 (54.3%) this is because they are still able to exhale the total air inhaled. In addition, individuals with MDR-TB often do other activities such as exercising every morning, meditating and drinking warm water before therapy SDB. Almost half of participants have also completed the treatment period so that most of their lung function is in normal condition and is much better than before.

According to previous research Sunarmi & Kurniawaty (2022) Based on gender, in 2017, the total number of new TB cases, especially males, was 1.4 times higher than that of females. Based on the results of the study, the prevalence of tuberculosis in men is 3 times higher than that of women. This may be due to men being more prone to TB threat situations such as smokers and lack of knowledge about the disease. The survey revealed that 68.5% of men smoke and only 3.7% of women. Men have heavy workloads and unhealthy lifestyles such as smoking and alcohol. Women are more observant of their health than men, which is why women are less likely to develop pulmonary tuberculosis.

In addition to gender, the age component also has a great influence on pulmonary TB disease, one of the most common groups of individuals with MDR-TB in the MDR-TB poly of Ibnu Sina Gresik Hospital is the age of 55 years > 26 (74.3%) people. Sunarmi and Kurniawaty, (2022) stated that old age is more prone to being infected with pulmonary tuberculosis because parts of the body suffer from depreciation in old age. The rest consist of no less than 9 (30%) of

participants aged 19-55 years (productive age), this is also due to many things, including because people at that age spend their time and energy working. where a lot of energy is used, shortening the rest time can weaken the body's immune system. In addition, according to research Mengkidi, Dorce, (2006) , physical exercise has a great influence on the respiratory system. A person who regularly does physical activity, such as exercise, can increase the oxygen supply to the lungs. Exercise habits increase the work and role of the lungs, heart and blood vessels as shown by the decrease in resting heart rate, increased pulse rate, increased lung vital activity, decreased lactic acid accumulation, increased stroke cholesterol in blood vessels, increased HDL cholesterol and decreased atherosclerosis. In general, all sports, games and sports help improve physical fitness to some extent.

The researcher assumed that a slight over half, 19 participants or equal to 54.3% had normal lung function. Normal lung function tends to be higher than abnormal because individuals with MDR-of who have normal lung function often do regular exercise, adhere to taking medication, and routinely carry out control which is usually done once a month. According to Kahar (2018) Regular exercise can modify and nurture the function of various organs of the body, especially the heart and lungs (cardiorespiration). The heart-respiratory task needs to be ideal so that every part of the body, the cell, always receives oxygen-carrying blood as an energy-producing metabolic fuel. Increased cardiac respiration is characterized by an increase in respiratory function, namely an increase in the vital volume of the lungs.

The results of this study showed that there was no statistically significant effect of Slow Deep Breathing (SDB) therapy on lung function in individuals with Multi-Drug Resistant Tuberculosis (MDR-TB) at the MDR-TB Polyclinic of Ibnu Sina Gresik Hospital after one month of intervention. Despite the lack of statistical significance, descriptive data revealed an increase in average lung function from 63.3% to 70%, which may be attributed to concurrent treatments and routine physical exercises performed by the patients.

Nevertheless, patients reported feeling more comfortable during and after the SDB sessions. They experienced reduced symptoms such as coughing, shortness of breath, and excessive sputum production. These subjective improvements suggest that SDB may have potential benefits in enhancing patients' comfort and well-being, even if not significantly altering spirometry results in the short term. This is consistent with Husna (2021), who found that diaphragmatic breathing exercises aid in strengthening the diaphragm, reducing respiratory effort, conserving energy, and optimizing oxygen intake, all of which contribute to better respiratory comfort and function.

This research also aligns with a study by Pasolang (2022), titled *"The Effectiveness of Respiratory Muscle Exercises on Improving Lung Function in the Early Period of Extubation."* Pasolang emphasized the importance of non-pharmacological interventions, such as breathing exercises, in preserving respiratory muscle strength and supporting normal lung function. These exercises, when consistently practiced, can play a preventive and rehabilitative role, particularly in pulmonary diseases. Although our study did not confirm a significant improvement in lung function statistically, the subjective feedback from participants supports the potential of SDB therapy as a valuable component of holistic care.

Accordingly, individuals with MDR-TB who engage in consistent physical activities, adhere to pharmacological treatments, and participate in non-pharmacological interventions—such as slow deep breathing therapy—can support the recovery process and help maintain or improve lung function. In this study, nearly half of the participants had completed their treatment period, which may have contributed to better lung function outcomes. This finding aligns with research by Kahar (2018), which reported that regular physical exercise increases oxygen supply to the lungs, thereby enhancing pulmonary function and promoting cardiovascular health. Therefore, lifestyle factors, in combination with medical treatment, play an important role in the overall health outcomes of MDR-TB patients.

Slow deep breathing is a relaxation technique aimed at controlling deep and slow breathing, breathing techniques with a breathing speed of no more than 10 times per minute and slow breathing. During relaxation, muscle fibres lengthen, nerve impulses to the brain decrease, brain function and other bodily performance are weakened. Slow deep breathing is a non-pharmacological intervention that individuals with MDR-TB can undertake to improve lung function. In addition, there are procedures that can be carried out to increase the role of the lungs. i.e. diaphragm muscle breathing exercises, Pursed lip Breathingand Equal breathing (Bella, 2023). In accordance with the research of Bella (2023) which explains that interventions such as SDB can improve lung function in individuals with MDR-TB.

Further, SDB itself can be one of the effective therapies to improve lung function in individuals with MDR-TB because the therapy is a relaxation technique aimed at controlling deep and slow breathing, breathing techniques with a breathing speed of no more than 10 times per minute and slow breathing. During relaxation, muscle fibers lengthen, tissue thrust to the brain decreases, brain and body work decreases. along with the study carried out (Sumartini & Miranti, 2019) entitled "Influence of SDB against of individuals with MDR-TB ". The results of the study found that there was an increase in oxygen saturation by 2.3% to 2.5% after being carried out.

Slow Deep Breathing is a non-pharmacological technique designed to elicit relaxation by focusing on calm, conscious inhalation and exhalation, often accompanied by affirmations like "I relax" or "I am calm." According to Azwaldi et al (2023), such techniques help reduce muscle tension, slow heart rate and respiratory rate, and promote parasympathetic nervous system activity. These effects are consistent with diaphragmatic breathing benefits described by Husna (2021), where strengthening the diaphragm and reducing oxygen demands contribute to more efficient respiration. In this study, respondents reported feeling more comfortable during SDB therapy sessions, particularly due to reductions in coughing, sputum, and breathing discomfort. This aligns with Pasolang's (2022) research, which demonstrated that respiratory muscle exercises can help maintain lung function and improve breathing quality during recovery.

It is known that individuals with MDR-TB in this study had impaired lung function, which may be attributed to several demographic and lifestyle factors. Most respondents were male, older in age, and had a history of smoking. This is consistent with the findings of (Hapsari et al., 2013), who concluded that individuals living in families with smoking habits were four times more likely to contract tuberculosis. Indeed, it was also noted that the participants who experienced better lung function often engaged in regular physical activity, adhered to both pharmacological and non-pharmacological therapies, and had completed or were near the end of their treatment period. These factors likely contributed to better baseline lung function, which in turn, may have diluted the measurable impact of the SDB intervention. As supported by Kahar (2018), consistent physical activity increases oxygen supply to the lungs and improves overall cardiorespiratory health.

Moreover, adherence to medication and the presence of a Treatment Supervisor (PMO) are critical to the success of MDR-TB therapy. As (Alipanah et al., 2018) noted, strong treatment adherence significantly correlates with positive TB outcomes. PMOs play a key role in supporting patient compliance during the long treatment period. Participants in this study also reported using warm beverages to ease breathing—a strategy supported by Marwansyah (2019), who stated that warm water helps reduce bronchial irritation and promotes mucus clearance. Therefore, the cumulative effect of regular exercise, strict adherence to therapy, supportive habits like warm fluid intake, and SDB exercises likely worked in synergy to promote respiratory well-being.

Several limitations in this study should be acknowledged. First, the use of a pre-experimental one-group pretest-posttest design limits the ability to control for confounding variables, which may have influenced the results. Second, the absence of a control group prevents direct comparison and reduces the strength of causal inferences regarding the effect of SDB therapy. Third, the short duration of the intervention (only one month) may have been insufficient to produce measurable physiological changes in lung function. Lastly, self-reported adherence to the breathing regimen was not objectively monitored, which could affect the consistency and accuracy of therapy implementation across participants.

5 CONCLUSION

Practicing SDB therapy three times daily for 15 minutes each session for a total one month presented no significant difference on the lung function. This outcome suggests that the observed improvement might have been influenced more by routine treatment and physical activity rather than the breathing therapy itself. These findings suggest that while SDB therapy may offer subjective benefits such as comfort, reduced shortness of breath, and increased relaxation, its standalone impact on improving measurable lung function in MDR-TB patients is limited. The therapy may still hold value as a complementary strategy in enhancing individuals with MDR-TB. Considering this study, it is highly recommended that future studies should involve a control group and a larger sample size to better evaluate the independent effect of SDB on lung function.

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