

Conference Paper

Is Tuberculosis Increasing Blood Pressure?

Bangga. A. Satrya and P. Riono

Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

Abstract

This research's purpose was to understand the association between TB status with blood pressure's differences in Indonesia in 2013. This research used data from *Riskesdas*. Linear regression analysis and logistic regression were used on 38.002 sample subject regardless of the TB status whose blood pressure and glucose rate were examined. The result of this research showed that there's an association between TB and blood pressure. With the decreasing of systolic blood pressure as 2.3 mmHg and subjects with TB are 1.1 times most likely also suffer hypertension. The results of this study showed that the blood pressure in subjects who were diagnosed with tuberculosis after adjusting for blood glucose. Age. Sex. And economic status is lower 1.9 mmHg (95% CI-6.0 – 2.2) than the subjects who were not diagnosed with TB. Hypertension odds ratios in subjects who were diagnosed with tuberculosis after adjusting for blood glucose. Age. Sex. And economic status was 0.94 lower (95% CI 0.58 to 1.52) than the subjects who were not diagnosed with TB.

Keywords: Hypertension; Tuberculosis; Blood pressure

Corresponding Author:

Bangga. A. Satrya

banggaagungsatrya@gmail.com

bangga.agung@ui.ac.id

Received: 21 December 2018

Accepted: 23 January 2019

Published: 28 February 2019

Publishing services provided by
Knowledge E

© Bangga. A. Satrya and P. Riono. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the 3rd IMOPH & the 1st YSSOPH Conference Committee.

1. Introduction

Hypertension is one of the risk factors expected as 25.8% in Indonesia in 2013 [1]. New cases of Tuberculosis (TB) happened in 30 countries with a high TB burden. Six countries which contributed 60% of TB cases are India, Indonesia, China, Nigeria, and South Africa [2]. A factor which encourages hypertension on someone is kidney disease or infection which happens in a long time, and TB doesn't only attack the lungs. But also other organs such as kidney [2, 3]. Cardiovascular disease is the leading cause of death caused by non-communicable diseases. It's estimated that 17.5 million people died from cardiovascular disease in 2012. They are accounting for 31% of all deaths in the world. There are 16 million deaths under 70 years due to non-communicable diseases. 82% are in low and middle-income countries, and 37% of them are caused by cardiovascular disease [4]. Cardiovascular disease is caused by disorders of the heart and blood vessels and includes coronary heart disease. Cerebrovascular disease (stroke). Raised blood pressure (hypertension) peripheral artery disease, rheumatic heart disease, congenital heart diseases and heart failure [5].

Blood pressure is the strength of blood pushing the artery walls, which carry blood from the heart to other parts of the body. Normal blood pressure rises and falls throughout the day. But if it remains high for a long time. It can damage the liver and cause

 **OPEN ACCESS**

health problems. High blood pressure increases the risk of other cardiovascular diseases such as heart disease and stroke [6]. Hypertension. Also known as tall or raised blood pressure. Is a condition in which the blood vessels have persistently elevated pressure [7]. Hypertension according to the Ministry of Health Republic of Indonesia in 2013 is an increase in systolic blood pressure greater than 140 mmHg and diastolic blood pressure over 90 mmHg on two occasions with an interval of five minutes with enough rest/quiet [8]. Hypertension is the increase in systolic blood pressure greater than 140 mmHg and diastolic blood pressure over 90 mmHg [9, 10].

The prevalence of hypertension in Indonesia is still high. Basic Health Research (*Risikesdas*) in 2013 stated that the incidence of hypertension is higher at an age equal to 18 years. This data obtained through the answers “had been diagnosed health workers” (9.4%) and “had been diagnosed by health personnel or taking their hypertension medication” (9.5%). Thus. There were 0.1% of the population who took medication even though they had never been diagnosed with hypertension. The prevalence of hypertension in Indonesia was based on the results of measurements on people equal to the 18 years was 25.8%. That means the percentage of health workers’ coverage was only 36.8%. While the majority (63.2%) cases were undiagnosed. Prevalence of hypertension based on interviews (if ever diagnosed health workers and taking medication hypertension) increased from 7.6% in 2007 to 9.5% in 2013 [1].

The leading causes of cardiovascular disease are tobacco consumption. Physical activity. Unhealthy diet and harmful use of alcohol [5]. Hypertension may be caused by several things. Such as renal disease (e.g., renal parenchymal disease and renal artery stenosis). Coarctation of the aorta and endocrine disorders [11]. Some of the conditions or diseases that can cause high blood pressure are kidney disease. Diabetes Long term kidney infection. Obstructive sleep apnea, Glomerulonephritis. Narrowing of the arteries that supply blood to the kidney, Hormonal problems (an underactive thyroid. overactive thyroid, Cushing’s syndrome, acromegaly hyperaldosteronism, and pheochromocytoma) Lupus and scleroderma [12].

TB is one of 10 causes of death worldwide. In 2015. As many as 10.4 million people were diagnosed with TB, and 1.8 million died of TB disease (included 0.4 million among people with HIV). TB occurred worldwide. But more than 95% of TB deaths occurred in low and middle-income countries. The most significant number of TB cases happened in Asia, Which was about 61% and Africa with 26%. As many as 87% of new TB cases occurred in 30 countries with a high TB burden. Six states accounted for 60% of TB cases were India, Indonesia, China, Nigeria, Pakistan, and South Africa [2].

Tuberculosis (TB) is a disease caused by bacteria called *Mycobacterium tuberculosis* that spread through the air from person to person. Bacteria usually attack the lungs. But TB bacteria can attack any part of the body such as the kidney, spine, and the brain. Not all people infected with TB bacteria become sick. There are two conditions associated with TB: 1) latent TB and 2) TB disease. If not treated properly. TB disease can be fatal [13]. About a third of the world’s population has latent TB, which means that people have been infected by the TB bacterium but not (yet) sick and can not transmit the disease [2].

Indonesia is one of the countries with a high TB incidence in Southeast Asia and the world [3]. The proportion of confirmed TB patients increased significantly from 1999 to

2003 from 7% to 13%. This indicator tended to decline from 2003 to 2014 but increased again to 14% by 2015 [14]. TB prevalence in Indonesia was also high. The prevalence of Indonesian people was diagnosed with TB in 2007 and 2013 did not experience a difference early. i.e 0.4%. Five provinces with the highest TB are West Java, Papua, Jakarta, Gorontalo, Banten, and West Papua. Residents diagnosed with TB by health personnel. 44.4% were treated with the drug program [1].

Tuberculosis (TB) remains a major health problem in low- and middle-income countries. Many countries low and middle income who also had ar Menul diseases such as hypertension. Based on this research about relevant literature and obtained three retrospective cohort studies, three case-control studies eight cross-sectional study 12 series of cases and 20 case reports that convey the relationship between tuberculosis and hypertension. One cohort study found the prevalence of hypertension is higher among people with TB compared with control patients. Cross-sectional study reported the prevalence of hypertension in people with TB ranged from 0.7% to 38.3% [15].

Chung's research in Taiwan from 1997 to 2010 which used retrospective cohort study found that 38.7% of the subjects who had hypertension of 168 male subjects with TB status. Lin's research which used cross-sectional study in Taiwan in 2015 showed 43.8% of the 73 subjects with TB had hypertension. In 2000 to 2010 in Taiwan. Ko researched with the cross-sectional design of the study revealed that there was a prevalence of hypertension of 36.8% to 71.3% of the 9.831 subjects with tuberculosis [15].

The Health Research and Development Agency of the Ministry of Health Republic of Indonesia (Ministry of Health RI) conducted Basic Health Research (*Riskesmas*) in 2013 which had a relatively representative sample of the population in Indonesia. Based on the high prevalence of TB and hypertension in Indonesia. Researchers wanted to find out whether there was an association between the incidence of TB and differences in blood pressure in adults in Indonesia by using *Riskesmas* data in 2013.

2. Methods

This research is quantitative research conducted to determine the relationship status of Tuberculosis (TB) and increasing blood pressure by seeing the relationship of independent variables. The dependent variable. And other variables that affected changes in blood pressure. The study design was a cross-sectional study (cross-sectional). This study used secondary data from *Riskesmas* in 2013 from all provinces in Indonesia. Processing and data analysis were conducted by the authors in Jakarta on March - May 2017.

In this study used data *Riskesmas* in 2013 with 1.027.763 samples; conducted on subjects aged ≥ 15 years who had variable blood pressure and blood glucose, so the subject of his research became 38.002. Data processing which was aimed to produce the right information had three stages: 1) cleaning the data processing. 2) editing and 3) coding. Data analysis conducted in this study included descriptive analysis, Simple association analysis, And multivariable analysis. The investigation was performed by using STATA 12.0 program.

3. Results

3.1. Systolic blood pressure

Definition of systolic blood pressure was used in this study was the systolic blood pressure in the first. Second and third measurement. After having had three times the examination. An average of the three would be taken. If it only had two tests. An average of two would be made while if it's just done once. The results of the investigation would be directly taken to be his systolic blood pressure values.

There were 38.002 subjects taking measurements of systolic blood pressure. The average systolic blood pressure was 127.3 mmHg subjects (95% CI 126.9 to 127.7) with SE 0.2 (see table 1).

TABLE 1: Distribution of Subjects According to the Measurement of Systolic Blood Pressure.

Variables	N	Mean	SE	95% CI
Systolic Blood Pressure	38.002	127.3	0.2	126.9 – 127.7

3.2. Hypertension status

The definition of hypertension used in this study was divided into hypertension and no hypertension. Hypertension was a subject that had systolic blood pressure above 140 mmHg together with diastolic blood pressure above or equal to 90 mmHg. It's not called hypertension if the question had systolic blood pressure below 140 mm Hg or diastolic blood pressure below 90 mmHg. The subject of hypertension was 30.5% (see table 2).

TABLE 2: Distribution of Subjects According to the Status of Hypertension.

Hypertension Status	Proportion (%)	95% Confident Interval (%)
Hypertension	30.5	29.6 – 31.3
No Hypertension	69.5	68.7 – 70.2

3.3. Analysis of independent variables

The independent variable in this study is tuberculosis. The definition of disease used in this study was divided into no TB and TB. Not TB is a subject that is not in diagnosis TB by health professionals. TB is a subject in the diagnosis of tuberculosis by health professionals and obtains anti-tuberculosis drugs (OAT). Tuberculosis subjects were 0.4% (see table 3).

TABLE 3: Distribution of Subjects According to the Incidence of Tuberculosis.

Tuberculosis Status	Proportion (%)	95% Confident Interval (%)
TB	0.4	0.3 – 0.5
Not TB	99.6	99.5 – 99.7

3.4. Analysis of covariate variables

Covariate variables in this study were blood glucose, age, sex, and economic status. Blood glucose was classified according to the results of the examination. The first group was subjected whose blood glucose measurement values were below 200 mg/dl and the second group was subjects whose blood glucose was above 200 mg/dl. Age subjects were grouped into four groups. The first group of 15-31 years old, the second group of 32-42 years, the third group 43-53 years and the fourth group of more than 53 years. The age grouping was obtained from subjects with ages lowest to highest, with each of the same age distribution that is 25%. Economic status was grouped into high economic status (top economic status and upper middle economic status) and low economic status (middle economic status, lower middle economic status, and lower economic status) (see table 4).

Blood glucose of the subject more in the group of subjects with a blood glucose below 200 mg/dl (97.54%). By sex. Subjects with female sex had a more significant proportion (61.32%). Themes by age are more significant at age 34-53 years (25.6%). Most of the subjects based on their economic status have lower economic status (56.86%) (see Table 4).

TABLE 4: Distribution of Subjects Based on Variables Covariates.

Variables	Proportion (%)	95% Confident Interval (%)
Blood Glucose		
Blood Glucose <200	97.55	97.3 – 97.8
Blood Glucose ≥200	2.45	2.2 – 2.7
Gender		
Women	61.32	60.6 – 62.0
Man	38.68	38.0 – 39.3
Age		
15-31	25.3	24.7 – 26.0
32-42	25.2	24.5 – 26.0
43-53	25.6	25.0 – 26.3
> 53	23.9	23.1 – 24.7
Economic Status		
High Economic Status	43.14	41.7 – 44.6
Low Economic Status	56.86	55.4 – 58.3

3.5. Systolic blood pressure based on tuberculosis. Blood glucose, gender, age, and economic status

The mean value of systolic blood pressure in subjects with TB status had average systolic blood pressure higher than that of non-TB subjects of 129.7 mmHg (95% CI 125.2-134.1). The mean value of systolic blood pressure in subjects whose blood glucose was ≥200 mg/dl was higher than that of blood glucose subjects >200 mg/dl of 141.5 mmHg

(95% CI 138.5-144.5). The mean value of systolic blood pressure in female-sex subjects was 127.1 mmHg (95% CI 126.6-127.6) and in subjects with male sex having mean systolic blood pressure was 127.7 mmHg (95% CI 127.2-128.1), higher than female subjects. The average value of systolic blood pressure increased by age group and the average of systolic blood pressure in subjects with the age group >53 years that was 141.7 mmHg (95% CI 140.9 to 142.6). The issue of the high economic status of the average value of systolic blood pressure was lower than in subjects with low economic status with 127.0 mmHg (95% CI 126.4 to 127.6) (see Table 5).

TABLE 5: Mean Meaning of Systolic Blood Pressure based on Tuberculosis, Blood Glucose, Sex, Age and Economic Status.

Variables	Mean	95% Confident Interval
Tuberculosis		
TB	129.7	125.2 – 134.1
Not TB	127.3	126.9 – 127.7
Blood Glucose		
≥200	141.5	138.5 – 144.5
<200	127.0	126.6 – 127.4
Gender		
Women	127.1	126.6 – 127.6
Man	127.7	127.2 – 128.1
Age		
15-31	114.1	113.7 – 114.4
32-42	122.5	121.9 – 123.0
43-53	131.9	131.2 – 132.5
> 53	141.7	140.9 – 142.6
Economic Status		
High Economic Status	127.0	126.4 – 127.6
Low Economic Status	127.6	127.1 – 127.1

3.6. Hypertension based on tuberculosis. Blood glucose, sex, age, and economic status

The proportion of hypertensive subjects with TB status was 30.7%, subjects with hypertension on blood glucose ≥200 mg /dl was 46.3% and subjects with hypertension on blood glucose <200 mg/dl was 21.8%. Based on gender, female subjects with hypertension were 23.5%, and male subjects with hypertension were 20.6%. The issues with the highest hypertension were in the age group >53 years. i.e., 52.2% and the smallest in the 25-31 year age group of 9.8%. Low economic status of subjects with hypertension was 22.2%, and issues with tuberculosis with high economic status are 22.6% (see table 6).

TABLE 6: The proportion of Hypertension by Tuberculosis, Blood Glucose, Gender, Age and Economic Status.

Variables	Hypertension	
	Proportion (%)	95% Confident Interval (%)
Tuberculosis		
Tuberculosis	34.4	24.3 - 44.5
not Tuberculosis	30.5	29.7 - 31.3
Blood glucose		
≥200	54.1	48.7 - 59.4
<200	30.0	29.1 - 30.7
Gender		
Women	33.1	32.0 - 34.0
Man	26.5	25.6 - 27.5
Age		
15-31	9.8	9.0 - 10.7
32-42	23.8	22.5 - 25.1
43-53	37.4	36.0 - 38.9
> 53	52.2	50.6 - 53.8
Economic Status		
High Economic Status	31.7	30.4 - 32.9
Low economic status	29.7	28.8 - 30.6

3.7. Tuberculosis base on blood glucose, gender, age and economic status

The proportion of subjects with tuberculosis in blood glucose ≥ 200 mg/dl was 1.02% and subjects with tuberculosis in blood glucose < 200 mg/dl was 0.39%. Based on gender, female subjects with TB were 0.3%, and male subjects with TB were 0.59%. Based on the age group, the most numerous subjects with TB were in the age group > 53 years. I.,e. 0.68%. Subjects with Low economic status were 0.42%, and issues with high economic status were 0.4% (see table 7).

3.8. Tuberculosis analysis of the systolic blood pressure

This analysis was conducted to see the relation of tuberculosis with systolic blood pressure before and after adjusted with variable blood glucose age, gender, and economic status. In the analysis of the relationship of tuberculosis with blood pressure systolic before the adjustment (crude) with variable confounder, it was obtained that there was an increase in systolic blood pressure in subjects with TB. The average difference in systolic blood pressure in the matter with tuberculosis was 2.3 mmHg with constant 127. mmHg but after adjusted with variable confounder (blood glucose, age, gender, and economic status), the average difference in systolic blood pressure in subjects with TB was 1.9 mmHg with constant 114.4 mmHg. Furthermore, if variable confounder was

TABLE 7: The proportion of TB by Glucose Blood, Sex, Age, and Economic Status.

Variables	Tuberculosis (TB)	
	Percentage	95% Confident Interval (%)
Blood glucose		
≥200	1.02	0.1 - 1.9
<200	0.39	0.3 - 0.4
Gender		
Women	0.30	0.2 - 0.4
Man	0.59	0.4 - 0.7
Age		
15-31	0.18	0.1 - 0.2
32-42	0.40	0.2 - 0.6
43-53	0.40	0.2 - 0.6
> 53	0.68	0.5 - 0.9
Economic Status		
High Economic Status	0.42	0.2 - 0.5
Low economic status	0.40	0.2 - 0.5

adjusted without age, the average difference in systolic blood pressure in subjects with TB was 1.7 mmHg with constant 126.2 mmHg (see table 8).

TABLE 8: Results of Tuberculosis Linear Regression Analysis with Systolic Blood Pressure (Crude and Adjusted).

variables	Crude		* Adjusted		** Adjusted	
	β	95% CI	β	95% CI	β	95% CI
TB	2.3	-2.1 – 6.7	-1.9	-6.0 – 2.2	1.7	-2.8 – 6.2
Cons	127.3	126.9 – 127.7	114.4	113.8 - 115.0	126.2	125.5 - 127.0

* Adjusted by blood glucose. Age. Gender. and economic status
 ** Adjusted by blood glucose. Gender. and economic status

3.9. Tuberculosis analysis of hypertension

This analysis was conducted to see the simple odds ratios and odds ratio that had been controlled (variable blood glucose. age. gender. and economic status) between tuberculosis and high blood pressure (hypertension). In the analysis of the relationship of tuberculosis with high blood pressure before the adjustment (crude) with variable confounder found an odds ratio of 1.19. The odds ratio after adjusted with confounder variables (blood glucose. Age, gender, and economic status) was 0.94, but the odds ratio after adjusted with confounder variables without variable age was 1.21 (see Table 9).

4. Discussion

TABLE 9: Results of Tuberculosis Logistic Regression Analysis with High Blood Pressure (Hypertension) (Crude and Adjusted).

Variables	Crude		* Adjusted		** Adjusted	
	OR	95% CI	OR	95% CI	RO	95% CI
TB	1.19	0.76 - 1.86	0.94	0.58 - 1.52	1.21	0.75 – 1.93
Cons	0.44	0.42 - 0.45	0.14	0.13 - 0.15	0.50	0.47 – 0.53

* Adjusted by blood glucose. Age. Gender. and economic status

** Adjusted by blood glucose. Gender. and economic status

4.1. Systolic blood pressure and hypertension

Riskesdas 2013 took three times the examination for systolic and diastolic blood pressure. Based on the results of the study, it showed that 38.002 subjects that had systolic blood pressure at first, second and third measurements were 127.3 mmHg. According to the blood pressure classification of JNC VII 2013, the average systolic blood pressure was included in the prehypertension category. Prehypertension is the value of systolic blood pressure between 120 mmHg to 139 mmHg. And diastolic blood pressure between 80 mmHg to 89 mmHg. In subjects who had blood pressure classification prehypertension, lifestyle modification and environmental adjustment can lower blood pressure and reduce the possibility of blood pressure change of classification of prehypertension to hypertension. Studies showed that the rate of progression from prehypertension to hypertension could occur within a period of 2 to 4 years ranged between 30-40% [16, 17]. According to the National Institutes of Health (2004), the pattern of blood pressure might change with age. Systolic blood pressure may continue to increase throughout life, but diastolic blood pressure does not extend to increase. Diastolic blood pressure increased only until age 50 [18].

The definition of hypertension used in this study was divided into hypertension and no hypertension. Hypertension was a subject that had systolic blood pressure above 140 mmHg together with diastolic blood pressure above or equal to 90 mmHg. It's not called hypertension if the question had systolic blood pressure below 140 mm Hg or diastolic blood pressure below 90 mmHg. Based on these definitions, the proportion of subjects with hypertension in this study was as much as 30.5%.

4.2. Tuberculosis influence on systolic blood pressure

TB is caused by bacteria called *Mycobacterium tuberculosis*. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as kidneys, spine, and brain [19]. One cohort study found a significantly higher prevalence of hypertension among TB patients compared with control patients. Studies cross-sectional report hypertension prevalence in TB patients ranged from 0.7% to 38.3% [15]. One of the factors affecting the increase in blood pressure someone is kidney disease or infection of the kidneys with a long time. And TB does not only attacks the lungs but also can on other organs, and one of them is the kidney [2, 3]. Tuberculosis definitions used in this study were divided into no TB and TB. No TB is not a subject that is not in diagnosis

TB by health professionals. TB is a subject in the diagnosis of tuberculosis by health professionals and obtains anti-tuberculosis drugs (OAT).

Tuberculosis research results relating to systolic blood pressure showed the difference between the results before adjustment (crude) and after the adjustment using a variable after confounder (blood glucose, gender, age, and economic status). The average difference in systolic blood pressure in subjects with TB was 2.3 mmHg with constant 127.3 mmHg. The means that there was an increase in blood pressure of 2.3 mmHg in subjects with TB compared with subjects without TB. After adjusted with variable confounder (blood glucose, age, gender, and economic status) the mean difference in systolic blood pressure in subjects with TB was -1.9 mmHg with a constant of 114.4 mmHg. It could be said that after the adjustment, there was a decrease in systolic blood pressure in TB patients compared to subjects without TB. A decline in average difference - average systolic blood pressure in subjects with TB after adjustment had great possibilities as adjusted for age, systolic blood pressure was getting greater as the age of the subject, which was 114.1 mmHg in the age group 15-31 years, 122.5 mmHg (aged 32-42 years), 131.9 mmHg (aged 43-53 years) and 141.7 mmHg in the age group >53 years. Similarly, the proportion of TB by age group increased the proportion of subjects with tuberculosis by age group. ie 9.8% (age 15-31 years), 23.8% (age 32-42 years), 37.4% (age 43-53 years) and 52.2% in the age group >53 years. If it's adjusted with the variable confounder without age, the mean difference in systolic blood pressure in subjects with TB was 1.7 mmHg with constant 126.2 mmHg.

4.3. Tuberculosis influence on hypertension

TB can cause hypertension through their immunological response such as cell destruction - parenchymal cells in the lung tissue - the lung. The disruption will cause constriction of blood vessels around it, causing pulmonary hypertension. Hypertension can occur when TB infects the kidneys; causing damage to the kidney tissue, reducing kidney function and weakening the kidney's ability to regulate blood pressure. Based on the autopsy of TB patients, it's found evidence that kidney patients experienced 50-65% of shrinkage [15].

The results of this study indicated the proportion of subjects with hypertension in patients with TB (30.7%) and subjects with hypertension without TB (22.3%) differed slightly. In the analysis of tuberculosis relationship with blood pressure high before the adjustment (crude) with variable confounder, it found an odds ratio of 1.2. The odds ratio after adjusted with confounder variables (blood glucose, age, gender, and economic status) was 0.9. In a study Ogbera 2015 in Nigeria, from 4,000 subjects with TB, there are 2.7 to 8.7% having Tuberculosis [15]. A decrease in the odds ratio of subjects with TB to hypertension after adjustment was possible because of adjustment of the age variable. The proportion of hypertension increased with the increasing age group of the questions by 0.18% (15-31 years), 0.40% (aged 32- 42 years), 0.40% (age 43-53 years) and 0.68% in the age group >53 years. Similarly, the proportion of TB by age group, an increasing proportion of subjects with tuberculosis by age group was 9.8% (age 15-31 years), 23.8% (age 32-42 years), 37.4% (age 43-53 years) and 52.2% in the age group

>53 years. The odds after adjusted with confounder variables without the age variable was 1.21, reinforcing that age was a strong confounder causing a decrease in the odds ratio.

5. Conclusion

Based on the results of the literature review and data analysis that has been done to obtain a view of the relationship between tuberculosis and blood pressure differences in adults in Indonesia, it can be concluded as follows:

1. The mean systolic blood pressure of the subjects with TB (129.3 mmHg) was higher than that of subjects without TB (127.3 mmHg).
2. There was an association between tuberculosis and systolic blood pressure. Before adjusting, there was an increase in blood pressure by 2.3 mmHg, and after adjustment, there was a decrease in blood pressure by 1.9 mmHg.
3. Tuberculosis odds ratio to hypertension, before adjusted it's 1.2 to have hypertension but after adjustment, the subject with TB had an odds ratio of 0.9.

Acknowledgment

The work was supported by Department of Biostatistics and Population Studies. Faculty of Public Health, Universitas Indonesia and Data Management Laboratory, Ministry of Health Indonesia.

Competing Interest

Authors declare that there is no conflict of interest.

References

- [1] Badan Penelitian dan Pengembangan Kesehatan. Riset Kesehatan Dasar. Jakarta: Kementerian Kesehatan RI. 2013
- [2] World Health Organization. 2017. Tuberculosis. [Online] Available at: <http://www.who.int/mediacentre/factsheets/fs104/en/>
- [3] National Health Service. Symptoms of tuberculosis. [Online] 2016 Available at: <http://www.nhs.uk/Conditions/Tuberculosis/Pages/Symptoms.aspx\underbar>
- [4] World Health Organization. Cardiovascular diseases (CVDs). [Online] 2016 Available at: <http://www.who.int/mediacentre/factsheets/fs317/en/>
- [5] World Health Organization. Cardiovascular disease. [Online] 2017 Available at: http://www.who.int/cardiovascular_diseases/en/
- [6] Centers for Disease Control and Prevention. Effects of High Blood Pressure. [Online] 2014 Available at: <https://www.cdc.gov/bloodpressure/effects.htm>
- [7] World Health Organization. Hypertension. [Online] 2017 Available at: <http://www.who.int/topics/hypertension/en/>
- [8] Pusat Data dan Informasi. Hipertensi. Jakarta: Kementerian Kesehatan RI. 2014
- [9] World Health Organization. Q&As on hypertension. [Online] 2015 Available at: <http://www.who.int/features/qa/82/en/>

- [10] Centers for Disease Control and Prevention. About High Blood Pressure. [Online] 2014 Available at: <https://www.cdc.gov/bloodpressure/about.htm>
- [11] Lilly. L.S. Pathophysiology of Heart Disease A Collaborative Project of Medical Students and Faculty. China: Lippincott Williams & Wilkins. A Wolters Kluwer business. 2011
- [12] National Health Service. Causes of high blood pressure (hypertension). [Online] 2016 Available at : [http://www.nhs.uk/Conditions/Blood-pressure-\(high\)/Pages/Causes.aspx](http://www.nhs.uk/Conditions/Blood-pressure-(high)/Pages/Causes.aspx)
- [13] Centers for Disease Control and Prevention. Basic TB Facts. [Online] 2016 Available at: <https://www.cdc.gov/tb/topic/basics/default.htm>
- [14] Pusat Data dan Informasi. Tuberkulosis Temukan Obati Sampai Sembuh Jakarta: Kementerian Kesehatan RI. 2016
- [15] Seegert. A.B. dkk. Tuberculosis and hypertension—a systematic review of the literature. *Int J Infect Dis*. 2016 <http://dx.doi.org/10.1016/j.ijid.2016.12.016>
- [16] Julius S. Nesbitt SD. Egan BM. dkk. Feasibility of treating prehypertension with an angiotensin-receptor blocker. *N Engl J Med*. 2006;354:1685–97.
- [17] Diaz. K.M. & Shimbo. D. Physical Activity and the Prevention of Hypertension. *Current hypertension reports*. Vol. 15. No. 6. 2013 pp. 659-68.
- [18] National Institutes of Health. The Seventh Report of the Joint National Committee on Prevention. Detection. Evaluation. And Treatment of High Blood Pressure. National Institutes of Health. 2004
- [19] Centers for Disease Control and Prevention. Tuberculosis (TB) Disease: Symptoms & Risk Factors. [Online] 2016 Available at: <https://www.cdc.gov/features/tbsymptoms/>