The impact of physical and non-physical factors of houses on the tuberculosis endemic sufferer cases in Magelang

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Abstract. The house becomes one of the basic human needs after food and clothing. The quality of the house is determined by physical factors and other factors such as the socio-cultural economy of the inhabitants. Tuberculosis is one of the most infectious diseases with high mortality in Indonesia, Central Java ranks third on the national scale after West Java and East Java in 2016. Magelang has the highest new cases of tuberculosis in Central Java at 775.32 per 100,000 population in 2016 and increase case 845.4 per 100,000 population in 2017. Tuberculosis infection occurs with various factors, including physical (home), and non-physical (socio-cultural and economic) of the inhabitants. The problem is how the physical and non-physical factors of the house affect on the endemic cases of tuberculosis patients in Magelang. The purpose of the study is to examine the effect of physical and non-physical factors on the increasing cases of tuberculosis patients in Magelang. In this article, the researcher uses qualitative descriptive methods with literature review. The results of this review literature will be used to examine empirical cases in Magelang.

Keywords: House, tuberculosis, endemic, physical, non-physical, economic

1. Introduction
House is one of the basic needs to shelter and place to gather with family [1]. It is used by family life especially for Javanese [2]. WHO stated that house is a physical structure or shelter completed with useful environment for physical and mental health and the social condition is good for family and individual health [3]. A house that has poor air quality can bring out health problems [4].

The health problems in social environment are diseases like, diarrhea, chickenpox, cough, tuberculosis and so on. Indonesia is an endemic area for various kinds of infectious diseases because of the tropical climate [5]. The tuberculosis is one of the infectious diseases that closely related to residence environment [6]. Since 2000, the Health Ministry has stipulated 10 efforts of diseases eradication and environmental sanitation. One of them is a unified movement for tuberculosis eradication [5].

In 2017, one third world inhabitants had been infected by tuberculosis bacteria. Two third total case in the world was divided into eight countries. Indonesia was on third position (8%) as a country with the most TB patients after China (9%) and India (27%). After that, followed by countries like, Philippines (6%), Pakistan (5%), Nigeria (4%), Bangladesh (4%), and South Africa (3%) [3].
In 2017, Case Detection Rate (CDR) in Central Java reported 44.6% was on third position after DKI Jakarta 104.7%, West Java 53.2%. It was still above the average national CDR as much as 42.8%. The Case Notification Rate (CNR) of TB increased since 2016 as much as 139 per 100,000 people and 162 per 100,000 people in 2017 [7]. The CNR factor is supported by the CDR [6]. In 2017, the CNR in Magelang was the highest in Central Java with 845.4 per 100,000 people [8]. TB spread through the miniscule sputum splotch. For human, TB spread naturally through exposure, infection, illness, and the last is death [6]. There are two different aspects in TB development risks: risk on the TB prevalence in residence community and risk of infection that develops into disease [9]. The exposure stage will increase through some indicators: the amount of contagious case in public and environment factor. The environment factor is related to the ventilation [6].

In this study, we aimed to define the latest evidence about the association between the impact of physical and non-physical factors of house and the tuberculosis endemic cases in Magelang. Additionally, we aimed to investigate the empirical cases in Magelang and recommend it to the next study as well.

2. Methods

2.1. Search strategy
We created a strategy to find out the systematic literature review aimed to identify TB cases in the world, drew the correlation between ideas and theories into questions and problems, and identified the relation between ideas and applications in the field. The literature review was used to prepare clear purposes to pursue the right vocabularies that were used in the study[10].

The study was limited to the articles published in 2018 on ScienceDirect, DOAJ, BMC Public Health and Indonesian articles in Google Scholar databases. The study terms combined the text words into two parts. Part one was “tuberculosis” and “house” and part two was “tuberculosis” and “economic”. The details that were identified listed on the Figure 1.

We screened all the titles and abstracts. There were four articles about house and five articles about economy that were related to TB cases.

2.2. Definitions of house and scope
The population growth since 1950 until 2014 grew from 746 million to 3.9 billion world population and UN project stated that in 2050, there will be 66% citizens live in urban area. The rapid urbanization will need better fostered environment and housing design in this area [11]. If we talk about a house, it is not only about its physical form but also its resident and environment. The resident and environment that intended to are social, ritual, culture, and economy [12]. The risk transmission factor divided into two: an environment and a population factor [5]. The Health Ministry stated that the TB transmission risk physically related to bad ventilation air [6]. It also had the regulation about TB endemic management by taking maintenance and repair on housing quality and its environment according to the healthy house standard [13]. The non-healthy standard of house and environment construction was one of the transmission risk factor for some diseases like, malaria, dengue, and TB [8]. A healthy house should be spared from disease transmission [14].

A study conducted by Singh stated that a household physical environment and an individual residence affected the appearance of TB significantly. A clean environment should be presented to reduce TB endemic. The TB endemic environment risk factors were about smoke inside the house, separated kitchen, building materials, number of member in one house, and shared bathroom [15]. Wiwit stated that there was a relation between ventilation, sunlight exposure, humidity, density, type of floor and TB endemic. His study found out that the density and ventilation were the biggest risk factors of TB endemic [16].
So, Achmadi concluded that the environment risk factor and demography became one of the TB transmission factors [5]. Then, supported by Rapoport that stated a house was not only its physical but also the society and environment [12]. From these two theories, it can be categorized that there are a physical and non-physical factor.

2.2.1. Physical factors
An air sanitation effort inside the house toward physical polluter source has close relation with the temperature and ventilation rate. The temperature inside the house that always low can cause hypothermia and dehydration or even heat stroke if it is always high. The temperature rises because the ventilation is far from standard, residence is too dense, geography, and topography condition yet it can be prevented by increasing the air circulation through adding mechanic ventilation [4].

The study conducted by Deni (2014) found out that if a person who lived in a house with natural ventilation that predominantly used and not eligible had the risk three times more likely to be infected TB compared with the person who lived in a house with the eligible natural ventilation [19]. It is different from the study conducted by Rosiana (2014) that stated there was no relation between the ventilation area and TB case [20]. Therefore, the ventilation is an area for air in a house to circulate. Poor air quality can cause the microorganism growth. It becomes one of the major factors of TB infection.
### Table 1. Physical factor studies included in the literature review.

| Authors           | Jurnal                                | Study design        | Study period | Setting     | Key Findings                                                                                                                                 |
|-------------------|---------------------------------------|---------------------|--------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Saqib et al., 2018| Social Science Journal                 | Cross-sectional     | 2016         | Pakistan    | Results show that the incidence and intensity of CHE were higher for households in the lower income-quintile.                                |
| Singh et al., 2018| BMC Public Health                     | Cross-sectional     | 2015-2016    | India       | Present study is to examine the association of household environment with the prevalence of Tuberculosis in India.                        |
| Aditama et al., 2019| International Journal of Science and Healthcare Research | Case control design | 2018         | Aceh, Indonesia | This study aims to determine the correlation between ventilation, lighting, humidity, occupancy density, type of floor and house temperature with the incidence of pulmonary tuberculosis in the work area of Lhoong CHC Aceh Besar District in 2018. |
| Muhammad et al., 2020| Althea Medical Journal                | Case control design | 2019         | Surabaya, Indonesia | The objective of this study was to provide supporting facts between the physical environment of the houses and the incidence of pulmonary tuberculosis. |

### 2.2.2. Non-physical factors

Discussing a house is not always about its physical construction but it talks about the society as well. The society here covers social, culture, and economy factor [12]. The social and economy factor that affect TB is income [23]. Poverty has the closest correlation with TB. The houses located in a dense and slum area cause the rise of TB endemic transmission and malnutrition causes the decline of immune system. These two factors are predominant for the disease transmission. Low income and high density can raise the TB infection [9].

Xia [24] stated that the proportion of age group and people with low economic-social status, and poor education level could increase TB CNR. It is supported by the study conducted by Pelissari (2017) that stated income inequality and poverty were the determinants of tuberculosis incidence [25]. The poorest proportion defined as individual proportion with per capita household income equal or less than Rp 1,580,000 in 2018.

### Table 2. Non-physical factor studies included in the literature review.

| Authors, Year of publication | Jurnal                                | Study design        | Study period | Setting     | Key Findings                                                                                                                                 |
|------------------------------|---------------------------------------|---------------------|--------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Saqib et al., 2018           | Social Science Journal                 | Cross-sectional     | 2016         | Pakistan    | Results show that the incidence and intensity of CHE were higher for households in the lower income-quintile.                                |
| Liu et al., 2020             | Infectious Disease of Poverty          | Cross-sectional     | 2016-2017    | Eastern China | Medical and pretreatment costs lead to high costs of TB care, especially among patients from the poorest households. It is necessary to train health system staff in general hospitals to promptly identify and refer TB patients. Poor programmes are also needed to protect TB patients from the medical poverty trap. |
| Fløe et al., 2015            | International Journal for Infectious Disease | Retrospective case-control study | 1998-2010   | Denmark     | The aim of this study was to evaluate health-related costs and socio-economic parameters of patients with active TB and their spouses both before and after diagnosis and treatment in a national. |
2.3. **Selection criteria**

The article consists of two tables, physical factors and non-physical factors table. We had been screened the title and the abstract each remaining paper, and potentially relevant articles.

The inclusion criteria from table 1 and 2 were being applied as follows: 1) The temperature and ventilation rate included in physical factors of houses on the tuberculosis endemic sufferer cases; 2) The economic rate included in non-physical factors of houses on the tuberculosis endemic sufferer cases 3) tuberculosis infection disease were confirmed by laboratory diagnosis.

2.4. **Data extraction**

We extracted the data from all included studies. Common themes were identified and collected. The data and information extracted included: 1) authors and year of publication, 2) journal, 3) study design, 4) study period 6) setting 7) key findings from publication that eligible for inclusion in the final literature review.

2.5. **Data synthesis**

The result from the selected information from the figure would be analyzed empirically in Magelang City because it has three sub-district areas: North Magelang, Central Magelang, and South Magelang. The amount of the citizens in 2017 was 121,673 people[30]. Even though Magelang City is not the most populous city in Central Java but it becomes one of the cities with the highest endemic TB sufferers.

**Table 1**

| Authors, Year of publication | Journal | Study design | Study period | Setting | Key Findings |
|-------------------------------|---------|--------------|--------------|---------|--------------|
| Zhang et al., 2020            | BMC Public Health | Regression | 2006-2017 | Shandon Province, China | This results contribute to the understanding of which economic policies can better reduce the TB burden. |
| Cui et al., 2019              | International Journal of Environmental Research and Public Health | Case-contact studies | January-June 2018 | Guangxi, China | We found that an extended traveling time from home to the medical facility was an important socioeconomic factor for Mtb transmission in the family. |

![Figure 2](image1.png) **Figure 2.** Magelang city is one of the cities/regencies with the highest number of tuberculosis[8].

![Figure 3](image2.png) **Figure 3.** Comparison of the CNR of Magelang City and Magelang District[8].
In figure 2 and 3, it can be noted that Magelang City becomes one of the cities with the highest CNR in Central Java. Magelang city by the number of the cases 621.1 per 100,000 people is in proportion to 55.2 per 100,000 people in Magelang District.

3. Results
Based on reading the title and abstract 1261 were excluded and 9 were included for the full-text review process. Of these, 1146 studies were excluded with reasons that title without suitable keywords. The excluded paper didn’t asses a TB outcome (n=115). Further screening and review of the titles/abstracts/full text were filtered reveal 9 articles that met the inclusion criteria.

3.1. Physical factors
In this article, we found that if a person lived in a house with natural ventilation that predominantly used and not eligible had the risk three times more likely to be infected TB compared with the person who lived in a house with the eligible natural ventilation. The other studies found that there was no relation between the ventilation area and TB case.

3.2. Non-Physical factors
Poverty had the prominent correlation with TB. The houses located in a dense and slum area cause the rise of TB endemic transmission and malnutrition caused the decline of immune system. These two factors were crucial for the disease transmission. Low income and high density could raise the TB infection.

3.3. Samples
There were five samples obtained from Magelang Public Health Office.

Figure 4. The TB sufferer 1 is a deep-fried snacks seller and has been infected TB since 2017. His earning is around Rp 15,000 per day. His house is not proper enough for a living. The sunlight is unable to enter the house, there is no glass roof tile, and the floor is ground. The cleanliness is very poor because there are a lot of trashes around the house.

Figure 5. The TB sufferer 2 works as a trader and her daily earning is less than Rp 50,000. She lives with her husband and two kids. Her house faces west so the sunlight enters the house easily. The roster ventilation is above the window and door on the west part of the house. Another side of the house coincides with her neighbor’s so she doesn’t have the other windows on the other sides of her house.
Figure 6. The TB sufferer 3 is a teenager that lives with her parents and she has suffered TB since 2018. His parents earning is around Rp 1,000,000 per month. His house faces east and there are some windows around the house so the air circulation is good.

Figure 7. The fourth TB sufferer is a washing worker that lives with her husband and she got TB in 2018. Her husband cannot work anymore because he got an accident several years ago. Based on the interview we had done, we found that they got an income as much as Rp 500,000 per month. The temperature inside the house is 31°C. The poor ventilations were found at north and south of the house.

Figure 8. The fifth TB sufferer was a student of senior high. Her parents were traders. She had suffered TB since 2018. The ventilations inside her house were only at north and south. The west side of the building adjoined with the neighbor’s house and the east one adjoined with the hencoop. The temperature inside the house was 31.2°C.

Table 3. Comparison sample houses.

| Physical factors | Non-physical factors |
|------------------|---------------------|
| Ventilation | Temperature | Income/month | Occupation |
| - House 1 | Without | 29.0 | Rp 500,000 | Fried food seller |
| - House 2 | Less | 32.6 | Rp 1,500,000 | Merchant |
| - House 3 | Less | 27.5 | Rp 1,000,000 | Student |
| - House 4 | Less | 31.0 | Rp 500,000 | ((Buruh Cuci)) |
| - House 5 | Less | 31.2 | Rp 500,000 | Merchant |
4. Discussion
A house is the place to shelter and gather with the family. A healthy house should prevent its habitants from the infectious diseases. One of them is tuberculosis. In 2017, one third world population have been infected tuberculosis. Indonesia is the country with the third highest number of TB sufferers after China and India. It is an endemic area for the infectious diseases because of its tropical climate. Central Java is the province with the third highest after DKI Jakarta and West Java as CDR in Java Island. In 2017, Magelang City one of city had the highest CDR in Central Java.

The world population growth in UN project stated that 66% world citizens will live in urban area. They spend 90% of their times indoor. A healthy house should prevent its habitants from the infectious diseases. Discussing a house is not always about its physical construction but it talks about the society and environment as well. The transmission of TB factors divided into two: the environment and population factor.

The environment factor is related to the air inside the room towards the physical polluter that has a correlation with the temperature and ventilation rate. Clean air can create a healthy life. On the other hand, the poor quality of air will increase the microorganism growth.

The non-physical factor closely related to the social and economy; earnings. Poverty has the close relation with the social problems. TB sufferers lose their jobs because of their illness. Most of the people say that TB appears in poor society.

Magelang City is chosen as the research area because it is one of the cities with the highest number of TB sufferers in Central Java. The comparison between TB cases in Magelang City and Magelang District shows the significant result.

From the three samples, it can be concluded that TB sufferers have low earnings and their houses have a very limited windows and roster ventilations. To obtain more valid results, it needs further research towards the samples and measurement in more details.

5. Conclusion
Our study highlights both physical and non-physical factors toward TB sufferers. From the samples that had been investigated, it showed that the houses with poor amount of ventilations indicated its owners that had low income.

Further research is needed towards investigating the (physical) and socio-economic (non-physical) risk factors. In this context, there is a correlation between TB, physical and non-physical factors that is more integrated in detail or retrospectively. If Tb cases in Magelang City will be eliminated, screening high risk population is highly needed.

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