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Anemia Management Model in Pulmonary Tuberculosis Using Beetroot and Tomato Combined With A High-Calorie and High-Protein Diet

Evarina Sembiring[1]; Henny Syafitri[2]; Amila[3*)]

[1]Public Health Program Study of Sari Mutiara Indonesia University
[2,3*)] Nursing Program of Sari Mutiara Indonesia University

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ABSTRACT

Beetroots and tomatoes are rich In vitamins, iron, folic acid, and other nutrients that can be used as an alternative in treating anemia. High protein and calorie intake dietary is necessary to improve patients' nutritional status in pulmonary tuberculosis. The purpose was to examine the effect of beetroot juice consumption, tomato juice combined with a high protein and calorie diet on hemoglobin pulmonary tuberculosis. This research was an analytical comparative with quasi-experimental design by pre-test and post-test control group design. This study was conducted to 45 patients of Pulmonary tuberculosis who having anti-TB treatment at Pulmonary Policlinic Sari Mutiara Medan General Hospital, using purposive sampling technique, divided into three treatment groups. All of the treatments were administered for 30 days, pre and post-treatment were given the hemoglobin test. Data were analyzed by using paired t-test and One Way Anova, followed by Linear Regression. All of three group treatments are having an increasing level of hemoglobin, mean hemoglobin level in Group I: 2.5 gr/dl, p-value = 0.000., Group II: 1.8 gr/dl. p-value = 0.002. , Control group It: 1.1 gr/dl, p-value = 0.004.Beetroot juice with a diet high in proteins and calories most effective to increase levels of hemoglobin and nutritional status in pulmonary tuberculosis, this intervention can be recommended as a management modeling of anemia in pulmonary TB patients who received anti-TB treatment.

Penanganan Anemia pada Tuberkulosis Paru Melalui Pemanfaatan Jus Bit dan Tomat Dengan Kombinasi Diet Tinggi Protein dan Kalori

ABSTRAK

Bit dan tomat kaya dengan vitamin,zat besi,asam folat dan nutrisi lainnya dapat digunakan sebagai alternatif dalam mengobati anemia. Diet tinggi protein dan kalori diperlukan untuk meningkatkan status gizi pasien tuberkulosis paru. Tujuan penelitian adalah untuk menguji pengaruh konsumsi jus bit,jus tomat yang dikombinasikan dengan diet tinggi protein dan kalori terhadap hemoglobin tuberkulosis paru. Jenis penelitian ini adalah analitik komparatif dengan desain squasi eksperimen pre test dan post test kontrol. Penelitian ini dilakukan terhadap 45 penderita TB Paru dengan program pengaoabatan anti TB di Polikilinik Paru RSU Sari Mutiara ,menggunakan tehnik purposive sampling yang dibagi menjadi 3 kelompok perlakuan. Semua kelompok dilakukan treatmen selama 30 hari,sebelum dan sesudah treatmen dilakukan pemeriksaan hemoglobin. Analisa data menggunakan uji t berpasangan dan One way Anova dilanjutkan dengan Regresi Linier. Hasil penelitian didapatkan ketiga kelompok perlakuan mengalami peningkatan kadar hemoglobin ,rerata kadar hemoglobin pada kelompok I: 2.5 gr/dl p .value= 0.00, Kelompok II: 1.8 gr/dl. p-value= 0.002, Kelompok Kontrol: 1.1 gr/dl, p-value= 0.004. Jus bit dengan diet tinggi protein dan kalori paling efektif untuk meningkatkan kadar hemoglobin dan status gizi pada tuberkulosis paru, Intervensi ini dapat direkomdasikan sebagai model dalam managani anemia pada tuberkulosis paru. dengan program pengobatan tanti TB (OAT).

Kata kunci:

Anemia
Tuberculosis
Jus Bit
Jus Tomat
Diet Tinggi Protein
Diet Kalori

**) corresponding author*

Professional Program in Nursing of Sari Mutiara Indonesia University

Email: mila_difa@yahoo.co.id

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INTRODUCTION

Tuberculosis (TB) is still a health issue that poses a serious global public health concern. TB is one of the top 10 causes of mortality in the world (Glaziou et al., 2013). It is estimated that the number of death caused by TB reached to 1.3 million cases. Indonesia, itself, is one of the 8 countries with the highest TB burden in the world, namely India (27%), China (9%), Indonesia (8%), Philippines (6%), Pakistan (5%), Nigeria (4%), Bangladesh (4%), and South Africa (3%). (WHO, 2018; Kemenkes RI, 2018). Pulmonary Tuberculosis is a chronic infection in lung tissue caused by Mycobacterium tuberculosis. Patients with pulmonary TB are at a great risk to also suffer from anemia due to the infection process and metabolism needs. One of the risk factors of pulmonary TB is iron deficiency anemia which is often associated with bleeding due to hemoptysis and hematopoietic disorder (Isanaka et al., 2012).

Malnutrition and tuberculosis are the two most common diseases in many developing countries in the world. As the result, anemia which is the most common complication in tuberculosis may also occur with prevalence rate around 16 to 76% in different studies (Rizwan, 2014).

In Indonesia, 60% of TB patients suffering from malnutrition were also reported to have anemia problem (Karyadi et al., 2000). Anemia is a medical condition in which the hemoglobin level is lower than 13 g/l in men, lower than 12 g/l in non-pregnant women, and lower than 10 g/l in pregnant women (Camaschella, 2015; Gil-santana et al., 2019). It is also an indicator of poor nutritional status and health condition. Anemia is caused by deficiency of iron, folic acid, vitamin B12, vitamin A, chronic diseases, parasitic infection and chronic inflammation (Gupta et al., 2009).

Anemia of chronic disease is the most condition associated with pulmonary TB, iron deficiency with or without anemia may contribute to advancing the disease (Bashir et al., 2015). Anemia in tuberculosis patients occurs as a result of disturbance in the process of erythropoiesis by inflammatory mediators, shortened erythrocyte life span, iron metabolism disorders and insufficient nutrients, namely calories, protein and vitamin (Oliveira, 2014). In addition, the Mycobacterium tuberculosis requires iron for its growth resulting in iron deficiency as a component of hemoglobin. (Devi et al., 2003; Isanaka et al., 2012). TB infection increases energy requirements to maintain normal physical function which is characterized by increased resting energy expenditure (REE). Besides, it can also cause or aggravate malnutrition due to appetite suppression and catabolism increase (Ren et al., 2019). This increase reaches 10-30% of energy consumption of normal individuals. Energy consumption of patients with tuberculosis is in the range of 35-40 kcal per kg of ideal weight. In addition, protein intake of tuberculosis patients is 1.2–1.5 gr per kg of body weight or 15% of the total daily energy or approximately 70–100 per day (World Health Organization, 2013; Nthiga et al., 2017).

This process causes anorexia in TB patients as the result of increased leptin production which eventually leads to food intake decrease. TB infection may also cause nutrient malabsorption and changes in body metabolism. They disturb protein and endogenous lipid synthesis and result in the increase of proteolysis and lipolysis which cause REE increase. This condition is called as anabolic block and associated with wasting process leading to malnutrition (Schwenk et al., 2003). Inadequate energy intake makes the body use the excess energy reserves to meet physiological needs which eventually cause dramatic body weight loss and biochemical disorders.(Nthiga et al., 2017). As a result, this condition will bring an impact on immune system decrease and the infection becomes progressive and slow down healing process in pulmonary TB patients. Protein calorie and iron malnutrition will affect immune system and reduce body endurance towards diseases including pulmonary tuberculosis (Gurung et al., 2018; Maggini et al., 2018).

Therefore, recovering from malnutrition by providing the body with adequate nutrients and high protein content foods will stop depletion from repairing cells, mucosal tissue, and cell integrity, so that patients' immune will increase (Maggini et al., 2018). To resolve anemia and malnutrition problems in pulmonary TB patients, they are also required to consume foods containing iron and folic acid (World Health Organization, 2013; Ren et al., 2019). Besides, it is also necessary for the patients to have a diet which is rich in calorie and protein, vitamin and mineral.. Dietary intake of high protein and high calorie is necessary to improve nutritional status of patients (Nthiga et al., 2017). The principles of diet in pulmonary TB patients are high-calorie, high-protein, enough fat, vitamins, and minerals. A high-protein and high-calori diet can help the patients to get sufficient nutrients to meet their increased needs of calorie and protein. Normally, the energy consumption in patients with infectious disease is higher due to hyper catabolism and malnutrition (World Health Organization, 2013).

Beetroots (Beta vulgaris) and tomatoes (Lycopersium Commune) provide many health benefits. The high content of iron (Fe) and folic acid in these vegetables can be used as an alternative in treating anemia in tuberculosis patients. Beetroots are rich in vitamins (A, C, B1, B2, B3, and B6), iron, folic acid, potassium, magnesium, phosphor, sodium, calcium and other nutrients. In average, 100 gram (3.5 oz.) beet contains 0.80 mg (6%) iron and 109 µg folic (vitamin B9) (Kumar, 2015; Clifford et al., 2015). Red beetroots have many potential health benefits, such as to prevent anemia (help produce red blood cells), reduce blood pressure, function as an antioxidant, and to boost immune system. Iron (Fe) in beetroots is a micro mineral which is mostly found in human body (Clifford et al., 2015; Neha et al., 2018). Based on a study on female adolescents in a state high school in Tamilnadu (Priya, 2013) found that providing beetroots for 20 days every morning significantly increased their hemoglobin level.

On the other hand, tomatoes (Lycopersium Commune) are rich in vitamin C and also provide many health benefits. This vegetable does not only contain vitamin C, but also high content of iron (Fe). A cup of tomato contains at least 3.39 mg iron. In addition, as a source of minerals, tomatoes are useful for bone and tooth formation (calcium and phosphor), while iron (Fe) in tomatoes plays an important role in red blood cells or hemoglobin production (Bhowmik et al., 2012). Tomatoes also have other nutrients such as alkaloid sloganize (0.007%), spooning, folic acid, citric acid, bioflavonoid, protein, fat, sugar (fructose, glucose), adenine, trigonelin, choline, tomatin, minerals (Ca, Mg, P, K, Na, Fe, sulfur, chlorine), vitamins (B1, B2, B6, C, E, niacin), histamine, and lycopenethe (Raiola et al., 2014).

The tomato is a food very rich in lycopene, numerous studies have shown that people who ate tomatoes regularly have a reduced risk of contracting cancer diseases such as lung, prostate, stomach, cervical, breast, oral, colorectal,

esophageal, pancreatic, and many other types of cancer. Tomato is also good for liver health, skin, kidneys, eyes, hair, diabetics, pregnancy,and tomato juice is known as good energy drink (Bhowmik et al., 2012; Olga I. Ustinova*, 2016).

According to (Raiola et al., 2014) regular consumption of tomatoes can reduce the risk of infection, cancer, and non-infectious chronic diseases..Folic acid in tomatoes can also prevent megaloblastic anemia and anemia in pregnant women. The tomato juice has an exceptionally rich composition, the tomatoes are used at metabolic disorders, cough, atherosclerosis, obesity, anemia, and constipation. (Hidajati, 2018) in their study, found that giving 660 mg tomato extract for 10 days could significantly increase hemoglobin level of pregnant mothers in their trimester II, with p value 0.021 (p>0.005).

A diet rich in calories, proteins, fats, minerals, and vitamins was considered to be an essential for anemia patient's pulmonary tuberculosis, and it is required to increase the nutritional status of patients and increase the iron as well as folic acid for the for mation of hemoglobin (Bashir et al., 2015; Maggini et al., 2018). World Health Organization (2013) released operational guidelines for nutritional care and support of patients with TB recommending, an adequate diet, containing all essential macro and micronutrients, is necessary for the well-being and health of all people, including those with TB infection or TB disease.

Soymilk is a nutritious drink made from soybeans, and one kind of food that has high nutrient content, such as protein and carbohydrates.,fat, carbohydrates vitamins and minerals. The nutrients contained in soy can produce energy and maintain optimal body function. Soymilk can be sufficient iron to reduce anaemi (Messina, 2016). Normally, the nutrients in 100 grams of dry soybean contain 268 calories, 30.90 gr protein, 15.10 gr fat, 30.10 gr carbohydrate, 196.00 milligram calcium, 506.0 milligram phosphor, 6.90 milligram iron (Fe), 95.00 vitamin A, 0.93 milligram vitamin B1, and 20.00 milligram water (Rizzo & Baroni, 2018).

Increasing the amount of iron in the soybeans milk has the potential to be a solution to reduce the number of patients with iron deficiency anemia (Darmawan et al., 2017). Soy milk contains of 60 to 90% nutritional value of cow's milk. may help clear the congestion in chest,medical research has associated soy milk with tuberculosis and It is also used for type 2 , Diabetes, Asthma, Lung Function, all type of Cancers (Lung Cancer) (Bolla, 2015).

As a source of essential nutrients, eggs have been used worldwide to support the nutritional needs of human societies. Eggs are a rich sources of protein,fats and micro nutrient play an important role in basic nutrition,eggs also containts various trace nutrients that are important for health, eggs are rich in several nutrients that promote hearth such a betanine and choline. More than half the protein of an eggs is found in the egg white along with vitamin B2 and lower amounts of fat and cholesterol than yolk.The whites are rich source of selenium,vitamin D,B6,B12, A, D, E and K,and minerals such as zinc,iron and copper.Egg yolk contain more 77 calories, protein : 69 gram and healthy of fat :59 gram (Miranda et al., 2015; Ruxton et al., 2010).

Addressing the above issues need to be an alternative solution to solve the problem of pulmonary TB with anemia, such as improved nutritional status and increased levels of hemoglobin. Therefore, the researcher's aim was to know the effect of beetroot juice and tomato juice when combined with a diet proteins and rich in calories on hemoglobin levels, in three different intervention groups and to discover an effective model for anemia treatment in pulmonary tuberculosis.

METHOD

Research Type and Design

This research was an analytical comparative with *quasi-experimental* design by pre-test and post-test control group design.

Samples Procedures

The sample size selected for this study consist of 45 adult patients of Pulmonary tuberculosis who having treatment programs at Pulmonary Policlinic Sari Mutiara Medan General Hospital. Purposive sampling technique was used to select the samples, with criteria : male: hemoglobin <13 gr/dl and women hemoglobin <11 gr/dl, not taking the drug or supplements that affect blood hemoglobin and without comorbiditie. This study was conducted after receiving the written approval from the Comite Etic Health Research of Nursing Faculty of University of Sumatera Utara. Dated: April, 05th 2016, No :1014/IV/SP/2013 and written informed consent was obtained.

Intervention Procedures

Before doing the intervention, all subjects will be measured their body mass index (BMI) using weight scales and gauges. Data of hemoglobin level was measured by using hemoglobin measurement tools named hemacromax plus with Indonesian Red Cross standard in collaboration with laboratory staffs. Then the subjects were randomly grouped into three groups of each 15 peoples. Before doing the treatment, the subjects received the treatment (intervention) in 30 days by their respective groups, and all forms of interventions were delivered to respondent's home. The forms of intervention for the three groups were as follows: Treatment Group I (a cup of beetroot (Beta vulgaris) juice as much 250 cc) and a diet rich in calories and proteins (a cup of soybean milk as much 250 cc) and one boiled egg) for 30 days. Treatment Group II (a cup of tomato juice (250 cc) and a diet rich in calories and proteins (a cup of soybean milk as much 250 cc and one boiled egg) for 30 days. Treatment Group III = Control group (only a diet rich in calories and proteins (a cup of soybean milk as much 250 cc and one boiled egg) for 30 days.

After giving intervention for all of the groups for 30 days, the researcher measured the hemoglobin levels of the respondents back in the three groups. The results which influence on increasing of hemoglobin level most will test in the second phase that is to the new case of pulmonary tuberculosis patient and will serve as anemic prevention model on pulmonary tuberculosis.

Data analysis

Data were analyzed by using paired t test to compare the average of increasing hemoglobin levels before and after treatment in each group. One Way Anova Folowed by Tukey' multiple Comparation Test were using to compare the ratio of increasing average of hemoglobin levels from the three intervention groups. *p value less* than 0.05 (P <0.05) were considered statistically significant. Multivariate analysis: was used to determine the factor with the most significant influence on hemoglobin levels by using Linear Regression.

RESULTS AND DISCUSSION

The result of the respondent characteristic analysis in this study illustrates the distribution of respondents based on age, sex, body mass index (BMI), and average hemoglobin level before and after intervention in each intervention groups.

Table 1
Distribution of pulmonary TB patients with anemia by age and BMI

Variable	Group I			Group II			Control Group		
	Mean	SD	Min-Max	Mean	SD	Min-Max	Mean	SD	Min-Max
Age	45.8	±20.8	18-79	44.3	±19.3	17-77	43.9	±16.1	18-70
BMI	22.7 kg/m^2	4.8	16-29	19.2 kg/m^2	10.2	14-24	20.7 kg/m^2	2.6	15-24

As shown in table 1 that the mean of age from the three groups who are having anemia was 45 years old, The youngest was 17 years old and the oldest was 79 years. The average value of BMI of the three groups was 20.86 kg/m^2. the lowest of BMI was 14 kg/m^2, and the highest of BMI was 29 kg/m^2. This study results showed that the age of pulmonary TB patients who are having anemic was people in the productive age category. Also table 1 illustrate that majority of Patient Tuberculosis with anemia are having low BMI, is associated with poor nutrition or malnutrion.

Table 2
Distribution of pulmonary TB patients with anemia by gender (N= 15)

Variable	Group I		Group II		Control Group	
	N	%	N	%	N	%
Male	8	63.3	9	60.0	7	53.3
Female	7	36.7	6	40.0	8	46.7

As shown in table 2 that approximately 63.33% of the subjects groups were male and the number having anemia of male more higher than female subject from three different group.

Table 3
Hemoglobin level of pulmonary TB patients' before and after treatment among Group I, Group II and Control Group

Measurement	N	Mean (gr/dl)	SD	SE	p-value
Group I					
Pre-test	15	10.7	1.3	0.3	0.000
Post-test	15	13.2	1.1	0.2	
Group II					
Pre-test	15	10.2	1.6	0.4	0.002
Post-test	15	12.0	1.5	0.4	
Control Group					
Pre-test	15	10.3	1.8	0.5	0.004
Post-test	15	11.4	1.6	0.4	

The t-dependent test was used to verify the differences between pretest and posttest of hemoglobin levels in each cluster, while the t-independent test was performed to examine disagreements over hemoglobin levels from the group I, group II and control group. As shown in table 3 that in group I it showed that after the administration of the beetroot (Beta vulgaris) juice and a diet rich in calories and proteins (a cup of soybean milk as much 250 cc) and one boiled egg) for 30 days, and there was increasing hemoglobin as 2.5 gr/dl. Statistical test results showed that the p-value = 0.000 (P <0.05), meaning that there was a significant difference in the means of hemoglobin level before and after giving the treatment. In group II, It showed that after the administration of the Solanum lycoperisium juice with a diet rich in calories and proteins (a cup of soybean milk as much 250 cc) and one boiled egg) for 30 days, there was increasing hemoglobin as 1.8 gr/dl .Statistical test results showed that p-value = 0.002 (P <0.05), meaning that there was a significant difference in mean hemoglobin levels before and after giving the treatment. In control group It showed that after the administration of diet rich in calories and proteins there was increasing hemoglobin as 1.1 gr/dl. Statistical test results revealed that p-value = 0.004 (P <0.05), it can be concluded that there was a significant difference between the mean hemoglobin level before and after giving the treatment.

Table 4
Linear Regression

Measurement	R *Square*	*p*-value	*Beta Coefficients*
Group I		0.000	5.140
Group II	0.547	0.002	2.961
Control Group		0.004	0.840

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In the multivariate logistic regression analysis, the factor which had the most significant effect on the hemoglobin level was determined by the value of coefficient beta. The statistical analysis found that the coefficient beta of the intervention group I (beetroot juice and high-calorie high-protein diet) was 5.140, indicating that 250 cc of beet juice (100 gram of beet), 250 cc of soy milk (100 gr soybeans) and 1 boiled egg can increase hemoglobin level 5.1 times in pulmonary TB patients who are undergoing anti-TB medication. The obtained value of coefficient of determination (R Square) which was 0.547, shows that the linear regression equation could explain that 54.7% of the hemoglobin level of the tuberculosis patients was influenced by Treatment Group I (250 cc of beet juice and a high-calorie and high-protein diet containing 250 cc of soy milk and 1 boiled egg) and the remaining, 45.3%, was affected by Treatment Group II (tomato juice and a high-calorie high-protein diet) and the control group (high-calorie and high-protein diet).

DISCUSSION

In the present study, demographic characteristics include gender, age and BMI (Body Mass Index). The results obtained that from the total of 45 pulmonary TB respondents who were also suffering from anemia, 53.3% of the incident of anemia occurred in male respondents. Literatures denote that men are at a greater risk to suffer from lung-related diseases than women. This is associated with men's habits which tend to smoke and drink alcohol more than women. Smoking and alcohol drinking can lower human immune, resulting in greater risk to suffer from pulmonary TB (Kemenkes RI, 2018; Isanaka et al., 2012**;** Gil-santana et al., 2019)**.** In 2017, the total number of TB cases in Indonesia was 420.994 and the number of TB cases in men was 1.4 times higher than that in women. Based on a Tuberculosis Prevalence Survey, the prevalence of TB in men is 3 times higher than in women. The higher risk in men is probably due the habits of smoking and lack of adherence to taking medicine. This survey found that 68.5% of male respondents smoked and only 3.7% of female respondents did (Kemenkes RI, 2018).

In our study, around half of the tubercular patients with anemia were in the productive age arangge 15-49 years old. Data concerning tuberculosis cases in 2013 from Basic Health Research (known in Indonesian as Riskesdas) shows that 75% of pulmonary TB patients were in the productive age arange 15-49 years old (Kemenkes RI, 2018). People with pulmonary TB who are in the range of productive age are likely to be more difficult to work and be a burden to the family. Similar results also found by (Glaziou et al., 2013; Oliveira, 2014) that more pulmonary tuberculosis cases were found in productive-age men who were smoking, alcoholic and highly addictive drug user. Ren et al (2019) also reported that the majority (53.7%) of TB patients aged between 18 and 49, with the mean age being 45.5 years old (SD=18.7).

The present study found that the average Body Mass Index of the 45 respondents in the study was 20.6 kg/m2 (normal). However, it was found that there were some respondents who had poor nutritional status and were very thin (malnutrition), with BMI was 14. kg/m2. It was also obtained that the varied nutritional status of the respondents would result in different healing process of the disease. Normally, body mass index is measured to identify risk factors of individuals to suffer from anemia. Besides, patients' poor nutritional status will also be associated with the occurrence of anemia. The decrease of BMI indicates a relationship of anemia, mechanism of nutritional status resulting from wasting disease by Mycobacterium tuberculosis and immunity decrease due to the infection by pathogenic microorganism (Bashir et al., 2015; Ren et al., 2019).Activation of immune response during infection will increase energy consumption**.** The risk of pulmonary TB patients with low body weight to fail in the therapy and experience relapse is likely high (Maggini et al., 2018) According to Lai et al (2017)**,** TB patients with BMI below 18.5 kg/m are at risk of death, especially those with TB who had TB treatment.

This study also reported that the level of hemoglobin of the respondents before the intervention was in moderate category, with average level 10.4. g/dl. However, patients with severe anemia were still found, with hemoglobin level was 7.46.g/dl. According to (Isanaka et al., 2012) that Low Fe level is multifactorial. Inadequate dietary Fe, malabsorption due other secondary infections and increased blood loss/hemoptysis in Pulmonary tuberculosis (PTB) may reduce body iron stores. This data indicates that poor nutritional status and health condition will negatively affect the healing process. In the treatment process, the patients received anti-TB drugs which would affect their healing process. According to (Ren et al., 2019) Malnutrition can also have a negative impact on the treatment of TB. Malnutrition will reduce the level of protein in the patient's body, and thus delayed the recovery of lesions.

Post the intervention, this study found that the respondents of the three groups showed an increase of hemoglobin level, namely: the lowest hemoglobin level was 9.1 gr/dl, the highest level was 13.46 gr/dl, the average was 12.16 gr/dl and the average of the increase was 1.76 gr/dl. It can be inferred that providing beetroot juice, tomato juice and a high-calorie and high-protein diet to patients with pulmonary TB who are receiving TB treatment has an impact on the increase of hemoglobin level. Despite the fact that the increase in each patient was varied depending on the nutritional status and anemia category, the utilization of beetroot juice, tomato juice and a high-calorie and high-protein diet significantly increased patients' hemoglobin level. This study also found that patients who experienced increased hemoglobin level during their medication had a greater opportunity to be healed**.**

The present study, in the multivariate logistic regression analysis, found that from the groups, anemia management in pulmonary TB patients which received anti-TB treatment the most significant effect on the hemoglobin level was determined by intervention group I. This group received an intervention of 250 cc of beet root juice combined with a high-calorie high-protein diet containing 250 cc of soy milk and 1 boiled egg for a period of 30 days. the level of hemoglobin increased as many as 2.5 g/dl, with coefficient beta was 5.140 and coefficient of determination (R square) was 0.547.

This study reported that the level of hemoglobin increase in pulmonary TB patients who were receiving anti-TB treatment was affected by the high content of nutrients in beet juice and the high-calorie and high-protein diet.(containing 250 cc of soy milk and 1 boiled egg) for a period of 30 days. Beetroot juice is rich in vitamins and minerals, such as iron which is required in hematopoiesis process, and folic acid which is important in forming and repairing damaged cells, Vitamins and minerals can play important role in treatment of tuberculosis. Beetroot juice are rich in iron, which is easily assimilated by the body, they build up the hemoglobin and cleanse the blood It is a very good

source of folic acid, Folate is very involved in the production of new cells and the maintenance of existing cells (Kumar, 2015; Neha et al., 2018). Besides the beet juice, nutrients which are rich in calorie and protein are also needed in pulmonary TB management. According to (World Health Organization, 2013; Nthiga et al., 2017) micronutrients play an important role in pulmonary TB patients who are receiving anti-TB treatment, particularly those which can help to boost body immunity, such as vitamin A, selenium, vitamin D, B3, B6, B12, folic acid , calcium and magnesium. All micronutrients and nutrients needed by pulmonary TB patients can be found in beetroots (Dhawan et al., 2019).

Some previous studies also found that beet juice were useful in resolving anemia (Kavitha & Denish, 2020) on a study conducted toward a group of female adolescents living in a dormitory in Bidar, Karnataka, India, found that there was a significant increase of Hemoglobin level in the respondents after the consumption of beet juice in a certain period of time. The results showed that there was a significant correlation ($p<0.05$) between pre-test and post-test values of the hemoglobin level of the respondents. Similar finding was also obtained by (Lotfi et al., 2018) reporting that beet juice which was given to a group of female soccer had a significant effect on hemoglobin level, so that the juice can be consumed to prevent anemia and increase hemoglobin in athletes with anemia issue.

Basically, TB patients need to have a balance nutrient intake to accelerate the healing process. Therefore, they need a high-calorie and high-protein diet to 1) provide sufficient nutrient and energy to fulfill the increased energy and protein requirements; 2) prevent and reduce the risk of tissue damage; 3) gain ideal body weight for patients with less body weight; and 4) prevent and reduce the risk of further tissue damage. Shortly, sufficient calorie and protein intakes will ensure new cells formation in the tissue (World Health Organization, 2013; Nthiga et al., 2017; Maggini et al., 2018).

In this study, apart from giving beet juice in increasing hemoglobin level as an intervention in anemia management in pulmonary TB patients, the patients also received anti-TB therapy combined with a high-calorie and high-protein diet by giving 250 cc of soy milk and a boiled egg in a period of 30 days. Therefore, it can be assumed that the required nutrient intake was sufficient and complementary. The principles of diet in TB patients are a high-calorie and high-protein diet, as well as sufficient fat, vitamins, and minerals. A high-calorie and high-protein diet was given to TB patients, so that they received sufficient intakes to meet the increase need of calorie and protein. Normally, energy requirements in patients with infections are likely to be high due to hyper catabolism and recovery from malnutrition (Nthiga et al., 2017; Gurung et al., 2018)

Soy milk is a liquid extraction of soy beans. Protein in soy milk contains amino acid of which the structure and properties approximate those in cow milk (Rizzo & Baroni, 2018). Soy foods are rich source of high quality protein and soy provide the some quality protein as meat, milk and eggs (Darmawan et al., 2017). Therefore, soy milk can substitute cow milk in providing the need of protein. Besides, soy milk also contains numerous minerals (such as calcium, phosphor, and iron) and vitamins (such as vitamin A, D, E, and K). In the form of fresh milk, it contains iron, calcium, carbohydrate, phosphor, vitamin A, high dosage of vitamin B complex, water and lecithin that can be absorbed more quickly and better in human body. The nutrients contained in soy can produce energy and maintain optimal body function (Kohli et al., 2017; Messina, 2016).

Other advantages of soy milk are that it does not contain lactose, its protein content does not cause allergy, it is low fat and cholesterol free, but rich in nutrients. Previous study reported that soy milk is also used to treat patients with high cholesterol level, hypertension, to prevent coronary artery and blood vessel disease, diabetes type 2, asthma, pulmonary malfunction, all kinds of cancer (lung cancer, breast cancer, endometrial cancer, prostate and thyroid cancer), and also to prevent osteoporosis and slow down kidney failure (Messina, 2016**;** Bolla, 2015**;** Rizzo & Baroni, 2018)

Egg is another food alternative in the high-calorie and high-protein diet. Egg is a source of animal protein which is easy to digest and highly nutritious. For humans, eggs are one of the best sources of high quality protein (Kuang et al., 2018). Thus, it is really recommended to be consumed, particularly, by patients who are in recovery process. Besides, it can also relieve the symptoms of anemia. Despite its low cost, egg is rich in nutrients and considered as a kind of food with complete nutrient content (Miranda et al., 2015; Ruxton et al., 2010).

Eggs can make a significant contribution to a healthy diet, Composition and Nutrient values of a medium-size boiled egg (100 gram): Proximates : Energy : 155 k.cal, Water : 74.62 gram, Protein : 12.58 gram, Total lipid (fat) : 10.61 gram, Sugars, total : 1.12 g, Minerals : Calcium, Ca : 50 mg, Iron, Fe : 1.19 mg, Magnesium, Mg 10 mg , Phosphorus, P 172 mg, Potassium, K 126 mg, Sodium, Na : 124 mg, Zinc, Zn : 1.05 mg, Vitamins **:** Tiamin : 0.066 mg, Ribofavin : 0.513 mg, Niacin : 0.064 mg, Vitamin B : 0.121 , Folate, DFE : 44 µg, Vitamin B12 : 1.11 µg, Vitamin A, RAE 149 µg, Vitamin A, 520 IU, Vitamin E (-tocopherol) : 1.03 mg, Vitamin D (D2 + D : 2.2 mg,, Vitamin D : 87 mg, Vitamin K (phylloquinone) 0.3 µg. Lipids : SFAsb : 3.267 g, MUFAs : 4.077 g, PUFAsb 1.414 g, Cholestero 373 mg (Kuang et al., 2018)**.**

Previous study also reported that eggs are a nutrient-dense food , rich in essential vitamins and minerals, as well as antioxidants. Eggs may be used as a potential natural source of antioxidant,the antioxidant function of eggs could prevent humans from a large number of degenerative processes (Ruxton et al., 2010). Some nutrients in egg are zinc, selenium, retinol and tocopherols which can protect people from numerous degenerative processes. Egg also contains other bioactive compounds which play a significant role in therapy and prevention of chronic and infectious diseases. Studies report that some properties of the compounds in egg are antimicrobial, immune modulatory, antioxidant, anticancer and anti-hypertension (Miranda et al., 2015).

Since pulmonary TB brings negative effect on protein metabolism and nutritional status to its patients, anti-TB treatment and good nutritional status will accelerate the healing process. Sufficient nutrient intake during the treatment and recovery processes is required to help the patients recover from malnutrition and infection (World Health Organization, 2013; Ren et al., 2019).The inadequate intake of micronutrients, particularly vitamins and minerals, such as vitamin A, E and C, zinc, selenium, is associated with immune response disorder (Nthiga et al., 2017**;** Maggini et al., 2018)**.**

By giving beet juice combined with a high-calorie and high-protein diet containing 250 cc of soy milk and a boiled egg for a period of 30 days, all components of micronutrient and macronutrient which are essential in the intervention will be fulfilled. As the result, the nutritional status and immune system of patients with pulmonary TB will be increased and the anemia can be resolved. Previous studies also support the idea that regular anti-TB treatment and

sufficient nutrient intake will increase patients' body weight, hemoglobin level and immune system (Ren et al., 2019; Gil-santana et al., 2019). Micronutrients are of great importance in the management of TB, especially those that boost the immunity (e.g. Vitamins A and E, and selenium) and vitamin D, B3, B6, B12, folate, calcium and magnesium as well as those that their demand is increased by intake of TB treatment (World Health Organization, 2013; Lai et al., 2017).

LIMITATION OF THE STUDY

This study had several weaknesses. This study did not record all the food and drinks consumed before each meal and make a method of recording the type and amount of food consumed 24 hours ago (24 jam food records).

CONCLUSIONS AND SUGGESTIONS

Providing beetroot juice, tomato juice and a high-calorie and high-protein diet to patients with pulmonary TB who are receiving TB treatment has an impact and significantly increased patients' hemoglobin level. The increase of hemoglobin level in each patient was varied depending on the nutritional status and anemia category. Almost all of pulmonary TB patients which received anti-TB treatment, after administration of theree group treatments are having increasing level of hemoglobin, but group received an intervention of 250 cc of beet juice combined with a high-calorie high-protein diet containing 250 cc of soy milk and 1 boiled egg for a period of 30 days. most effective to increase levels of hemoglobin and nutrional status in pulmonary tuberculosis, received anti-TB treatment.

Suggestions

1. This intervention can recomended as a management modelling of anemia in pulmonary TB patients which received anti-TB treatment.
2. All patient Pulmonary TB and their family ,encourage to make a beetroot juice and gives a diet high protein and calori such soya milk and an eggs for everyday to increasing levels of hemoglobin.
3. Nurses can encourage all patients with pulmonary TB who have anemia to consume beetroot juice with a diet high proteins and calories especially for patients with pulmonary TB who are on treatment program because this intervention can be a natural therapy of anemia as a preventive complications of therapy.

Conflict of Interest Statement

The authors have no conflict of interest to declare.

REFERENCES

Bashir, B., Abdallah, S., & Mohamedani, A. (2015). Anemia among patients with pulmonary tuberculosis in port Sudan, eastern Sudan. *International Journal of Recent Scientific Research*, *6*, 4128–4131.

Bhowmik, D., Kumar, K. P. S., Paswan, S., & Srivastava, S. (2012). Tomato-A Natural Medicine and Its Health Benefits. *Phytojournal*. 1(1). 33-43

Bolla, K. N. (2015). Soybean Consumption And Health Benefits. *Soybean Consumption And Health Benefits*, *4*(7), 50–53.

Camaschella, C. (2015). Iron-Deficiency Anemia From. *N Engl j Med*, *372*, 1832–1843. https://doi.org/10.1056/NEJMra1401038

Clifford, T., Howatson, G., West, D. J., & Stevenson, E. J. (2015). The potential benefits of red beetroot supplementation in health and disease. *Nutrients*, *7*(4), 2801–2822. https://doi.org/10.3390/nu7042801

Darmawan, M. A., Karima, N. N., & Maulida, N. N. (2017). Potential of Iron Fortification Complex Compounds against Soybean Food for Anemia Problem Solution in Indonesia. *Journal of Advanced Agricultural Technologies*, *4*(2), 185–189. https://doi.org/10.18178/joaat.4.2.185-189

Devi, U., Rao, C. M., Srivastava, V. K., Rath, P. K., & Das, B. S. (2003). Effect of iron supplementation on mild to moderate anaemia in pulmonary tuberculosis. *British Journal of Nutrition*, *90*(3), 541–550. https://doi.org/10.1079/bjn2003936

Dhawan, D., Sharma, S., Ph, I., & Scholar, . D. (2019). Exploration of the Nourishing, Antioxidant and Product Development Potential of Beetroot (Beta Vulgaris) Flour. *International Journal of Health Sciences & Research (Www.Ijhsr.Org)*, *9*(6), 280.

Gil-santana, L., Cruz, L. A. B., Arriaga, M. B., Mirand, P. F. C., Fukutani, K. F., Silve, P. S., Silva, E. C., Oliveira, M. G., Mesquita, E. D. D., Rauwerdink, A., Cobelens, F., Oliveira, M. M., Kritski, A., & Andrade, B. B. (2019). *Tuberculosis-associated anemia is linked to a distinct inflammatory profile that persists after initiation of antitubercular therapy*. *December 2018*, 1–8. https://doi.org/10.1038/s41598-018-37860-5

Glaziou, P., Falzon, D., Floyd, K., & Raviglione, M. (2013). Global epidemiology of tuberculosis. *Seminars in Respiratory and Critical Care Medicine*, Oliveira, M. G., Delogo, K. N., Oliveira, H. M. de. https://doi.org/10.1055/s-0032-1333467

Gupta, K., Gupta, R., Atreja, A., Verma, M., & Vishvkarma, S. (2009). Tuberculosis and nutrition. In *Lung India*. https://doi.org/10.4103/0970-2113.45198

Gurung, L. M., Bhatt, L. D., Karmacharya, I., & Yadav, D. K. (2018). Dietary Practice and Nutritional Status of Tuberculosis Patients in Pokhara: A Cross Sectional Study. *Frontiers in Nutrition*. https://doi.org/10.3389/fnut.2018.00063

Hidajati, S. S. H. K. (2018). Tomato Fruit Extract Improves the Levels of Hemoglobin (HB) in Pregnant Women the Anaemia who Get Fe Supplementation. *International Journal of Science and Research (IJSR)*.

Isanaka, S., Mugusi, F., Urassa, W., Willett, W. C., Bosch, R. J., Villamor, E., Spiegelman, D., Duggan, C., & Fawzi, W. W. (2012). Iron deficiency and anemia predict mortality in patients with tuberculosis. *Journal of Nutrition*, *142*(2), 350–357. https://doi.org/10.3945/jn.111.144287

Karyadi, E., Schultink, W., Nelwan, R. H. H., Gross, R., Amin, Z., Dolmans, W. M. V., Van Der Meer, J. W. M., Hautvast, J. G. A. J., & West, C. E. (2000). Poor micronutrient status of active pulmonary tuberculosis patients in Indonesia. *Journal of Nutrition*, *130*(12), 2953–2958. https://doi.org/10.1093/jn/130.12.2953

Kavitha, S., & Denish. (2020). An Experimental Study To Determine The Effectiveness Of Beetroot Juice On

Hemoglobin Among Girls Of Selected Hostel Girls , Bidar , Karnataka. *World Journal Of Advance Healthcare Research*, *4*(1).

Kemenkes RI. (2018). Infodatin Tuberkulosis. *Kementerian Kesehatan RI*, 1–8.

Kohli, D., Kumar, S., Upadhyay, S., & Mishra, R. (2017). Preservation and processing of soymilk : A review. *International Journal of Food Science and Nutrition*.

Kuang, H., Yang, F., Zhang, Y., Wang, T., & Chen, G. (2018). The Impact of Egg Nutrient Composition and Its Consumption on Cholesterol Homeostasis. In *Cholesterol*. https://doi.org/10.1155/2018/6303810

Kumar, Y. (2015). Beetroot: A Super Food. *Internal Journal of Engineering Studies and Technical Approach*, *01*(3), 1–7.

Lai, H. H., Lai, Y. J., & Yen, Y. F. (2017). Association of body mass index with timing of death during tuberculosis treatment. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0170104

Lotfi, M., Azizi, M., Tahmasbi, W., & Bashiri, P. (2018). The Effects of Consuming 6 Weeks of Beetroot Juice (Beta vulgaris L.) on Hematological Parameters in Female Soccer Players. *Journal of Kermanshah University of Medical Sciences*. https://doi.org/10.5812/jkums.82300

Maggini, S., Pierre, A., & Calder, P. C. (2018). Immune function and micronutrient requirements change over the life course. In *Nutrients*. https://doi.org/10.3390/nu10101531

Messina, M. (2016). Soy and health update: Evaluation of the clinical and epidemiologic literature. In *Nutrients*. https://doi.org/10.3390/nu8120754

Miranda, J. M., Anton, X., Redondo-Valbuena, C., Roca-Saavedra, P., Rodriguez, J. A., Lamas, A., Franco, C. M., & Cepeda, A. (2015). Egg and egg-derived foods: Effects on human health and use as functional foods. In *Nutrients*. https://doi.org/10.3390/nu7010706

Neha, P., Sk, J., Nk, J., Hk, J., & Hk, M. (2018). Chemical and functional properties of beetroot (Beta vulgaris L.) for product development: A review. . *International Journal of Chemical Studies*, *6*(3), 3190–3194.

Nthiga, I., Mbithe, D., Mugendi, B., Nyangaresi, D., & Wambui, T. (2017). Dietary practices of pulmonary tuberculosis patients attending clinic at lodwar county and referral. *International Journal of Food Science and Nutrition*, *2*(1), 123–127.

Olga I. Ustinova*, and Y. V. U. (2016). *Research Journal of Pharmaceutical , Biological and Chemical Sciences Animal Models*. *4*(2), 1800–1810.

Oliveira, M. G. (2014). Anemia in hospitalized patients with pulmonary tuberculosis*. *J Bras Pneumol. 2014;40(4):403-410*. http://dx.doi.org/10.1590/S1806-37132014000400000

Priya, N. G. (2013). Beet root juice on haemoglobin among adolescent girls. *IOSR Journal of Nursing and Health Science*. https://doi.org/10.9790/1959-0210913

Raiola, A., Rigano, M. M., Calafiore, R., Frusciante, L., & Barone, A. (2014). Enhancing the health-promoting effects of tomato fruit for biofortified food. In *Mediators of Inflammation*. https://doi.org/10.1155/2014/139873

Ren, Z., Zhao, F., Chen, H., Hu, D., Yu, W., Xu, X., Lin, D., Luo, F., Fan, Y., Wang, H., Cheng, J., & Zhao, L. (2019). Nutritional intakes and associated factors among tuberculosis patients: A cross-sectional study in China. *BMC Infectious Diseases*. https://doi.org/10.1186/s12879-019-4481-6

Rizwan, F. (2014). A Cross-sectional Study of Morphological Types of Anemia in Pulmonary Tuberculosis Patient and Associated Risk Indicators in a Selected Hospital of Dhaka City, Bangladesh. In *International Journal of Chemical, Environmental & Biological Sciences*.

Rizzo, G., & Baroni, L. (2018). Soy, soy foods and their role in vegetarian diets. In *Nutrients* (Vol. 10, Issue 1). https://doi.org/10.3390/nu10010043

Ruxton, C. H. S., Derbyshire, E., & Gibson, S. (2010). The nutritional properties and health benefits of eggs. In *Nutrition and Food Science*. https://doi.org/10.1108/00346651011043961

Schwenk, A., Hodgson, L., Rayner, C. F. J., Griffin, G. E., & Macallan, D. C. (2003). Leptin and energy metabolism in pulmonary tuberculosis. *The American Journal of Clinical Nutrition*, *77*(2), 392–398. https://doi.org/10.1093/ajcn/77.2.392

WHO. (2018). Global Tuberculosis Report 2017: Leave no one behind - Unite to end TB. In *WHO - Technical Report Series;727*. http://www.who.int/tb/publications/global_report/gtbr2017_main_text.pdf?ua=1

World Health Organization. (2013). Guideline : Nutritional care and support for patients with tuberculosis. *World Health Organization*, 54. http://apps.who.int/iris/bitstream/10665/94836/1/9789241506410_eng.pdf