



## Application of Nightingale's Environmental Theory: The Effect of Heliotherapy on The Clinical Improvements in Individuals with Tuberculosis

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### A B S T R A C T

Tuberculosis is a global health problem. Sunlight can trigger vitamin D production, so it increases the immunity system. This study analyses Nightingale's environmental theory through the effect of heliotherapy on the clinical improvements in individuals with tuberculosis. It was a quantitative study using a quasi-experimental design with a pretest-posttest approach and a control group. In addition, the population was 59 individuals with tuberculosis in Depok Sleman District, Yogyakarta. Meanwhile, there were 24 respondents by purposive sampling method. The intervention group at Depok 3 Public Health Centre (PHC) was 17 respondents with heliotherapy and anti-tuberculosis drugs, while the control group at Depok 2 PHC was 17 respondents with anti-tuberculosis drugs. The independent variable was heliotherapy, while the dependent variable was the clinical improvements consisting of weight, cough, and shortness of breath. Heliotherapy was conducted for four weeks with an intensity of four times a week for 25 minutes a day. Instruments used weigh scale, Borg Scale, and Leicester cough questionnaire. In addition, data analysis used the Wilcoxon Test and paired T-Test with a significance of 0.05. The results showed that there were clinical improvements in the intervention group ( $p=0.000$ ). In addition, there were increased clinical improvements in weight and cough scores in the control group ( $p=0.000$ ). However, there was no significant difference in the shortness of breath score in the control group ( $p=0.06$ ). In conclusion, the application of Nightingale's environmental theory through heliotherapy affects clinical improvements in individuals with tuberculosis.

### INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis*, attacking various organs, especially the lungs (Kemenkes RI, 2016). For more than a few decades, tuberculosis (TB) becomes a concern in global health problems. It is still a primary health problem in many countries, especially developing countries such as Indonesia. Some of the clinical symptoms caused by tuberculosis are persistent cough, shortness of breath, and weight loss. According to data from the Global Tuberculosis Report in 2015, about 10.4 million new tuberculosis cases occurred worldwide. The six countries with the highest new tuberculosis cases were India, Indonesia, China, Nigeria, Pakistan, and South Africa.

Indonesia was ranked 2nd globally with the most TB sufferers after India and 45% of global tuberculosis cases (WHO 2016)

Yogyakarta province has 25 health care facilities. The Yogyakarta Provincial Department of Health stated that Sleman Regency is the Regency with the highest number of TB patients in the Yogyakarta province, with 340 patients. Sleman Regency has 212 cases of new pulmonary TB patients, and 67 of them were in the Depok sub-district. Several outpatients said that they did not undergo other supporting treatment other than the treatment given from the Puskesmas. The Indonesian Tuberculosis Eradication Association explains that TB control relies on efforts from the government and community. Therefore, there is a need for a new therapy to improve repair and accelerate healing in TB patients.

Nightingale's theory focuses on the physical environment. Nightingale defines and explains that the concepts of ventilation, warmth, light, diet, cleanliness, and noise play a vital role in healing disease. One of the five components is the concept of light. In particular, Nightingale identifies direct sunlight as a specific need for patients. Nurses should expose patients to sunlight to achieve the beneficial effects of sunlight (Alligood 2017).

Handono's research reported that sun therapy by sunbathing in patients with chronic obstructive pulmonary disease (COPD) decreased shortness of breath and increased comfortable and relaxed feeling. In addition, Sugiarti's study revealed that giving Vitamin D as supplementary support could speed up sputum conversion time and improve high radiological features (100%) compared to the placebo group (76.7%). The study indicated that vitamin D therapy could complement Anti-Tuberculosis Drugs.

Vitamin D is recommended as prophylaxis for tuberculosis patients because it is easy, and the costs required are affordable. Sun therapy or heliotherapy is one practical and efficient way to get vitamin D (Handono, Ashifa, and Kristiawan 2020; Sugiarti and Ramadhian Mr 2018). Therefore, this study analyses Nightingale's environmental theory through the effect of heliotherapy on the clinical improvements in individuals with tuberculosis.

## **METHOD**

This study was a quantitative study using a quasi-experimental design with a pretest-posttest approach and control group. The intervention group was the treatment group with heliotherapy and Anti-Tuberculosis Drugs, while the control group was the treatment group with Anti-Tuberculosis Drugs. In addition, the population was 59 individuals with tuberculosis in Depok Sleman District, Yogyakarta. Meanwhile, there were 24 respondents by purposive sampling method. In addition, the sample size was determined with Sastroasmoro's formula (2014). The treatment group was 17 individuals with tuberculosis at Depok3 Public Health Centre (PHC), and the control group was 17 individuals with tuberculosis at Depok 2 PHC. The inclusion criteria were positive smear pulmonary TB patients aged 18-

50 years and had no allergies to sun exposure. The independent variable was heliotherapy, while the dependent variable was the clinical improvements consisting of weight, cough, and shortness of breath. Heliotherapy was conducted for four weeks with an intensity of four times a week for 25 minutes a day (Masulili, Zainul, and Junaidi 2017). The authors interacted with respondents by using a video call after respondents signed informed consent. We did a pre-test in intervention and control groups, after four weeks, we carried out a post-test in both groups. Instruments to measure weight used weighing scale, to evaluate shortness of breath utilized the Borg Scale, and to assess cough used a Leicester cough questionnaire. A previous study reported that the Leicester cough questionnaire was valid with a reliability value of 0.686 (Hasanah, Permatasari, and Karota 2016). Data analysis used the Wilcoxon Test for shortness of breath and paired T-Test for weight and cough with a significance of 0.05.

## RESULT

In this study, the characteristics of respondents consisted of age, gender, and smoking habit. Both intervention and control groups were mainly aged 19-33 years old (82.5% in the intervention group and 64.8% in the control group), male (58.8% in the intervention group and 70.9% in the control group). In addition, they had smoking habits (52.9% in the intervention group and 58.8% in the control group). The characteristics of individuals with tuberculosis in this paper can be seen in table 1 in detail.

Table 1 Characteristics of respondents in the intervention and control groups by age, gender, and smoking habit

characteristics of respondents	Intervention Group		Control Group	
	frequency	percentage (%)	frequency	percentage (%)
Age (years old)				
19 – 33	14	82.5	11	64.8
34 – 48	3	17.5	6	35.2
Gender				
Male	10	58.8	12	70.9
Female	7	41.2	5	29.4
Smoking Habit				
Smoking	9	52.9	10	58.8
Not Smoking	8	47.1	7	41.2

Table 2 Frequency Distribution of Weight, Cough, Shortness of breath, and Statistics Analysis Results

Variable	Group	Pre-test (Mean±SD)	Post-test (Mean±SD)	$\rho$
Weight	Intervention	49.71±5.0	50.59±5.2	0.00*
	Control	50.00±5.3	50.59±5.2	0.00*
Cough	Intervention	97.24±9.5	114.94±10.5	0.00*
	Control	99.12±9.5	112.00±10.7	0.00*
Shortness of breath	Intervention	1.294±1.1	0.471±0.7	0.00*
	Control	1.353±0.8	1.118±0.6	0.06

\*Significant test result

Table 2 reveals the paired T-test results on weight and cough and the Wilcoxon test results on the shortness of breath. There were significant differences in clinical improvements before and after heliotherapy in the intervention group ( $p=0.00$ ). In addition, there were significant differences in weight and cough score before and after heliotherapy in the control group ( $p=0.00$ ). However, there was no significant difference in the shortness of breath score in the control group ( $p=0.06$ ).

## DISCUSSION

This study showed clinical improvements in the intervention group. In addition, there were increased clinical improvements in weight and cough scores in the control group. However, there was no significant difference in the shortness of breath score in the control group. Increased clinical improvements in both groups because they were taking Anti Tuberculosis Drugs. However, the intervention group experienced more significant clinical improvements than the control group after heliotherapy application for four weeks. It is in line with Handono's (2016) study analyzing solar irradiation to reduce shortness of breath in COPD patients. The study was conducted for four weeks every morning and evening with a duration of about 15-20 minutes. The study showed that respondents with solar irradiation reported more comfortable feelings and had less shortness of breath (Handono, Ashifa, and Kristiawan 2020).

Heliotherapy is a medical therapy involving sun exposure. Treatment is done by sunbathing under heat or sunlight, which is believed to cure some infectious diseases. This treatment has been carried out long before antibiotics were discovered and used as a treatment for several diseases (Emokpae et al. 2016; Jarrett and Scragg 2017).

Sun exposure is the primary source of vitamin D, and 90% of vitamin D is formed in the skin. Vitamin D function regulates calcium homeostasis and is also involved in regulating cellular functions, including cell growth. Vitamin D affects the formation of immunity and antibodies against pathogens and bacteria (Turnbull and Drobniowski 2015).

Nightingale's theory focuses on the physical environment. The theory explains that ventilation, warmth, light, diet, cleanliness, and noise are vital in healing disease. One of the concepts of the five components is the concept of light. In particular, the theory identified direct sunlight as a specific need for the patient. A previous study using sunlight has been carried out by Masulili (2017). The study revealed that 54.6% of respondents who sunbathed from 08.00 to 09.00 AM in the arm, leg, and face area showed increased vitamin D production by 200 IU/day. The study indicated that sunlight could improve vitamin D levels in most respondents. As a result, there would be an increased immunity system for clinical improvement (Masulili, Zainul, and Junaidi 2017). In addition, sun exposure significantly contributes to most respiratory illnesses such as influenza because sunlight triggers vitamin D production. Furthermore, it can inactivate the influenza virus, improve mood, and release endorphins to increase immunity (Whittemore 2020).

Recent research by Asyary (2020) evaluated sun exposure to Covid-19 patients. Those research indicated that sunlight increased the immunity system, provided faster clinical recovery, slowing the virus replication in the body, and preventing virus transmission. However, sunlight exposure could not eliminate the virus in the body (Asyary and Veruswati 2020). Symptoms of Covid-19 have similarities with tuberculosis, including shortness of breath, cough, and increased sputum production triggered by decreased immunity system. In addition, reduced immunity system in individuals with tuberculosis also causes anorexia causing weight loss (Mandala 2015). Heliotherapy is proven to increase clinical improvements in tuberculosis patients. However, it does not eliminate bacteria, so it is essential to continue anti-tuberculosis drugs during treatment. From several studies and theories above, the Authors believe that applying Nightingale's theory through heliotherapy is useful for improving tuberculosis patients' clinical conditions. In addition, heliotherapy is recommended non-pharmacological complementary therapy for individuals with tuberculosis (Asyary and Veruswati 2020; Handono, Ashifa, and Kristiawan 2020).

## CONCLUSIONS

In conclusion, the application of Nightingale's environmental theory through heliotherapy affects clinical improvements in individuals with tuberculosis. Heliotherapy could be the recommended non-pharmacological complementary therapy for tuberculosis.

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