The Effect of Active Cycle of Breathing Technique (ACBT) Therapy on the Improvement of Oxygen Saturation in Pulmonary Tuberculosis Patients at Bojong Nangka Primary Health Center, Tangerang

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Abstract. Droplets from patients who are positive for Acid-Fast Bacilli (AFB) are the means by which pulmonary TB, a protracted infectious illness, is spread to other individuals. The Active Cycle of Breathing Technique (ACBT) is one of the interventions that does not involve the use of pharmaceuticals and has the potential to enhance oxygen saturation. The objective of this research was to investigate the impact that ACBT treatment has on the enhancement of oxygen saturation levels in patients suffering from pulmonary TB who were treated at the Bojong Nangka Primary Health Center in Tangerang. For the purpose of this investigation, a quasi-experimental approach was used, and a Non-Equivalent Control Group Design was utilized. The total sample consisted of thirty participants. Prior to and during the ACBT intervention, a Purmed pulse oximeter was used in order to determine the level of oxygen saturation. Analysis of the data was carried out with the use of the Paired t-test. According to the findings, the average oxygen saturation rose from 96.40% to 98.37% ($p = 0.000$), indicating a significant increase. ACBT treatment is a useful method for raising oxygen saturation in patients with pulmonary tuberculosis, and it may be used as a nursing intervention that does not involve the use of pharmaceuticals.

Keywords: ACBT Therapy, Oxygen Saturation, Pulmonary Tuberculosis

1 Introduction

Pulmonary tuberculosis (TB) is a chronic infectious disease caused by *Mycobacterium tuberculosis*, primarily attacking the human lungs. This disease is transmitted through droplet nuclei released by patients with Acid-Fast Bacilli (AFB) positive during coughing or sneezing. The inhalation of these droplets by healthy individuals can lead to infection [1].

Tuberculosis remains a major global public health problem. According to the *Global TB Report* (2023), Indonesia ranks second in the world in terms of TB burden, following India and ahead of China. It is estimated that Indonesia records approximately 1,060,000 TB cases and 134,000 TB-related deaths annually, which equals 17 deaths every hour. The Ministry of Health of the Republic Indonesia confirmed that in 2023, TB cases in Banten Province alone reached

FIC 2025, July 30-31, Serang, Indonesia

DOI 10.4108/eai.30-7-2025.2360963

42,429 out of a total population of 13,344,636. Furthermore, data from the Tangerang District Health Office indicated that in 2022, the number of pulmonary TB cases increased to approximately 9,000, predominantly among individuals in the productive age group of 18–45 years [2].

Clinically, pulmonary TB presents with signs and symptoms such as chronic daily cough, abnormal breath sounds or wheezing, shortness of breath, chest pain, productive cough with green thick or yellow sputum, weight loss, and fatigue [3]. Shortness of breath in TB patients often leads to decreased oxygen saturation below normal levels. Reduced blood oxygen concentration impairs the ability of red blood cells to optimally deliver oxygen via hemoglobin to peripheral tissues, thereby disrupting oxygen supply to the body and leading to hypoxemia [4].

Medical management of pulmonary TB generally involves both pharmacological and non-pharmacological therapies. Pharmacological therapy, prescribed by physicians, typically includes bronchodilators and corticosteroids. Non-pharmacological interventions provided by physiotherapists include nebulization, breathing exercises, and the Active Cycle of Breathing Technique (ACBT) [5].

ACBT is a structured breathing method designed to facilitate airway clearance in individuals with pulmonary disease. It consists of three main components: Breathing Control (BC), Thoracic Expansion Exercises (TEE), and Forced Expiration Technique (FET) or "huffing." ACBT has been recognized for its efficacy compared to other airway clearance techniques [5].

Given the growing prevalence of TB and the critical role of oxygen saturation in patient outcomes, researchers were interested in raising the research topic The Effect of ACBT Therapy on the Improvement of Oxygen Saturation in pulmonary TB patients at Bojong Nangka Primary Health Center, Tangerang.

2 Methods

This quantitative study employed a quasi-experimental research design with a non-equivalent control group design. The study was conducted at Bojong Nangka Primary Health Center, Tangerang. The study population consisted of 33 patients diagnosed with pulmonary tuberculosis and registered at Bojong Nangka Primary Health Center. From this population, 30 respondents were selected as the sample using a total population technique. The remaining three individuals were not included due to logistical considerations, as the intervention was conducted through a door-to-door approach and the residences of these respondents were located at considerable distances.

The instruments used in this study included a pulse oximeter, standard operating procedures (SOPs), an observation sheet, and a demographic questionnaire. Additionally, informed consent forms were distributed to all respondents prior to their participation. The pulse oximeter was employed to measure the oxygen saturation of each respondent before and after receiving the Active Cycle of Breathing Technique (ACBT) intervention.

Data analysis was performed using both univariate and bivariate methods. The univariate analysis described the distribution of respondents according to gender, age, education level, occupation, and duration of tuberculosis. The bivariate analysis examined the effect of ACBT therapy on the improvement of oxygen saturation among pulmonary tuberculosis patients using a paired *t*-test.

This study was conducted with research permission from Bojong Nangka Primary Health Center under approval number B/000.9.2/575/IV/PKMBJN/2025.

3 Results

Table 1. Frequency distribution of gender, age, education, occupation, and duration of illness in pulmonary TB patients

Characteristics	Intervention N (%)	Control N (%)	Total N (%)
Gender			
Female	6 (40%)	4 (26,7%)	10 (33,3%)
Male	9 (60%)	11 (73,3%)	20 (66,6%)
Age			
< 40 years old	9 (60%)	7 (46,7%)	16 (53,3%)
≥ 40 years old	6 (40%)	8 (53,3%)	14 (46,7%)
Education			
Elementary School	3 (20%)	5 (33,3%)	8 (26,7%)
Junior High School	3 (20%)	3 (20%)	6 (20%)
Senior/Vocational High School	9 (60%)	5 (33,3%)	14 (46,7%)
Higher Education	0 (0%)	2 (13%)	2 (6,6%)
Employment			
Working	10 (66,7%)	7 (46,7%)	17 (56,6%)
Not working	5 (33,3%)	8 (53,3%)	13 (43,7%)
Duration of TB			
Less than 1 month	4 (26,7%)	3 (20%)	7 (23,4%)
More than 1 month	11 (73,3%)	12 (80%)	23 (76,6%)

Table 1 presents the demographic characteristics of pulmonary tuberculosis (TB) patients in both the intervention and control groups. In terms of gender, males constituted the majority in both groups (60% in the intervention group and 73.3% in the control group), indicating that TB was more prevalent among male participants.

Regarding age, most participants in the intervention group were under 40 years old (60%), while in the control group, the majority were over 40 years old (53.3%). This suggests a relatively balanced age distribution across both groups.

With respect to educational background, the largest proportion of respondents in both groups had completed senior or vocational high school education (60% in the intervention group and 33.3% in the control group). Only a small proportion of respondents (6.6%) had attained higher education.

In terms of employment status, more than half of the respondents were employed (56.6%), with a slightly higher proportion in the intervention group (66.7%) compared to the control group (46.7%).

As for the duration of illness, most respondents had been diagnosed with pulmonary TB for more than one month (73.3% in the intervention group and 80% in the control group), indicating that the majority had been undergoing treatment for a relatively extended period.

Table 2. Oxygen saturation before and after ACBT therapy at the intervention group

Paired Sample Statistics				
	Mean	**N**	**Sd**	**P-value**
Pre	96,40	15	0,632	0,000
Post	98,37	15	0,516	

As shown in Table 2, the mean oxygen saturation level in the intervention group increased significantly from 96.40% before therapy to 98.37% after therapy. The difference was statistically significant ($p = 0.000$), suggesting that the Active Cycle of Breathing Techniques (ACBT) intervention effectively improved oxygen saturation among pulmonary TB patients.

Table 3. Oxygen saturation before and after ACBT therapy at the control group

Paired Sample Statistics				
	Mean	**N**	**Sd**	**P-value**
Pre	96,79	15	0,674	0,334
Post	96,80	15	0,674	

Table 3 shows that in the control group, the mean oxygen saturation level before and after therapy remained almost unchanged (96.79% and 96.80%, respectively). The difference was not statistically significant ($p = 0.334$), indicating that without ACBT intervention, there was no meaningful improvement in oxygen saturation levels.

4 Discussion

4.1 Univariate factors

The distribution of gender in both groups indicates that the majority of pulmonary tuberculosis (TB) patients in the Bojong Nangka Primary Health Center were male, with 20 respondents (66.6%). This finding is consistent with the study conducted by Varida Naibaho & Herlina Kabeakan (2021) [6], which reported that 25 patients (61%) of pulmonary TB patients were male and 16 patients (39%) were female at Imelda Workers General Hospital, Indonesia [7].

These findings suggest that gender may be an important factor in the prevention and control of pulmonary TB. Men are more likely to be engaged in outdoor activities, work in high-risk environments, and adopt lifestyle habits that may weaken the immune system. Therefore, nursing interventions should include health education on healthy lifestyles and early detection of pulmonary TB, particularly targeting the male population [8].

The distribution of age in both groups shows that the majority of pulmonary TB patients at the Bojong Nangka Primary Health Center were under 40 years old, with 16 respondents (53.3%). This aligns with the findings of Rahmatillah et al. (2017), who reported that 20 respondent (54.5%) of pulmonary TB patients were aged 18–40 years, 10 respondent (32.3%) were aged 41–60 years, and 1 respondent (3.2%) were above 60 years.

These findings highlight that young and productive age groups are important targets for TB control interventions. Early detection, health education, and preventive measures should focus on this population as they are not only vulnerable but also potential vectors of TB transmission within communities [9].

The distribution of education levels in both groups shows that the majority of pulmonary TB patients had completed senior high school (*SMA/SMK*), with 17 respondents (56.6%). This is consistent with Mariska (2025) [10], who found that most pulmonary TB patients had senior high school education, accounting for 13 people (68.4%) of cases.

This finding indicates that pulmonary TB does not only affect individuals with low levels of education but also those with intermediate educational backgrounds. This may be due to health knowledge that not necessarily being accompanied by healthy behaviors, limited access to health services, or social and economic factors that act as risk determinants in TB transmission [8].

The distribution of occupational status in both groups shows that the majority of pulmonary TB patients were employed, with 17 respondents (56.6%). This finding is in line with Fitrianti et al. (2022), who reported that pulmonary TB predominantly occurred among employed respondents (55.9%) [11].

These results suggest that TB control interventions should target the working population through workplace TB screening programs, occupational health education, and improvements in workplace environments that support adequate ventilation and sanitation [9].

The distribution of illness duration in both groups indicates that most pulmonary TB patients had been suffering from TB for more than one month, with 23 respondents (76.6%). This finding is consistent with Nabilla et al. (2024) [12], who reported that the majority of TB patients had been ill for more than one month, with detailed distributions ranging from 1 to 6 months. The details are as follows: 1 month: 7 patients (12.7%), 2 months: 8 patients (14.5%), 3 months: 13 patients (23.6%), 4 months: 8 patients (14.5%), 5 months: 5 patients (9.1%), and 6 months: 14 patients (25.5%).

This study demonstrates that prolonged duration of pulmonary tuberculosis poses a significant challenge in disease control efforts and underscores the importance of treatment continuity as well as psychosocial support to ensure that therapy is completed thoroughly, thereby preventing relapse or resistance. Based on Table 3, the mean oxygen saturation before the intervention was 96.79 and after was 96.80, with a p-value of 0.334. These findings indicate that there was no significant difference in oxygen saturation levels before and after in the control group. Thus, it can be concluded that without the administration of Active Cycle of Breathing Technique (ACBT) therapy, oxygen saturation levels in pulmonary TB patients at Bojong Nangka Primary Health Center did not undergo any meaningful change.

The findings of this study are consistent with those reported by Mika Agustiana et al. (2024), which demonstrated that in the control group of the Active Cycle of Breathing Technique, the obtained p-value was $0.157 > \alpha$ (0.05). Thus, it can be concluded that there was no significant effect on the reduction of dyspnea among tuberculosis patients in the control group [13].

4.2 Oxygen Saturation Before and After ACBT Intervention (Intervention Group)

Based on Table 2, the mean oxygen saturation before the intervention was 96.40, which increased to 98.37 after the intervention, with a p-value of 0.000. These results indicate a significant effect of the Active Cycle of Breathing Technique (ACBT) on improving oxygen saturation among pulmonary TB patients at the Bojong Nangka Community Health Center. The improvement can be explained by the ACBT stages.

In the initial stage, breathing control enhances the efficiency of oxygen transport, improves ventilation-perfusion balance in the lungs, increases lung capacity, aids mucus clearance through ciliary (tiny hairs in the respiratory track) action, and reduces the workload of breathing.

This finding is consistent with Nurliah & Biu (2025), who reported a 4.6-point increase in mean oxygen saturation following ACBT intervention, after being given Active Cycle of Breathing Technique (ACBT) training [14].

4.3 Oxygen Saturation Before and After ACBT Intervention (Control Group)

Based on Table 3, the mean oxygen saturation in the control group was 96.79 before the intervention and 96.80 after the intervention, with a p-value of 0.334. These results show that there is no significant difference between oxygen saturation levels before and after treatment in control patients. It canbe concluded that without ACBT (active cycle of breathing technique) therapy, oxygen levels in pulmonary TB patients at the Bojong Nangka Primary Health Center did not change.

The results of this study are in line with research conducted by Agustiana et al. (2024), which showed that the results of the active cycle of breathing technique in Control Group obtained a p value = 0.157 > a (0.05). Thus, it can be concluded that there is no significant effect on the reduction of shortness of breath in tuberculosis patients in the control group [15].

5 Conclusion

This study demonstrated that the implementation of Active Cycle of Breathing Techniques (ACBT) had a significant effect on improving oxygen saturation among pulmonary tuberculosis patients. The intervention group showed a statistically significant increase in oxygen saturation levels after receiving ACBT therapy, whereas no meaningful change was observed in the control group. These findings indicate that ACBT can be an effective adjunctive therapy to enhance respiratory function and oxygenation in patients with pulmonary TB.

Based on the study findings, it is recommended that ACBT be integrated as a complementary component of pulmonary rehabilitation programs for patients with tuberculosis. Health professionals, particularly nurses and physiotherapists, are encouraged to apply and teach ACBT as part of routine care to support optimal pulmonary recovery. Further studies with larger sample sizes and longer intervention durations are suggested to confirm these results and to explore additional benefits of ACBT on other clinical outcomes such as lung capacity, sputum clearance, and quality of life.

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