

TBL-20Q-IDN: Validation of Tuberculosis Literacy Instrument in Urban Settings

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Abstract. Tuberculosis is a global concern, mainly in Indonesia, which is still one of the top five contributors to the illness. The disease can be avoided by increasing Tuberculosis Literacy among persons living with Tuberculosis (PLWTB) and those around them. However, measures to assess TB literacy are inaccessible and must be created. This study aims to determine the validity and reliability of a tuberculosis literacy test in urban settings. The TB literacy instrument was developed using the MEASURE Approach, a practical guide to instrument development and score validation in the social sciences. Ten young people evaluated the instrument for face validity and expert judgment. The validity analysis included 1411 participants from urban communities. The twenty questions about tuberculosis literacy were created by combining a matrix of four dimensions applied to three health areas. The validity study revealed that all questions are valid and reliable (LF>0.3, CR>0.7, RMSEA≤0.08). Except for the applied domain (L14-L20), all domains have an AVE greater than 0.5. It may be concluded that the instrument is reliable and valid for measuring tuberculosis literacy in urban areas.

1 Introduction

Tuberculosis is one of the direct infectious diseases that is still a serious concern at the global level. Tuberculosis remains the world's top 10 leading cause of death, with 10 million people infected in 2018 [1]. Even though TB-related deaths fell from 1.6 million in 2017 to 1.5 million in 2018, some countries are still on track to end the TB epidemic by 2030. The severity of TB epidemics in some countries shows that the incidence of TB cases varies widely from < 5 to > 500 new cases. Meanwhile, the number of relapse cases reaches 100,000 population per year [2].

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In 2021, Indonesia (13 percent) was one of the top five countries contributing to tuberculosis problems besides India (24 percent), the Philippines (10 percent), Pakistan (6.6 percent), and Nigeria (6.3 percent) (2). Based on data from Riskesdas from 2013-2018, the prevalence of pulmonary TB in Indonesia, based on diagnosis, is 0.4% of the total population. In other words, for every 100,000 Indonesians, there are 400 people diagnosed with TB cases [3]. The data has yet to achieve the target of the national strategic plan in 2024, where the prevalence of pulmonary TB will be 319 per 100,000 population [4].

In 2018, the provinces with the highest prevalence of pulmonary tuberculosis based on diagnosis were Banten and Papua (0.8%) and West Java (0.6%). There is a positive spatial autocorrelation of tuberculosis prevalence in Java. The GWR model shows that the average number of years in education, percent of households with floor space per capita < 8 m², and reporting easy access to healthcare facilities were associated with the prevalence of tuberculosis in some districts within the West and Central Java provinces [5]. Although Central Java province is not among the provinces with the highest cases, Central Java has experienced increased pulmonary TB cases. The health profile of Central Java Province in 2016 showed that CNR-positive BTA cases in Central Java in 2016 amounted to 115.36 per 100,000 population, an increase from the previous year. Meanwhile, the CNR for all TB cases in Central Java in 2016 was 118 per 100,000 population, which increased from the previous year [6].

Semarang City, the capital of Central Java province, has a population that mostly lives in densely populated urban areas. The high population density in an area is one factor that facilitates the transmission of pulmonary TB. High infection occurs in families and households with close contact with TB patients [7]. Another factor influencing TB transmission is the level of literacy related to the cause, mode of transmission, preventive behavior, diagnosis, and treatment of pulmonary TB. The instruments for TB literacy are not yet available and need to be developed.

The TB literacy instrument is based on the definition of health literacy. Health literacy is related to literacy and refers to people's knowledge, motivation, and competencies in accessing, understanding, appraising, and applying health information in order to make judgments and decisions in everyday life about healthcare, disease prevention, and health promotion in order to maintain or improve their quality of life over time [8]. Health literacy aims to enable people to develop transferable abilities in obtaining, comprehending, analyzing, and applying health information, particularly tuberculosis literacy [9].

Health literacy can be measured at different levels according to skills in understanding and applying specific knowledge [10]. Several instruments have been developed and tested on Indonesian people to measure the level of General Health Literacy, including HLS-EU-SQ10-IDN, HLS-EU-Q47, and HLS-SF12 [8,11,12,13].

Instruments for measuring tuberculosis literacy must be developed and tested for validity and reliability. A valid and reliable TB literacy measurement tool can evaluate a person's TB literacy rate appropriately, and health intervention programs can be applied to a population more effectively.

2 Method

The MEASURE Approach is used in the development of TB-literacy instruments. MEASURE means Make the Purpose and Rationale. Establish an empirical framework, articulate a theoretical design, synthesize content and scale development, use expert reviewers, recruit participants, and evaluate the validity and reliability [14].

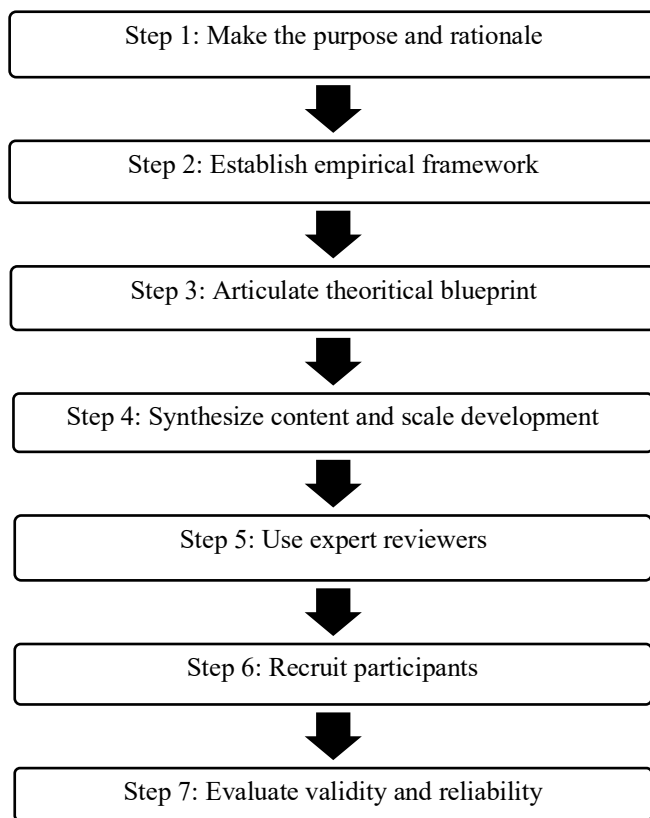


Fig. 1. Translation and validation steps in instrument development [14]

Step 1: Researchers assessed the existing literature on the proposed measurement construct to see whether an existing measure could be used/adapted or if instrument development research was required. There are 279 measures in health literacy with a wide range of health literacy fields, such as general health literacy, nutrition, maternal and infant care, mental health, oral health, non-communicable diseases (heart failure,

kidney disease, stroke), HIV, infectious diseases, the health literacy related to tuberculosis was not found [15]. However, the health literacy domain theories were established well [10,8,16]. The researcher adopted the four health literacy dimensions, i.e., acquiring information on medical or clinical concerns, understanding medical information, analyzing and evaluating medical information, making informed decisions on medical issues, and following medical recommendations [8]. The modification of those into the tuberculosis context explains the ability to access information about TB, understand TB information, evaluate TB information, and make decisions on TB issues.

Step 2: The researcher then constructs the framework by inserting the three health domains, especially in tuberculosis issues, into each dimension. The first dimension contains how to access information about the disease, the prevention, the risk factor (for example, smoking behavior), the diagnosis procedure, and prompt treatment. The second contains how to understand information about the symptoms of tuberculosis, the risk factors, and the tuberculosis treatment. The third is asking for the ability to evaluate the symptoms, prevention, environment, and behavior risk factors. Then, the last dimension contains how to decide to have preventive behavior, diagnosis behavior, and treatment behavior.

Table 1. The matrix of four dimensions applied to three health domain

	Access information relevant to health	Understand information relevant to health	Evaluate information relevant to health	Apply information relevant to health
Disease Prevention About the disease, the prevention, risk factor	L1, L2	L6	L11	L16, L17, L18
Health Care About the symptoms, diagnosis, and treatment	L3, L5	L7, L9	L13	L14, L15
Health Promotion About the social and physical environment	L4	L8	L10, L12	L19, L20

Step 3: The researcher builds the questions on each domain and dimension according to the matrix. Each question has four measurement scales, i.e., very difficult, quite difficult, quite easy, and very easy. The more questions are answered easily, the better

one's literacy level. Those scales were adapted from the HLS-EU instrument [17]. These 20 TB literacy questions provide 4 Likert-scale answers ranging from difficult to easy.

Step 4: The questions were designed by reviewing tuberculosis epidemiology, behavioral, and health literacy theories. The community health problems related to TB prevention were recognized, i.e., the TB patient's knowledge, attitude, and behavior; the TB prevention; the physical and environmental risk factors; the diagnosis and prompt treatment.

Step 5: Some practitioners and experts on Tuberculosis issues reviewed all of the TB literacy questions. Content validity involved practitioners from hospitals, TB programmers, TB activists, and community health facilitators. They advised rearranging the structure of each question, adding questions, and eliminating questions that were considered unnecessary. They added questions about assessing the importance of BCG vaccination to lower TB risk, and they preferred to exchange the word "TB" with "Tuberculosis or TBC," which was adapted to the terminology often used by Indonesians as well.

Step 6: After all questions were reviewed, face validity was conducted on ten young people (consecutively) to face the instrument. The paper-based instruments were given to them, so they tried to fulfill and comprehend each question. According to the process, the researcher did not get input on instrument improvements. All participants could understand the questions, and they did not face obstacles when answering some of these questions. The researchers then proceeded to test the instrument on a larger group.

Step 7: Validity and Reliability Analysis (Loading Factor, Average Variance Extracted, and Composite Reliability). This involved 1.411 participants in the Central Semarang Subdistrict chosen by cluster sampling technique [18,19]. The selection of participants considered the representation of each sub sub-district in Central Semarang. Enumerators collected data through direct interviews by visiting the participants' homes. Participants were heads of families or adults representing one household who were willing to be involved in the study by signing an informed consent form.

The stages of construct validity and reliability tests were as follows:

1. The Pearson product-moment correlation test was used to determine the validity of each item by comparing its score to the overall score. An item was valid if r value $> r$ table (20). The r table value was determined from the value of degrees of freedom (df) = $n - 2$ (n = sample size, df = 1409)
2. The reliability test of the instrument by calculating the value of internal consistency (Crönbach alpha). An instrument was reliable if it had a high-reliability value (Crönbach alpha > 0.70) (21). For an instrument that is still in development, Crönbach alpha > 0.60 could be accepted [22]

3. The confirmatory factor analysis (CFA) ensured that items represented construct (Dachlan, 2014). The Goodness of fit criteria for CFA are [22]: (1) Item loading factor > 0.4; Chi-square p-value >0.05; Root mean square error of approximation (RMSEA) ≤ 0,08; Comparative Fix Index (CFI) > 0.90; Standardized root means square residual (SRMR) <0.08; Average variance extracted (AVE) >0.5 Composite reliability (CR) >0.7

The study was conducted under ethical committee permission No. 240/KEPK/EC/2018.

3 Result and Discussion

3.1 The Characteristics of Participants

This survey is conducted among urban residents of the Central Semarang District. The instrument validation research included 1411 participants. Female participants dominated males by a margin of 65.41% to 34.59%. Their age ranges from 17 to 70 years (mean 48; standard deviation 12,122).

Their ages range from young to old. However, most participants ranged in age from 36 to 65 years. The participants were largely women who were housewives, while the majority of the adult men there worked both during the day and at night. Although female participants work, they do so close to their homes.

Table 2. The Characteristics of Participants (N=1411)

Variables	Categories	Frequency	Percentage (%)
Gender	Male	488	34.59
	Female	923	65.41
Age	17-25	75	5.32
	26-35	163	11.55
	36-45	318	22.54
	46-55	424	30.05
	56-65	340	24.10
	66-70	91	6.45

According to the findings of this study, women dominate men in survey participation and completion [15,16].

3.2 The Result of Validity and Reliability Test

The content validity study involves a systematic, subjective, and two-stage process. Initially, instrument design occurs, followed by a phase where experts evaluate and quantify instrument items, comparing theoretical and operational definitions. Validation is a comprehensive procedure that begins with assessing content validity. Subsequent analyses typically include evaluating reliability, establishing construct validity through factor analysis, and examining criterion-related validity. It has been demonstrated that while content validity is subjective, efforts can be made to standardize and objectify it.

Understanding content validity is crucial for clinicians and researchers, as it enables them to determine whether the instruments used in their studies are appropriate for the construct being studied, the target population, and the socio-cultural context of the study. It also informs whether new instruments need to be developed or modified. Training in content validity supports students, researchers, and clinical staff in better comprehending, utilizing, and critically evaluating research instruments more accurately [25].

The TB instruments tested construct validity and reliability on 1411 participants. They responded to 20 questions about TB literacy, and the findings were analyzed using the Pearson product-moment correlation test. Table 3 shows the test results in more detail.

Table 3. Result of Pearson product-moment correlation test (N=1411)

No	Item Variables	R value	R table	Result
L1	Find information about pulmonary TB <i>...menemukan informasi tentang TBC</i>	0.691	0.081	Valid
L2	Find out how to prevent pulmonary TB <i>...mencari tahu bagaimana cara mencegah TBC</i>	0.734		Valid
L3	Find out where to get pulmonary TB treatment <i>...mencari tahu dimana bisa melakukan pengobatan TBC</i>	0.737		Valid
L4	Get information about the risks of smoking against pulmonary TB <i>...mendapatkan informasi tentang risiko rokok terhadap TBC</i>	0.704		Valid
L5	Find a place to have a TB screening <i>...menemukan tempat untuk melakukan pemeriksaan TBC</i>	0.741		Valid
L6	Understand information about pulmonary TB from the media <i>...memahami informasi tentang TBC</i>	0.762		Valid

No	Item Variables	R value	R table	Result
L7	Understand information about the symptoms of pulmonary TB from health workers <i>...memahami informasi tentang gejala TBC dari tenaga kesehatan</i>	0.740		Valid
L8	Understand health warning information about the dangers of smoking <i>...memahami informasi peringatan bahaya rokok di media</i>	0.693		Valid
L9	Understand that pulmonary TB requires complete treatment <i>...memahami pengobatan secara tuntas penyakit TBC</i>	0.732		Valid
L10	Providing an assessment of the home/ living environment can help you stay healthy (e.g. keeping it damp, getting sunlight and fresh air in and clean) <i>...menilai kondisi lingkungan rumah dapat membantu Anda tetap sehat (misalnya menjaga kebersihan supaya tidak lembab, cahaya matahari dan udara segar dapat masuk)</i>	0.683		Valid
L11	Provide an assessment of why immunization is necessary to prevent pulmonary TB <i>...memberikan penilaian mengapa imunisasi perlu untuk mencegah TBC</i>	0.723		Valid
L12	Providing an assessment of littering & coughing behaviour can spread pulmonary TB <i>...memberikan penilaian tentang batuk sembarangan dan perilaku membuang ludah sembarangan dapat menularkan TBC</i>	0.635		Valid
L13	Provide an assessment of the signs or symptoms of pulmonary TB which requires examination at a health service <i>...memberikan penilaian tentang tanda atau gejala TBC yang memerlukan pemeriksaan ke layanan kesehatan</i>	0.672		Valid
L14	Self-examination to confirm diagnosis of TB if needed <i>.. melakukan pemeriksaan untuk memastikan status TBC</i>	0.685		Valid
L15	Treatment for TB if needed <i>...melakukan pengobatan TBC jika diperlukan</i>	0.707		Valid
L16	Make the decision not to smoke <i>...membuat keputusan untuk tidak merokok</i>	0.362		Valid
L17	Doing exercise regularly	0.497		Valid

No	Item Variables	R value	R table	Result
	<i>...melakukan kegiatan olah raga secara teratur</i>			
L18	Eating nutritious foods with attention to diversity, including eating fruits and vegetables <i>...makan makanan bergizi dengan memperhatikan keanekaragamannya (makan buah dan sayur)</i>	0.519		Valid
L19	Maintain the living conditions (room, boarding house, cottage or house) with sufficient light, adequate ventilation and not damp <i>... menjaga kondisi tempat tinggal/ rumah cukup cahaya, ventilasi dan tidak lembab</i>	0.585		Valid
L20	Drying the bedding to avoid humid conditions <i>...menjemur alas dan perlengkapan tidur agar tidak lembab</i>	0.508		Valid

Based on Table 2, the entire TB Literacy inquiry item is valid because the r value surpasses the r table. The reliability test results show that the TB literacy variable was reliable, with a Cronbach alpha value of more than 0.70 (0.925). The Crönbach alpha value of 0.925 is included in the strong category (0.91–0.93). It has been featured in major science education journals over the past year, showcasing various research examples where its application is evident. Recent surveys of studies published in respected journals indicate that Cronbach's alpha is frequently referenced; however, its usage is often not thoroughly explained, and the reported values are not always fully interpreted for readers. Despite known limitations outlined in methodological literature, science education still regards an alpha value of 0.70 as an adequate indicator of reliability or internal consistency for an instrument [26]. In line with previous research that conducted reliability tests on PATT instruments using the Rasch analysis method, it showed a very high-reliability value (a reliability index of 1.00) [24].

3.3 The Model of Confirmatory Factor Analysis

Figure 2 presents a model which relates to its dimensions and components. Almost every dimension (access, understanding, assessment, and application) has an AVE above 0.5 and a CR more than 0.7. Only the "apply" dimensions have AVE values near 0.5. The overall loading factor value for 20 literacy components is more than 0.3. It can be determined that all of the items on the TB Literacy variable are valid. Figures 2, Table 4, and Table 5 show the CFA model diagram and the results analysis.

Table 4. Construct validity and reliability test of TB literacy

Item	Dimension	Loading factor (λ)	λ^2	$\varepsilon(1 - \lambda^2)$	AVE	CR
1	Access	0.85	0.72	0.28	0.78	0.95
2	Access	0.91	0.83	0.17		
3	Access	0.90	0.81	0.19		
4	Access	0.87	0.76	0.24		
5	Access	0.89	0.79	0.21		
6	Understand	0.89	0.79	0.21	0.76	0.93
7	Understand	0.86	0.74	0.26		
8	Understand	0.85	0.72	0.28		
9	Understand	0.88	0.77	0.23		
10	Assess	0.81	0.66	0.34	0.69	0.90
11	Assess	0.85	0.72	0.28		
12	Assess	0.81	0.66	0.34		
13	Assess	0.85	0.72	0.28		
14	Apply	0.84	0.71	0.29	0.48	0.86
15	Apply	0.79	0.62	0.38		
16	Apply	0.32	0.10	0.90		
17	Apply	0.56	0.31	0.69		
18	Apply	0.71	0.50	0.50		
19	Apply	0.79	0.62	0.38		
20	Apply	0.72	0.52	0.48		

Table 5. Construct validity and reliability test of TB literacy

Goodness of Fit Criteria	Criteria Value	Value	Model Evaluation
Chi-Square Probability	≥ 0.05	0.00	Not good
RMSEA	≤ 0.08	0.04	Good
SRMR	< 0.08	0.108	Not good
TLI	≥ 0.95	0.480	Not good

Goodness of Fit Criteria	Criteria Value	Value	Model Evaluation
Coefficient of determination	1	0.998	Marginal fit
CFI	≥ 0.90	0.551	Not Fit

Table 4 shows that the overall criterion of goodness of the model is not met, so there needs to be a stage of formation of the second order. This instrument measures someone's ability to access information about tuberculosis. TB information includes prevention, treatment, the risk of smoking-related tuberculosis, and the place to have a TB screening. Acquiring and obtaining this information is essential because it is at the beginning of the learning process. Cognitions mediate behavior, so what people know and think influences their actions [27]. It is important to ensure that the information is valid. If someone has access to information but cannot be held accountable for its accuracy, this will lead to deceptive behavior. Previous research has suggested dimensions 3 and 4 are more difficult than dimensions 1 and 2. This indicates that the ability to assess the accuracy of knowledge and apply it to life is perceived to be more difficult than the ability to find and understand information [28]. Good skills in the four dimensions (access, understand, assess, and apply) contribute to a comprehensive set for tuberculosis health literacy.

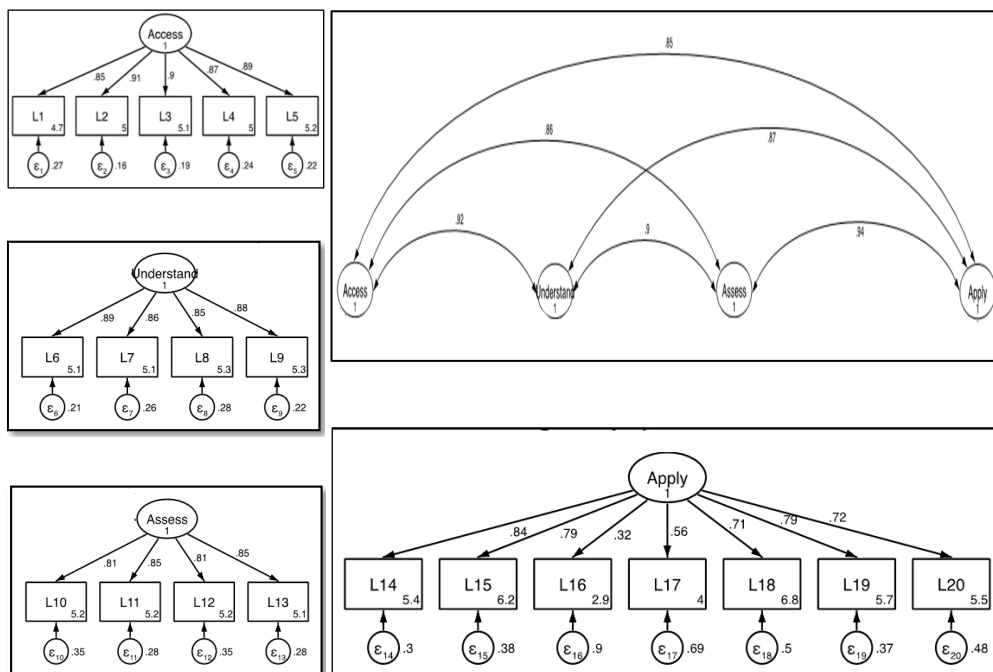


Fig. 2. Confirmatory Factor Analysis Model of TB Literacy

Several instruments used to measure literacy about tuberculosis have been developed in various countries and applied to the Saharian tribe in central India. They used the health literacy instrument on TB, which contained 20 questions about 1) symptoms of TB, 2) TB transmission, 3) TB diagnosis, 4) TB treatment, and 5) TB prevention. The composite score is categorized into three grades: low (<40), medium (41–60), and high (>60) [29]. Other studies have created tuberculosis-related health literacy tools for patients. Research conducted in China using 29 questions across four categories refers to the revised Bloom's taxonomy model. The CHLS-TB (Chinese Health Literacy Scale for Tuberculosis Patients) describes TB patients' steps to achieve good health literacy: remembering, comprehending, applying, and analyzing [30]. Both instruments measure TB literacy in four steps: accessing information, interpreting it, evaluating its relevance, and implementing it in daily activities. However, it differs in terms of the subjects measured. The TBL-20Q-IDN questionnaire has been validated to assess TB literacy in urban communities, whereas the CHLS-TB has been validated for assessing TB literacy in patients. Nonetheless, these two tests can be combined to assess health literacy about tuberculosis at various levels.

TB literacy questionnaires have been developed in some countries, but not all match the characteristics of low- and middle-income countries like Indonesia [29, 31]. Furthermore, in this study, adult subjects to assess validity and reliability ranged in age from 17 to 70 years. (Tabel 2). The resulting TB literacy questionnaire is expected to be utilized by adults of all ages.

4 Conclusion

The TB Literacy Instrument is a valid and accurate assessment of people's ability to get information about tuberculosis, understand and assess the truth of information, and apply that information in their daily lives. This instrument can be used by all genders, men and women, and those aged 17 to 70 in an urban society. Further validity and reliability testing is required to assess TB literacy in societies with diverse characteristics. Other researchers might implement various methodologies and strategies to assess the validity and reliability of the instrument's 20-question items.

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7 Conflict of Interest

This research may not result in a conflict of interest because it does not address sensitive issues and only involves people supporting the research. All authors received the right based on their collaboration.

8 Data availability statement

This data is freely accessible on the website: <https://www.sehariku.dinus.ac.id>.