Transmission rate factors among tuberculosis patients in West Kalimantan, Indonesia

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Abstract

Tuberculosis is a critical issue in a community, and the rising number of cases can be attributed the development and evolution of the bacteria responsible. As part of independent nursing actions, educational intervention is a solution to improve prevention and treatment success at the family and community levels. This study aimed to determine the factors for Tuberculosis transmission. This research was a correlation study with a cross-sectional design, involving a sample of 100 participants selected through purposive sampling. Independent variables for the present study include age, gender, occupation, diabetes record, body mass index (BMI), and level of knowledge. Meanwhile, the dependent variable in this study is the risk of transmission. This observation used a questionnaire with chi-square and logistic regression analysis. The result showed that families with a thin body mass index had a lower likelihood of carrying out infectious behavior (p=0.000). Most respondents have a high level of knowledge and a low potential for infectious behavior. In fact, a good education system, it will allow someone to be independently trained to change behaviors and attitudes for the better.

Introduction

Mycobacterium Tuberculosis is a bacterium responsible for Tuberculosis, a highly contagious and critical concern for both domestic and global communities.[1–3] Tuberculosis has had a significant impact on mortality rates, causing at least 1.6 million reported deaths in 2016.[4] It stands as a major contributor to mortality as a single infectious agent.[1,5,6] Furthermore, latent Tuberculosis infections are widespread, with approximately one-fourth of the global population carrying these latent infections.[7,8] These individuals may serve as potential reservoirs for active Tuberculosis cases, further complicating the control and prevention of the disease.[9,10]

Indonesia is one of the five countries with the highest Tuberculosis prevalence rates.[4] In 2017, there were 420,994 reported cases, and this number increased to 1,017,290 cases in 2018. West Kalimantan, a province in Indonesia, alone reported 28,343 cases of Tuberculosis.[11,12] This substantial increase in cases can be attributed to the development and evolution of the Tuberculosis-causing bacteria themselves. Tuberculosis is highly contagious and can easily spread through the air when individuals inhale contaminated air containing the bacterium. This ease of transmission makes it challenging to control the spread of the disease.[13–15] Additionally, factors such as the physical condition of the host, their nutritional status, and the environment they are in play significant roles in the spread of Tuberculosis. An imbalance in these factors can contribute to the increased prevalence of the disease.[16,17]

The fight against Tuberculosis faces various challenges, including outdated diagnostic methods reliant on centuries-old microscopes, low-sensitivity diagnostic techniques, limited usage of the Calmette Guérin (BCG) vaccine, and the use of drugs that have been in use for several decades.[18] With advancements in genomic data availability, there is now a better understanding of genotypic and ecological variations among related bacteria. Traditional species concepts, which are commonly used to define naturally occurring species in populations, cannot be readily applied to bacteria due to their unique characteristics.[19,20]

Efforts to address the problem of TB transmission require collaboration across different sectors. The increasing incidence of Tuberculosis is rooted in factors like poverty, economic inequality, and limited access to healthcare facilities, particularly in remote or island regions.[21,22] It's widely recognized by public health experts that the environment plays a crucial role in community health and can contribute to increased transmission of Tuberculosis.[23,24] Various factors influence the spread of Tuberculosis, including gender disparities (with men having a higher incidence than women), decreased immunity, duration of exposure due to shared residence, education, smoking habits, and home environment.[25,26] This study aimed to examine the risk factors for Tuberculosis transmission.

Materials and Methods

Research design

This research employed a quantitative approach with a cross-sectional design. Primary data was collected through direct observation using a questionnaire composed of three parts: demographic information, knowledge level, and risk of transmission.

Study participants

This study involved a sample size of 100 participants, and the participants were selected through purposive sampling. The respondents in this study were patients diagnosed with TB who possessed good communication skills and visited the TB clinic. However, individuals with TB who had coexisting psychiatric disorders were excluded from the study.

Variable, instrument and data collection

This study collected primary data through direct observation of Tuberculosis patients at one of hospital in West Kalimantan. The independent variables included age, gender, occupation, diabetes history, body mass index (BMI), and knowledge levels. These variables were used to assess their impact on the dependent variable, which was the risk of transmission. Data collection involved a questionnaire that incorporated questions related to age, gender, occupation, diabetes history, BMI, knowledge levels, and the risk of transmission. The questionnaire demonstrated validity and reliability with a total correlation exceeding 0.361 and an alpha Cronbach above 0.979. Data analysis involved bivariate chi-square tests, and the data was further examined using a logistic regression model with the enter method.

Data analysis

The data analysis in this study involved a bivariate chi-square test to assess the relationship between the predictor variables. If the p-value for a predictor variable was less than 0.25, it was considered for inclusion in the logistic regression model using the enter method. Logistic regression analysis was then employed to create a model that includes predictions and calculates Odd Ratio (OR) values. The independent variables considered in this study were age, gender, occupation, diabetes history, body mass index (BMI), and level of knowledge. The dependent variable was the risk of transmission. The significance level used for this study was set at 5%.

Ethical clearance

This research has passed the ethics review in the Faculty of Medicine Universitas Tanjungpura with number 3489/UN22.9 /PG/2022.

Results

The characteristics of the research respondents were presented in Table 1, providing valuable insights into the distribution and frequency of various independent variables related to the risk of Tuberculosis transmission. The majority of respondents were in the age group of 45-54 years (21%), male (52%), farmer (34%), no diabetes mellitus record (56%), has normal BMI (50%), and has high level of knowledge (65%). Based on Table 2 there was statistical test indicated that there was a partial relationship between each predictor variable including age, gender, diabetes record, BMI, and level of knowledge on the risk of transmission of Tuberculosis patients. Furthermore, each variable may be included in the regression model using the enter method with the hosmer-lameshow test parameter with a standard sig > 0.05 indicating that the model was capable of accurately predicting the risk of events. Based on the data processing the hosmer & lameshow test showed a significance value of 0.896 (sig > 0.05), it can be concluded that the variables of age, gender, diabetes record, BMI and level of knowledge that have entered the regression model have fit and are able to predict the chance of transmission (Table 3).

Based on the data processing results, Table 4 showed the estimation of the logistic regression parameters. In general, it can be seen that the independent variable which has a sig value < 0.05 can bee seen in BMI, either in the underweight, normal or overweight categories. The logistic transformation process can be symbolized by underweight (x1), normal (x2) and overweight (x3). Age (p value 0.818) did not have a significant relationship in the model and stimulant test. Descriptively, there are differences in the odd ratio value of each age category compared to 15 – 24 years old. The odd ratio values are 25-34 years (2.038 times), 35-44 years (1.044 times), 45-54 years (0.570 times), 55-64 years (0.386 times), age 65-74 years (0.000 times), age ≥ 75 years (2.191 times) may not transmitting. The B value indicates that there is a tendency to reduce the risk of transmission or increase the risk of transmission over time. Gender (p value 0.159) does not relate to stimulants in regression model analysis. Taking into account the value of the hazard ratio, women are 2.391 times less likely to be infected by TB than men. Respondents with comorbid disease records are partially related, but in the stimulant test model, the history of diabetes (p value 0.538) did not have a significant relationship. The resulting hazard report value indicates that a person with a diabetes record has a 1.473 times higher risk of infectious diseases than those without diabetes. BMI (p value 0.002) is significantly related to this regression model. A person with a normal BMI is 20 times less likely to transmit than a person with an underweight BMI. While 143 times less likely to transmit than a person with an underweight BMI. Factors based on the level of knowledge (p value 0.163) have a less significant relationship in the model. In general, based on model tests, a person with good knowledge of Tb is 2.5 times less likely to be infected, compared to a person with low knowledge (Table 4).

Discussion

The findings of this study indicate a significant relationship between infectious risk behavior and body mass index (BMI). This aligns with previous research that has shown an association between BMI and Tuberculosis incidence.[27] BMI is a critical indicator of nutrition and plays a significant role in the prevalence of Tuberculosis. A low BMI, which indicates underweight, is considered a risk factor for Tuberculosis.[28] Conversely, a high BMI or overweight status has been identified as a protective factor against the development of Tuberculosis, suggesting an intricate interaction between Tuberculosis and BMI.[29] Tuberculosis patients often exhibit poorer nutritional status, potentially due to decreased appetite as a symptom of the disease. Poor nutritional status can, in

Table 1. Distribution of transmission risk frequency by respondent characteristics.

Variable Independent	Risk of transmission		Total
	High n (%)	Low n (%)	
Age			
15-24 years old	7 (17.1)	13 (22)	20 (20)
25-34 years old	3 (7.3)	12 (20.3)	15 (15)
35-44 years old	3 (7.3)	12 (20.3)	15 (15)
45-54 years old	8 (19.5)	13 (22)	21 (21)
55-64 years old	9 (22)	8 (13.6)	17 (17)
65-75 years old	10 (24.4)	0 (0)	10 (10)
≥ 75 years old	1 (2.4)	1 (1.7)	2 (2)
Gender			
Male	32 (78)	20 (34)	52 (52)
Female	9 (22)	39 (66)	48 (48)
Occupation			
Civil Servant/Armed Forces Officer	1 (2.4)	3 (5.1)	4 (4)
Private employee	8 (19.5)	7 (11.9)	15 (15)
Pensioner	3 (7.3)	7 (11.9)	10 (10)
Housewife	2 (4.9)	2 (3.4)	4 (4)
Farmer	10 (24.4)	24 (40.7)	34 (34)
Farmers/fishermen	0 (0)	2 (3.4)	2 (2)
Student	5 (12.2)	2 (3.4)	7 (7)
Unemployed	12 (29.3)	12 (20.3)	24 (24)
Diabetes Record			
Yes	24 (58)	20 (34)	44 (44)
No	17 (42)	39 (66)	56 (56)
BMI			
Thin	18 (43.9)	1 (1.7)	19 (19)
Normal	20 (48.8)	30 (50.8)	50 (50)
Overweight	3 (7.3)	28 (47.5)	31 (31)
Knowledge Level			
Low (< 22,79 point)	21 (51.2)	14 (23.7)	35 (35)
High (≥ 22,79 point)	20 (48.8)	45 (76.3)	65 (65)
Total	41 (100)	59 (100)	100 (100)

Table 2. Results of the bivariate prediction test for transmission test.

Variable independent	Test	Sig.	Expected count < 5 (%)
Age *	Fisher's exact test	0.001	21.4
Gender*	Chi-square	0.000	0
Occupation	Fisher's exact test	0.284	56.3
Diabetes record *	Chi-square	0.015	0
BMI *	Chi-square	0.000	0
Knowledge level*	Chi-square	0.005	0

Table 3. Overview of model test result.

Step	-2 log likehood	Cox & Snell R Square	Nagelkerke R Square
1	71.122	0.474	0.639*
2	94.849	0.333	0.449**

turn, lead to reduced immunity and an increased risk of Tuberculosis infection. A reduced BMI may also negatively impact the prognosis for Tuberculosis treatment.[30,31] Nutritional status is known to play a crucial role in the outcome of TB treatment, with patients of better nutritional status demonstrating improved treatment responses. BMI serves as a practical and cost-effective measure to assess nutritional status.[32] Additionally, other studies have shown that individuals with higher body weight and a BMI greater than 18.5 are less likely to experience sputum conversion, which is the transition from a positive to a negative Bacillus Tuberculosis Acid (BTA) examination. This underscores the importance of maintaining a healthy nutritional status in Tuberculosis management.[32]

In the other hand, the results of this study show a relationship between age and TB transmission risk behavior. This is consistent with previous studies that most elderly have poor health behavior, such as lack of maximum treatment.[33] This is consistent with the theory of health belief model that a person has perceived barriers, namely confidence regarding self-confidence and behaviors.[34] An elderly person who has thoughts of hindrance in performing non-communicable actions will feel uneasy. This can be seen in the phenomenon of separation of utensils, bedroom, and closeness between family members.

Self-efficacy also contributes to the success of an older person with health behaviors. Self-efficacy can control risky behavior by increasing confidence that the disease has a chance to be healed.[35] This result is supported by previous studies that therapeutic excellence in improving self-efficacy and physical self-reliance can improve the quality of life of Tuberculosis patients, such as confidence in healing, being able to overcome pain, and carrying out activities independently.[36] Becoming elderly leads to physical and mental regression. Physical regression is not limited to the consequences of the disease, but the function of each cell that plays a role in reducing activity. These changes also affect someone's psychological level.[37] The results of this study are also supported by previous studies which show that at a young age, TB prevention behavior is better compared to old age.[38] The elderly with unhealthy behavior has a higher possibility to be infected by diseases including TB. The lack of knowledge and misperception of the disease suffered, leads to misbehavior in the prevention of TB transmission.[38]

The results of this study indicate that there is a relationship between gender and Tuberculosis transmission behavior. This result is different from the research of Ramadan *et al*. (2021) which shows that there is no significant difference between gender and TB prevention behavior.[38] Results from this study are also consistent with the study of Nurhayati *et al*. (2015) which shows that women are better at preventing TB than men.[39] The fundamental assumptions which make up the women hypothesis have tended to behave properly and healthily. Women tend to behave better than men. As a result, women are more concerned about their health.[40] Other studies also revealed that the level of knowledge is predisposed to a person. Women are more knowledgeable than men.[41] This may be triggered by someone's habit, for example, women in Indonesia are considered to behave cleanly, orderly, organized, and like to read. This is supported by the research conducted by Bajaj & Kilgore (2020) there are morphological differences in limbal tissues between males and females.[42] The literature indicates a negative correlation between the size of limbic tissue based on the control ability of risky situations.[42] The limbic system itself is part of the brain which consists of the amygdala, hypothalamus, thalamus, and hippocampus. Physiologically it possesses a function in initiating behavior, and emotions (anger, fear, sexual drive).[43]

The results of this study are also supported by Lee & Allen (2020) which shows that gender becomes confounding between healthy eating behavior and depression.[44] It can be seen by the behavior of young men who enjoy consuming fast food and soft drinks but dislike eating fruit. This phenomenon occurred as a result of the difference in cerebral tissue between the two. Since the last decade, neuroscientists have found that the number of tissue nuclei in the brain affects cognitive, affective, and behavioral functions.[45]

The results of this study indicate that a diabetic person has a potential of 1.473 times more likely to transmit TB. The results of

Table 4. Estimated logistic regression parameters.

Variable	Sig.	OR	AOR	95% C.I.for exp(B)	
				Lower	Upper
15- 24 years old *	0.818				
25-34 years old	0.512	0.538	2.038	0.243	17.107
35-44 years old	0.969	0.250	1.044	0.118	9.246
45-54 years old	0.500	0.250	0.570	0.111	2.915
55-64 years old	0.278	0.615	0.386	0.069	2.155
65-74 years old	0.998	1,125	0	0	
≥ 75 years old	0.786	1.615	2.191	(0.008)	634.764
Gender	0.159	0.144	2.391	0.710	8.049
Diabetes Record	0.538	0.363	1.473	0.430	5.046
Underweight *	0.002				
Normal (x1)	0.012	0.037	20.332	1.944	212.637
Overweight (x2)	0.000	0.006	143.136	9.412	2176.747
Knowledge Level	0.163	0.296	2.500	0.691	9.051
Constant	0.012		0.034		

*category references. **dependent variable: high risk of infection (0), low risk of infection (1).

this study are in line with previous studies which show that TB is more common in someone with a diabetes record.[46] In this case, the function of emotions also influences physiological implications such as fear which may increase pulse rate, blood sugar levels, and trembling.[43] The incidence of diabetes mellitus (DM) is related to genetic, environmental, immunity, and other factors. Another study states that 30-50% of diabetics have mental disorders such as anxiety, frustration, depression, and irritability which may worsen the quality of life.[47] DM itself can be referred to as a great initiator of changes in the human body system, both physically and mentally.[47] Increased self-efficacy and internal health locus can initiate the formation of drug compliance and healthy behavior. Self-efficacy can give someone encouragement to determine self-confidence and modify the situation that has occurred.[48] Previous studies have shown that high levels of anxiety can decrease self-efficacy scores. According to Bandura, a person's belief in his capacity or competence can carry out a series of tasks to achieve the desired goal and overcome obstacles. Critical thinking skills can also be supported by a high level of self-efficacy.[49,50]

Knowledge is something that is known to humans or as a result of human intelligence itself. Knowledge is also the content of one's mind to comprehend different things. Knowledge of TB prevention involves transmission, prevention, and appropriate treatment.[51] Notoadmojo (2003) revealed that knowledge and attitudes can influence family behavior and activity in related organisms.[52] The level of knowledge may affect the initiation and treatment of Tuberculosis. Based on the review of research, several factors are known to influence treatment adherence,[53] such as family support, positive self-esteem or self-efficacy, subjective norms, drug side effects, support of the Tuberculosis Drug Supervisor (PMO), the use of medication reminder aids, the patient's desire to recover, the patient's way of thinking and the patient's knowledge of Tuberculosis disease and the use of drugs that are in accordance with Ministry of Health standards.[54]

Conclusions

There is a relationship between age, gender, the record of diabetes mellitus, BMI, and level of knowledge. This research showed that empowering Tuberculosis patients is one of the nursing measures that can improve the quality of life of Tuberculosis patients and minimize the risk of transmission, especially between family members of patients. Among the things that need to be improved include lowering anxiety, increasing self-confidence, increasing knowledge and supporting good nutritional intake to reduce the risk of transmission. Healthcare workers can provide support to patients and their families through Tuberculosis control programs.

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