

Estimating the effect of lay knowledge and prior contact with pulmonary TB patients, on health-belief model in a high-risk pulmonary TB transmission population

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Objective: The research aimed to investigate the effect of lay knowledge of pulmonary tuberculosis (TB) and prior contact with pulmonary TB patients on a health-belief model (HBM) as well as to identify the social determinants that affect lay knowledge.

Methods: Survey research design was conducted, where participants were required to fill in a questionnaire, which measured HBM and lay knowledge of pulmonary TB. Research participants were 500 residents of Semampir, Asemrowo, Bubutan, Pabean Cantian, and Simokerto districts, where the risk of pulmonary TB transmission is higher than other districts in Surabaya.

Results: Being a female, older in age, and having prior contact with pulmonary TB patients significantly increase the likelihood of having a higher level of lay knowledge. Lay knowledge is a substantial determinant to estimate belief in the effectiveness of health behavior and personal health threat. Prior contact with pulmonary TB patients is able to explain the belief in the effectiveness of a health behavior, yet fails to estimate participants' belief in the personal health threat.

Conclusion: Health authorities should prioritize males and young people as their main target groups in a pulmonary TB awareness campaign. The campaign should be able to reconstruct people's misconception about pulmonary TB, thereby bringing around the health-risk perception so that it is not solely focused on improving lay knowledge.

Keywords: health-belief model, lay knowledge, prior contact to pulmonary TB patients, pulmonary tuberculosis

Introduction

Despite being one of the countries with the highest pulmonary tuberculosis (TB) cases globally, the prevalence and incidence of pulmonary TB in Indonesia demonstrates a slight positive trend by showing a decline every year. However, Indonesian Ministry of Health admits that such achievement is not the end of the story. If the case detection rates reaches 82.4%, then it is predicted that 17.6% of acid-fast bacillus (AFB)-positive patients are unable to get medical treatment or access to any health care facilities. Furthermore, Indonesia is currently ranked fourth globally in the list of countries with the highest burden of TB.¹⁻³

Case finding is critical in controlling pulmonary TB transmission,⁴⁻⁶ and therefore, it is a popular research topic in various developing countries with high-burden pulmonary TB such as Gambia, Nigeria, and Colombia.⁷⁻¹⁰ The strategy of new case finding, either AFB positive or AFB negative, relies solely on the patient, so health care workers are in a passive stance and depend on patients' awareness of the symptoms and their

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concern to seek medical help.² Currently, the Direct Observed Treatment and Short (DOTS) course implementation in Indonesia largely focuses on medical and curative strategy and gives little consideration to prevention and promotive aspects.^{11,12} However, the success of DOTS can be achieved only by building community awareness. Another key point is that strengthening preventive and promotive aspects is crucial, especially protecting the uninfected healthy people in the community.¹²

Based on prior research on patients' health-seeking behavior in Indonesia,^{13,14} lay knowledge of pulmonary TB is found to have a significant effect on several preventive health-related behaviors. Various prior research have also demonstrated that lack of lay knowledge is associated with less motivation to perform preventive behaviors,¹⁵ less chance to seek treatment,^{16,17} longer treatment delay,^{9,18,19} and higher social stigma.^{20,21} Lack of motivation to seek help can lead to treatment delay, which is a long pause between first symptom emergence and a patient's first visit to health care facilities.⁵ Meanwhile, the faster the patient is diagnosed and treated, the less chance of the disease being transmitted to healthy people.^{7,22}

Even though research regarding determinants of pulmonary TB knowledge have been extensive, there is little research concerning lay knowledge, especially in healthy people with a high risk of contracting pulmonary TB. Previous research confirm that gender, ethnicity, education, and income level determine the level of lay knowledge.^{12,23–26} Other research studies based in Indonesia mention that knowledge of pulmonary TB is generally poor regardless of their education level.^{14,26}

Therefore, we hypothesize (H1): People with higher income and education level, being a male, older, and having past experience in directly interacting with pulmonary TB patients will tend to be more knowledgeable about pulmonary TB.

Health-belief model (HBM) is a set of variables, which is used regularly to predict whether individuals strive to prevent, examine, or to control an illness. The variables include perceived susceptibility (one's perception on the chance of being exposed to a disease), perceived severity (one's perception on how severe the consequences that a disease can inflict), perceived benefits (one's perception on the benefits of freedom from a disease), perceived barriers (possible perceived constraints of a treatment recommended by health care workers), cues to action (a prompt or a trigger that entices health behavior), and self-efficacy (one's belief that they are able to carry out certain health behavior).^{27–29}

Perceived severity and susceptibility represent a cumulation of individual belief of a health threat (belief in a personal health threat [BP]). It implies that individuals are more likely to adopt a healthier lifestyle if their perceived risk of contracting certain diseases is also high and they believe that those diseases can severely impact their life.^{30,31} However, if they believe that the danger of illness is real, it is not yet sufficient to convince them adopting preventive behavior. The likelihood of adopting healthier lifestyle increases if they believe that preventive behavior is more beneficial (perceived benefits) and the constraints can be compromised (perceived barriers).^{28,31} Perceived benefits and perceived barriers jointly determine how individuals perceive the effectiveness of a health behavior.³¹

Previous studies of the use of HBM in understanding pulmonary TB control have been extensive, not only in patients, but also in lay people with high risk of contracting pulmonary TB.^{28,32} Historically, HBM and pulmonary TB were closely related as HBM was first used to investigate how people respond to a free chest X-ray as part of a pulmonary TB prevention program in the USA.^{30,31,33} Not long after being introduced, HBM had been widely used to investigate patients' response to early symptoms and to predict their adherence to medical treatment.^{31,33,34}

A study conducted by Hochbaum⁵⁰ showed that people who believe that their chance of contracting pulmonary TB is high and are convinced that pulmonary TB can affect their health severely are more likely to be motivated to undergo a chest X-ray. Another study conducted by Barnhoorn and Adriaanse³⁵ applied HBM to estimate pulmonary TB patients' compliance to treatment in India. Noncompliance patients are more likely to have lower level of perceived severity, health motivation, belief in the effectiveness of health behavior, and self-efficacy.³⁵ Our prior study in Surabaya, Indonesia, found that pulmonary TB patients with a lower level of lay knowledge tend to seek help longer than more knowledgeable patients.¹⁴

Therefore, we hypothesize (H2): People with higher level of lay knowledge of pulmonary TB and having previous contact with pulmonary TB patients will be more likely to believe that the threat of pulmonary TB is intense (BP) and tend to believe that a preventive behavior is necessary (belief in the effectiveness of a health behavior).

Methods

The current research aimed to investigate the determinant factors of lay knowledge and beliefs of pulmonary TB in a

high-risk population of pulmonary TB transmission, which covered Simokerto, Pabean Cantian, Semampir, Asemworo, and Bubutan districts in Surabaya, Indonesia. We chose a survey as our research design as most prior research also used the same design.^{27,35,36} We investigated the effect of certain social determinants, such as gender, ethnicity, income and education level, on lay knowledge. We also wanted to investigate the effect of lay knowledge and prior contact with pulmonary TB patients on HBM. Nonetheless, a survey fitted very well to fulfill the aims of this research.^{37,38} Ethics approval was obtained from the Board of Ethics, Faculty of Psychology, Universitas Airlangga to conduct the study.

Participants

Participants for this research were 500 Simokerto, Pabean Cantian, Semampir, Asemworo, and Bubutan district residents in Surabaya, Indonesia, which were five most susceptible districts in pulmonary TB transmission as well as five most densely populated districts in Surabaya.³⁹ The sampling technique used in this research was cluster random sampling, in which three subdistricts with the highest number of underprivileged households were selected from each district. All participants agreed to a sign informed consent form prior to taking part in the study and were ensured their data would be kept confidential.

Measures

HBM scale

The instrument used in this research was a Likert scale, constructed by the author based on each HBM variable definition, which is Champion and Skinner's²⁸ HBM-revised concepts. The 4-point Likert scale consisted of five subscales, which are perceived susceptibility (five items), perceived severity (five items), perceived benefits (nine items), perceived barriers (seven items), and self-efficacy (four items). Cues to action was implied by asking whether the participants have prior direct interaction with a pulmonary TB patient. Total score of perceived barriers was subtracted from perceived benefits and resulted belief in the effectiveness of a health behavior (BE). Perceived susceptibility and severity jointly represent BP.²⁸

After performing Cronbach's alpha analysis to test the reliability of the scale, reliability coefficients of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy were found: 0.464, 0.473, 0.801, 0.562, and 0.447, respectively. Thus, the reliability coefficients were ranging from moderate to high. All items in each scale obtained positive item-total correlation coefficients, so that none of items were eliminated.

Lay knowledge on pulmonary TB

Lay knowledge scale included several aspects of knowledge of pulmonary TB, which were 1) definition of the disease, 2) symptoms, 3) causes/etiology of the disease, 4) prediction of the prognosis, 5) risk of contagion, 6) worst consequences of the disease, and 7) lay perception of epidemiological seriousness.

To assure the validity of the research instruments, we used two strategies. The first is cognitive interviewing.^{37,40} We interviewed five people who share similar characteristics with research participants to ensure that participants would understand the meaning and instruction of each items in the instruments. Second, we discussed the questionnaire content with subject matter experts to ensure that all items in the questionnaire represent the measured construct. Form both processes, we received useful feedback for constructing and revising the scale.

Data analysis

Logistic and linear regression analysis were performed to test research hypotheses. Logistic regression was used to investigate the social determinants of lay knowledge. Before conducting logistic regression, lay knowledge was recoded into two categories; those who obtained less than average were coded poor and those who obtained more than average were coded good. Linear regression analyses were conducted to test whether lay knowledge and prior contact significantly influence BE and BP. All statistical analyses were conducted using SPSS 20 (IBM Corporation, Armonk, NY, USA).

Results

Participants' characteristics

Research participants were majority female (67%) and <30 years old (29.6%). Most of the research participants were senior high-school leavers (34.4%) and their income level was very low (<Rp1.000.000, 45.2%). Research participants' occupation were majority housewives (28.4%) and Javanese (57%) and had never interacted with pulmonary TB patients (56.8%). Research participants' sociodemographic data are described in Table 1.

Social determinants of lay knowledge

After performing logistic regression analysis, we were able to identify which independent variables significantly increased or reduced the likelihood of having a good lay knowledge (adjusted odds ratio [aOR], 95% confidence interval [CI]). The data are presented in Table 2.

Based on the data presented in Table 2, we found that age (1.063, 1.038–1.089, $p < 0.05$) is a significant predictor for lay

Table 1 Participants' characteristics (N=500)

Sociodemographic factors	%	% Missing
Age group (years)		0.00
18–30	29.6	
31–39	22.0	
40–47	24.6	
48–65	23.8	
Gender		2.4
Female	67.0	
Male	33.0	
Education level		0.00
No qualification	6.4	
Elementary school	30.6	
Junior high school	23.8	
Senior high school	34.4	
Diploma	1.4	
Undergraduate	3.4	
Income level		1.00
<Rp1.000.000	45.2	
Rp1.000.000–Rp1.500.000	25.4	
Rp1.500.001–Rp2.000.000	8.6	
Rp2.000.001–Rp2.500.000	10.4	
Rp2.500.001–Rp4.000.000	6.2	
>Rp4.000.000	3.2	
Occupation		0.4
Police/military officer	0.2	
Civil servant	1.2	
Private sector employee	19.2	
Entrepreneur	3.0	
Professional	2.0	
Street vendor	22.6	
Student	2.0	
Housewife	28.4	
Not working	15.6	
Others	5.4	
Ethnicity		0.2
Javanese	57.0	
Madurese	40.0	
Chinese	1.2	
Others	1.6	
Past experience of direct interaction with pulmonary TB patients		0.6
Yes	42.6	
No	56.8	

Abbreviation: TB, tuberculosis.

knowledge, which implies that as the participants grow older, it may increase their probability of having a good level of lay knowledge. Moreover, gender or being a female (4.127, 2.489–6.843, $p<0.05$) and prior contact with pulmonary TB patients (2.661, 1.728–4.097, $p<0.05$) are also found to be significant predictors for lay knowledge. It means that female participants and those who have prior direct contact with pulmonary TB patients have an increased chance to have good lay knowledge.

However, ethnicity, education, and income are not good predictors for lay knowledge, which implies that lay knowledge are rather similar across income and education level as well as ethnic groups.

Lay knowledge and HBM

After calculating the total score, perceived severity ($M=14.44$, $SD=2.09$) is higher and has a lower standard deviation than perceived susceptibility ($M=12.24$, $SD=2.16$). It implies that participants are likely to perceive pulmonary TB as a disease with serious health implication, but they are not aware that they are very likely to suffer from the disease.

Furthermore, the finding of this study shows that perceived benefits ($M=28.35$, $SD=3.78$) are higher than perceived barriers ($M=17.04$, $SD=2.78$); thus, participants tend to adopt preventive behavior and think that the barriers of conducting health behavior can be easily overcome. It generally implies that participants believe that the benefits of adopting preventive behavior are necessary and the obstacles of performing it can be easily resolved.

Table 3 presents linear regression model that includes knowledge of pulmonary TB and previous contact with pulmonary TB patients as independent variables and belief in personal health threat (BP) (Model 1), perceived susceptibility (Model 2), and perceived severity (Model 3) as dependent variables. It can be concluded that all three models were statistically significant ($p<0.05$). Moreover, knowledge is found to be a significant predictor for all three dependent variables ($p<0.05$), but previous contact is not sufficient to estimate belief in the personal health threat ($p>0.05$). The model that contributes the highest adjusted R^2 ratio is Model 3 (0.082, $p<0.05$), while lay knowledge and previous contact contribute ~3% of score variance for perceived susceptibility ($p<0.05$) and 5.9% of score variance for BP.

Table 4 describes the linear regression model that involves lay knowledge and previous contact with pulmonary TB patients as independent variables with BE (Model 1), perceived benefits (Model 2), and perceived barriers (Model 3) as dependent variables. All the three models are statistically significant ($p<0.05$).

Lay knowledge and previous contact jointly contribute the highest adjusted R^2 for BE (0.104, $p<0.05$). Meanwhile, for perceived benefits and perceived barriers, score variance of knowledge and previous contact explain 7.8% and 4.9%, respectively ($p<0.05$). Thus, it can be concluded that lay knowledge and previous contact explain BE better than

Table 2 Social determinants of lay knowledge of pulmonary TB

Determinants	β	SE	df	p-value	aOR	95% CI	
						Lower	Upper
Age	0.061	0.012	1	0.000*	1.063	1.038	1.089
Being a female	1.418	0.258	1	0.000*	4.127	2.489	6.843
Education level	–	–	5	0.194	–	–	–
Ethnicity	–	–	3	0.464	–	–	–
Interacting with TB patients	0.979	0.220	1	0.000*	2.661	1.728	4.097
Income level	–	–	5	0.204	–	–	–
Constant	–5.550	0.926	1	0.000	0.004	–	–

Notes: A binary logistic regression, good knowledge=1, poor knowledge=0, Nagelkerke $R^2=0.223$. * $p<0.05$.

Abbreviations: β , coefficient; SE, standard error; aOR, adjusted odd ratio; TB, tuberculosis.

Table 3 Determinant of belief in a personal health threat (N=500)

Variables	β	SE	F-test	p-value	aR ²	VIF
Model 1: Belief in a personal health threat						
Constant	4.962	0.071	16.497	0.000*	0.059	1.071
Knowledge	0.057	0.011		0.000*		
Previous contact	0.053	0.060		0.379		
Model 2: Perceived susceptibility						
Constant	2.373	0.048	1.651	0.000*	0.003	1.072
Knowledge	0.012	0.007		0.117		
Previous contact	0.019	0.041		0.635		
Model 3: Perceived severity						
Constant	2.589	0.045	24.930	0.000*	0.088	1.071
Knowledge	0.045	0.007		0.000*		
Previous contact	0.032	0.038		0.400		

Notes: Model 1: IV=knowledge, previous contact, DV=belief in a personal health threat. Model 2: IV=knowledge, previous contact, DV=perceived susceptibility. Model 3: IV=knowledge, previous contact, DV=perceived severity. * $p<0.05$.

Abbreviations: β , coefficient; SE, standard error; aR², adjusted R²; VIF, multicollinearity test.

Table 4 Determinant of belief in the effectiveness of health behavior (N=500)

Variables	β	SE	F-test	p-value	aR ²	VIF
Model 1: Belief in the effectiveness of health behavior						
Constant	0.271	0.065	29.778	0.000*	0.104	1.072
Knowledge	0.061	0.010		0.000*		
Previous contact	0.160	0.055		0.004*		
Model 2: Perceived benefits						
Constant	2.878	0.045	21.874	0.000*	0.078	1.072
Knowledge	0.042	0.007		0.000*		
Previous contact	0.031	0.038		0.413		
Model 3: Perceived barriers						
Constant	2.607	0.043	13.665	0.000*	0.049	1.072
Knowledge	–0.019	0.007		0.000*		
Previous contact	–0.129	0.037		0.000*		

Notes: Model 1: IV=knowledge, previous contact, DV=belief in the effectiveness of health behavior. Model 2: IV=knowledge, previous contact, DV=perceived benefits. Model 3: IV=knowledge, previous contact, DV=perceived barriers. * $p<0.05$.

Abbreviations: β , coefficient; SE, standard error, aR², adjusted R²; VIF, multicollinearity test.

perceived barriers and benefits, even though the adjusted R² is rather small for all models.

Discussion

Poor knowledge on pulmonary TB is a common problem, which often occurs in the developing countries with a high

burden of TB. A study in Jamaica investigated the level of knowledge, attitude, and treatment strategy of health care workers treating pulmonary TB and came into conclusion that only less than a half of research participants showed a satisfying understanding on pulmonary TB.⁴¹ Another study in Nigeria⁴² also concluded that knowledge and

attitude toward pulmonary TB was generally poor in their community.

Similarly, a study conducted in Sudan confirmed that most pulmonary TB patients' knowledge about their disease is poor. According to the study, only ~36% of participants show a good knowledge of pulmonary TB, and male participants are generally found to have a better knowledge than female participants.⁴³ However, our findings demonstrate the contrary, in which females have a better level of knowledge than males. It might be because culturally, Indonesian females are more open to and more likely to share information with others than males.⁴⁴ In addition, our findings support prior research conducted in Finland and German, which mention that females are generally more motivated in searching for health information and are more actively engaged in health promotion programme.^{45,46}

Therefore, pulmonary TB control should prioritize males and younger people to be their main target group. It is crucial because males and young people can potentially burden their family and society if they suffer from pulmonary TB. This is consistent with the fact that pulmonary TB patients in Indonesia are mostly in their productive age and some of them are the breadwinner of their family.^{2,11}

Experience of direct interaction with pulmonary TB is proven to have a significant association with knowledge and participants' belief in the effectiveness of a health behavior. If the participants have previous contact with a pulmonary TB patient, they are more likely to have a better level of knowledge, as well as likely to consider a particular health behavior as effective to prevent or to treat pulmonary TB. This result is consistent with the HBM model, which postulates that prior experience serves as cues to action and acts as the modifying factor that has a strong effect in altering individual's belief and knowledge about a particular disease.^{28,33} However interestingly, prior contact is found to have no influence on BP. It also implies that when lay people have an experience of interacting with pulmonary TB patients, despite being susceptible to developing pulmonary TB, they still perceive that they are not at risk of contracting the disease.

Furthermore, our finding shows that participants' perceived susceptibility is higher than perceived severity. It implies that participants properly understand that pulmonary TB is a threatening disease and causes severe consequences. However, they do not perceive themselves as having a high risk of infection, even though they live in a neighborhood with the highest risk of contracting pulmonary TB in Surabaya. This is perhaps because of the participants' lack of knowledge of how pulmonary TB is transmitted from patients to healthy

people. Pulmonary TB misconceptions may also cause their inaccurate risk perception.

Poor lay knowledge of pulmonary TB indicates that the community intervention with regard to controlling pulmonary TB still needs to be improved. Indonesian Ministry of Health has considered the importance of raising the awareness in people and educating lay people about pulmonary TB, and these strategies have been planned in the National Guideline for Tuberculosis Control.¹¹ However, the strategy is not extensively discussed, so that it is unclear how government prioritize the target group or how the campaign to raise people awareness looks like. Therefore, our research may provide an important evidence for the health authorities in designing community intervention.

Our research shows that people may be well-aware that pulmonary TB is extremely deadly, yet they are unwilling to adopt preventive behavior to protect themselves from being infected. Improving knowledge may not be the end of the story, as knowledge only works very well in providing useful facts of pulmonary TB. However, increasing lay risk perception of contracting pulmonary TB or motivating them to adopt preventive behavior can be more achievable by changing their attitude and belief in pulmonary TB.¹⁷ Some previous research demonstrate that it is very common in developing countries that lay people may develop misconceptions about pulmonary TB.⁴⁷⁻⁴⁹ Some of misconceptions may be rooted in cultural beliefs, especially in how people define the symptoms as well as early treatment of the disease.¹⁴

Even though knowledge is a good predictor for BE and BP, its adjusted R^2 is very small. This may be because 1) participants' knowledge is extremely low, so that it is insufficient to adequately change BE and BP or 2) there are other unidentified variables, which potentially have a more significant effect on BE and BP. We suspect that social influence, for instance, lay consultation, rumor, or even the influence of authority (eg, orderly, doctor, parents, and older people) might be more substantial than participants' knowledge in forming their health beliefs. Unfortunately, HBM has an unavoidable limitation as it cannot accommodate variables related to social influence, so that its estimation is rather questionable, especially in collectivistic societies.³¹

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Disclosure

The authors report no conflicts of interest in this work.

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