



# Adaptation and validation of the Van Rie tuberculosis stigma scale in Vietnam



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## ABSTRACT

**Objectives:** Tuberculosis (TB) stigma contributes to diagnostic delay, disease concealment, and reduced wellbeing for affected individuals. Despite the availability of several TB stigma scales, most high-TB burden countries do not have a culturally validated version available. This study evaluated the Van Rie TB stigma scale (VTSS) among people with TB in Vietnam.

**Methods:** This study consisted of two phases. In phase 1, the VTSS was culturally and linguistically adapted to the Vietnamese context. In phase 2, people with TB were invited to complete a survey containing the VTSS, a depression scale, and a quality of life scale. The data analysis included confirmatory factor analysis (CFA), exploratory factor analysis (EFA), construct validity, and floor or ceiling effects.

**Results:** In phase 1, items were reworded from the third person to the first person. The TB/HIV co-infection items (items 7 and 11) were the least relevant for people with TB (62% and 73% relevance, respectively). In phase 2, the CFA demonstrated adequate goodness-of-fit indices (GFI = 0.88, CFI = 0.96, RMSEA = 0.058); however several of the item factor loadings were low. The EFA demonstrated good internal consistency ( $\alpha = 0.85$ ) and revealed one dominant factor. Construct validity was low.

**Conclusions:** The VTSS demonstrated good psychometric properties in Vietnam. Depending on the purpose of the scale, the HIV co-infection items and item 10 could be considered for removal.

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## 1. Introduction

In many settings, tuberculosis (TB) carries significant stigma. TB is a leading infectious cause of death, killing 1.45 million people each year (World Health Organization, 2019). Stigma contributes to psychological morbidity associated with the illness and impedes public health efforts to prevent and manage the disease (Corrigan et al., 2018).

Stigma describes a situation when an individual has an attribute that is undesirable or discrediting (Goffman, 1963). This

is often followed by negative attitudes towards that person, thus excluding them from society. Stigma may adversely affect the delivery of healthcare to patients in several distinct ways. Structural stigma occurs when institutional policies lead to unfair treatment of those with a stigmatizing attribute and/or decrease opportunities for patients (Coreil et al., 2010). In contrast, public or social stigma occurs when a society holds a belief about a certain group of people, resulting in a negative emotional reaction and/or stigma enacted against patients, such as in the form of discrimination (Courtwright and Turner, 2010; Woith and Larson, 2008; Yan et al., 2018). Social stigma can influence the stigmatized individual to delay health-seeking behaviours and keep their condition a secret. Finally, self (or internalized) stigma occurs when an individual internalizes the social stigma of the discrediting attribute. These forms of stigma can lead to feelings of hopelessness, fear,

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loss of identity, low self-esteem, guilt, isolation, anxiety, and depression among people with TB (Isaakidis et al., 2013; Mak et al., 2006; Morris et al., 2014; Thomas et al., 2016; Vega et al., 2004). Studies among people with TB have shown that stigma is associated with a reduced treatment adherence and poorer treatment outcomes (Courtwright and Turner, 2010; Woith and Larson, 2008; Yan et al., 2018).

Measuring and minimizing stigma is an essential component of TB prevention and care. Scales may be used to quantify a latent variable, i.e. stigma, through the evaluation of correlated observable items (DeVellis, 2016). Validated and culturally adapted scales are required to measure stigma among people with TB (Courtwright and Turner, 2010). Despite the increase in the number of TB stigma scales, there are still many high TB burden settings without a locally adapted and validated TB stigma scale. There is currently no stigma scale for measuring TB-related stigma in Vietnam, which is one of the top 30 high-burden countries for both TB and multidrug-resistant TB (World Health Organization, 2015).

The 'patient's perspective towards TB' developed by Van Rie et al. in 2008 is one of the most frequently used TB stigma scales (Van Rie et al., 2008). It is commonly referred to as the Van Rie TB stigma scale (VTSS). The VTSS contains 12 items written in the third person; for example, "Some people with TB feel..." The VTSS has been validated and used across multiple settings and has been translated into six languages including English, Thai, Malay, Portuguese, Mexican, and Turkish (Almeida Crispim et al., 2016; Beser et al., 2018; Moya et al., 2014a; Van Rie et al., 2008). It has demonstrated an internal consistency of 0.83 using Cronbach's alpha. The VTSS includes self-stigma items of blame and guilt, enacted stigma (loss of friends/others negative reactions), and anticipated stigma including non-disclosure (Van Rie et al., 2008).

The aim of this study was to culturally adapt and validate the Van Rie stigma scale for use in people with TB in Vietnam. This scale was chosen as it is the most widely used TB stigma scale, and it was developed in the same geographic region as Vietnam.

## 2. Materials and methods

### 2.1. Study setting

Vietnam is a Southeast Asian country. It is estimated that 174 000 people in Vietnam develop TB each year, corresponding to an annual incidence of 182 per 100 000 population in 2018 (World Health Organization, 2018). Treatment is provided free of charge to people with TB by the Vietnamese national TB programme. This study was conducted between November 2018 and January 2019 in three provinces of Vietnam: Hanoi and Thanh Hoa in the north and An Giang in the south. This study was performed in two phases. In phase 1, the VTSS was culturally adapted for the Vietnamese context. In phase 2, the psychometric properties of the VTSS were evaluated.

### 2.2. Study design

#### 2.2.1. Participant eligibility

A cross-sectional survey was performed among adults aged  $\geq 18$  years, diagnosed with bacteriologically confirmed pulmonary TB, who had received standardized first-line TB medications from the national TB programme for at least 2 weeks (for infection control and health reasons). Participants were deemed ineligible for the study if they were being treated for drug-resistant forms of TB, as stigma is believed to manifest differently in this population (Mitchell et al., 2018).

Trained Vietnamese researchers, independent of the national TB programme, identified eligible participants among outpatients re-

ceiving treatment at the government TB clinics attached to three regional hospitals: Hanoi Lung Hospital, Thanh Hoa Lung Hospital, and An Giang Lung Hospital. The study participants completed the survey on a tablet computer or in paper form at the TB clinic, the hospital, in a nearby café, or at the patient's home. Participants were compensated for their time with a small allowance (approximately US\$2.50).

#### 2.2.2. Sample size

The sample size was based on the number required to conduct a factor analysis, i.e. between five and seven participants per scale item (DeVellis, 2016). As the VTSS contains 12 items, the target sample size was 84 participants (i.e.,  $7 \times 12$ ) (Terwee et al., 2007).

### 2.3. Phase 1: translation and localization

The local research team included an experienced TB epidemiologist and a social science researcher. Prior to translation, the applicability of the items to Vietnam was assessed. The research team noted potential difficulties for participants responding to questions asked in the third person. Previous experiences noted that participants were unsure of how to respond to such questions, misunderstanding the question as a reference to other people with TB. The use of the first person was deemed to be more suitable for this context.

The translation process developed by Sousa and Rojjanasrirat (Sousa and Rojjanasrirat, 2011) informed the translation of the VTSS into Vietnamese. This process involved two bilingual TB researchers translating the English version of the scale into Vietnamese. The scale was then back-translated into English. A consensus meeting was held with the two translators and the study coordinator to compare and discuss the items until a consensus was made. The translated scale was piloted in 37 people with drug-resistant TB, which identified no translation or misinterpretation issues. To evaluate the adequate translation for people with TB, each item in the questionnaire was followed by "Was this question easy to understand?"

To assess the compatibility of the VTSS in Vietnam, participants were asked whether each item was relevant to people with TB ("Was this question relevant for people with TB?"). Possible responses included 'relevant', 'mostly relevant', and 'not relevant'. Items rated as being not relevant by at least 20% of participants were assessed for exclusion.

### 2.4. Phase 2: psychometric scale evaluation

Phase 2 involved the psychometric evaluation of the VTSS. This included internal consistency, construct validity, and floor or ceiling effects of the new scale.

#### 2.4.1. Internal consistency

To test the suitability of the single factor VTSS in Vietnam, a confirmatory factor analysis (CFA) with goodness-of-fit indices was conducted. The confirmatory factor analysis was conducted using structural equation modelling (SEM) analysis in IBM SPSS Amos Graphics version 21 (Arbuckle, 2014). Model fit was assessed by calculating the non-normed fit index (NNFI: close to or  $\geq 0.95$ ), comparative fit index (CFI: close to or  $\geq 0.95$ ), the root mean square error of approximation (RMSEA: close to or  $\leq 0.06$ ), and the standardized root mean square residual (SRMR: close to or  $\leq 0.08$ ) (Hu and Bentler, 1999). The analysis was conducted using IBM SPSS Amos (Arbuckle, 2014).

As some items on the CFA had low factor loading, an exploratory factor analysis (EFA) was performed using principal component analysis with Promax rotation with Kaiser normalization. Factors included in the EFA had eigenvalues  $>1$ , contained three

or more items loading  $\geq 0.4$ , and had a logical theoretical link between the items. How the items loaded onto a single factor was also assessed. Cronbach's alpha and theta coefficients  $> 0.8$  are considered to have good to very good internal consistency; scores  $< 0.7$  are not considered consistent (Tavakol and Dennick, 2011). We also evaluated the Cronbach's alpha score if the item was deleted.

#### 2.4.2. Construct validity

To enable the evaluation of construct validity, the following scales were included in the participant questionnaire: a depression scale (the Patient Health Questionnaire (PHQ-9)) and a TB-specific health-related quality of life (HR-QOL) scale (Functional Assessment of Chronic Illness Therapy–Tuberculosis (FACIT-TB)) (Abdullah et al., 2015).

Pearson's correlation coefficients ( $r$ ) were calculated to compare participant stigma scores to the related constructs of depressive symptoms and HR-QOL (Terwee et al., 2007). It was hypothesized that stigma would have a moderate positive correlation with depressive symptoms and a moderate negative correlation with HR-QOL ( $r = 0.3$  to  $0.5$ ) (Stevenson et al., 2012; Sweetland et al., 2017). It was also hypothesized that stigma would have a minimal negative correlation to all HR-QOL subscales ( $r = -0.1$  to  $-0.3$ ).

#### 2.4.3. Floor or ceiling effects

Descriptive statistics were used to ascertain the presence of floor or ceiling effects. A floor or ceiling effect occurs when  $\geq 15\%$  of participants score either the maximum or the minimum score on a scale (Terwee et al., 2007). The presence of floor or ceiling effects limits the reliability and responsiveness of the scale, as the extreme high or low scores are unable to be distinguished from each other and do not represent the true stigma score (Terwee et al., 2007).

#### 2.4.4. Data collection and analysis

Data were collected using the Open Data Kit platform (Hartung et al., 2010). Responses for each scale were summed separately, with a maximum score for the FACIT-TB of 176, and PHQ-9 of 27. Statistical analyses were conducted using IBM SPSS Statistics and RStudio (IBM Corp 2013, RStudio Team 2020).

### 3. Results

#### 3.1. Demographic characteristics

The survey was completed by 84 people with TB. The records on the number of people approached to participate in the study in Hanoi and Thanh Hoa provinces were lost; therefore it was not possible to calculate participation rates in these two provinces. However, in An Giang Province, the participation rate was 53 out of 58 eligible participants (91%), which accounted for 63% of study participants.

The mean age of participants was 45 years and the mean duration of TB treatment at the time of the survey was 3 months. Two-thirds of the participants were male, reflecting the sex ratio of people treated for TB in Vietnam (Table 1) (World Health Organization, 2017a).

#### 3.2. Phase 1 – translation and localization

The Vietnamese translation of the scale was acceptable, with  $\geq 95\%$  of the study participants stating that each item was easy to understand, with a total scale understanding score of 97.2%. The relevance of each item for people with TB ranged from 62.0% to 96.2%, with the HIV-related items (items 7 and 11) scoring the least. In total, 73.3% of participants stated that item 7 "I am afraid to tell others that I have TB because others may think that I also

**Table 1**  
Sociodemographic characteristics of 84 people with TB in Vietnam, 2018–2019

Characteristics		Total (N = 84)	
Age (years), mean (SD)		44.5 (15.0)	
Treatment length (months) mean (SD)		3.2 (1.7)	
		n	(%)
Sex	Male	56	66.7
	Female	28	33.3
Province	Hanoi	16	19.0
	Thanh Hoa	15	17.9
	An Giang	53	63.1
Marital status	Married	59	70.2
	Boyfriend/girlfriend	2	2.4
	Divorced/separated	3	3.6
	Single	15	17.9
Education	Widowed	5	6.0
	Did not complete primary school	7	8.4
	Primary school	23	27.4
	Secondary school	21	25.0
	High school	13	15.5
	College or higher	17	20.2
Occupation	Full time	21	25.0
	Part-time	8	9.5
	Self-employed	15	17.9
	Unemployed	37	44.0
	Retired	1	1.2
Tested for HIV, results	Student	2	2.4
	Yes, positive	5	6
	Yes, negative	65	77.4
	Yes, awaiting results	7	8.3
	No	7	8.3

HIV, human immunodeficiency virus; SD, standard deviation; TB, tuberculosis.

have HIV/AIDS" was relevant for people with TB. Only 62.0% of participants reported that item 11 "I am worried about having HIV/AIDS" to be relevant for people with TB. All other scale items scored  $\geq 81.8\%$  for relevance for people with TB (Table 2). Therefore, the two items relating to HIV/AIDS were considered for removal from the VTSS in Vietnam.

#### 3.3. Phase 2 – psychometric scale evaluation

##### 3.3.1. Internal consistency

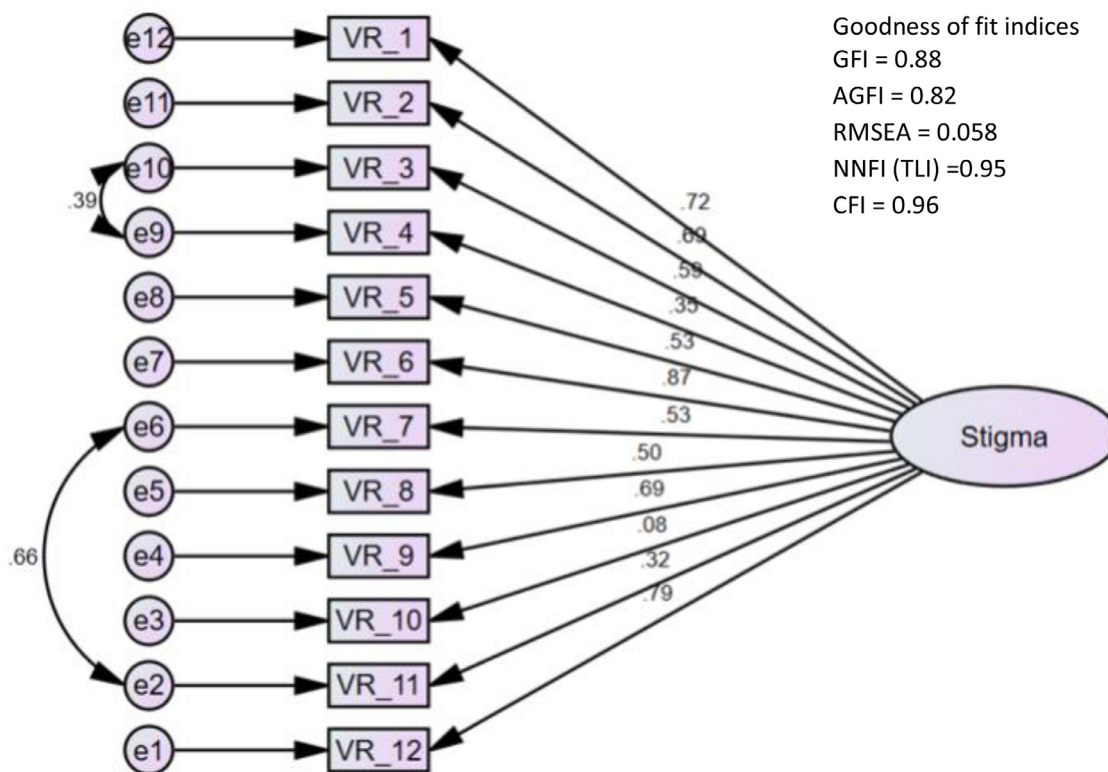
The results of the CFA are demonstrated in Figure 1. No factor loadings were significant, with the lowest coefficient seen for item 10. The CFA goodness-of-fit indices were close to or greater than the recommended threshold (Hu and Bentler, 1999). The goodness-of-fit index (GFI) was 0.88, which was close to the criterion of  $\geq 0.9$ . The comparative fit index (CFI = 0.96) and root mean square error of approximation (RMSEA = 0.058) were greater than the criteria for good model fit ( $\geq 0.95$  and  $\leq 0.06$ , respectively) (Hu and Bentler, 1999). Therefore, despite an overall good model fit for the VTSS in Vietnam, some items had lower factor loadings than ideal. To further examine the scale properties in this context, an EFA was also conducted.

The EFA identified four factors: disclosure, fear of TB/HIV co-infection, isolation, and guilt (Table 3). The four factors had Cronbach's alpha between 0.5 and 0.86. Two of these were lower than the 0.7 required for minimal consistency. Furthermore, it is preferred that subscales contain a minimum of three items, and three of the four subscales contained only two items. This could indicate that a 1-factor model would best fit this scale. Although the TB/HIV co-infection items were less relevant for people with TB in Vietnam, as mentioned in phase 1, they did load well to each other and the one component factor in the scale. The mean item score for both items was  $< 1$ , which correlates to the study participants reporting them as having low relevance for people with TB. Al-

**Table 2**  
Understanding and relevance of the Van Rie TB stigma scale among people with TB in Vietnam (N = 84)

No.	Scale item	Is this question relevant to people with TB? (%)			Was this question easy to understand? (%)		
		Yes	Sometimes	No	Yes	Mostly	No
1	I feel hurt by how others react to knowing that I have TB	84.6	5.1	10.3	95.2	4.8	0.0
2	I have lost friends when I shared with them that I have TB	83.8	10.0	6.3	97.6	2.4	0.0
3	I feel alone	81.8	10.4	7.8	98.8	1.2	0.0
4	I keep my distance from others to avoid spreading TB germs	96.2	2.5	1.3	100.0	0.0	0.0
5	I am afraid of going to TB clinics because other people may see me there	85.9	6.4	7.7	96.4	1.2	2.4
6	I am afraid to tell people outside my family that I have TB	91.3	5.0	3.8	97.6	1.2	1.2
7	I am afraid to tell others that I have TB because others may think that I also have HIV/AIDS	73.3	9.3	17.3	95.2	2.4	2.4
8	I feel guilty because my family has the burden of caring for me	87.3	7.6	5.1	98.8	0.0	1.2
9	I choose carefully who I tell about having TB	93.7	5.1	1.3	96.4	3.6	0.0
10	I feel guilty for getting TB because of my smoking, drinking, or other careless behaviours	82.3	10.1	7.6	96.4	2.4	1.2
11	I am worried about having HIV/AIDS	62.0	11.4	26.6	97.6	0.0	2.4
12	I am afraid to tell my family that I have TB	81.0	10.1	8.9	97.6	2.4	0.0

HIV/AIDS, human immunodeficiency virus/acquired immune deficiency syndrome; TB, tuberculosis.



**Figure 1.** Confirmatory factor analysis and goodness-of-fit indices of the Van Rie TB stigma scale in people with TB in Vietnam.  
TB: tuberculosis; VR: Van Rie item number; GFI: goodness-of-fit index; AGFI: adjusted GFI; RMSEA: root mean square error of approximation; NNFI (TLI): non-normed fit index (Tucker Lewis index); CFI: comparative fit index.

though item 10 “I feel guilty for getting TB because of my smoking, drinking, or other careless behaviours” was reported as relevant for people with TB in phase 1, it could be considered for removal from the VTSS in Vietnam, as it loaded low (<0.4) on both the CFA and EFA. The VTSS had very good internal consistency, with a Cronbach’s alpha of 0.85 and a theta coefficient of 0.87. No single items meaningfully reduced the alpha score (Table 3).

3.3.2. Construct validity

The reliability of the PHQ-9 was good (Cronbach’s alpha = 0.87) and the reliability of the FACIT-TB was excellent (Cronbach’s al-

pha = 0.91), therefore both scales were used to assess the construct validity of the VTSS. The VTSS had a weak positive correlation with depression ( $r = 0.20, P > 0.05$ ) and a weak negative correlation with HR-QOL ( $r = -0.21, P > 0.05$ ) (Table 4). Despite the weaker than anticipated correlations with the total depression and HR-QOL scales, three of the five HR-QOL subscales were significantly correlated with the VTSS, indicating that stigma mostly affects peoples’ emotional, social, and functional wellbeing. The correlation matrix also highlights the impact of isolation (factor 3) on HR-QOL ( $r = -0.03, P < 0.01$ ) and emotional wellbeing ( $r = -0.41, P < 0.01$ ).

**Table 3**  
Factor loadings and Cronbach's alpha of the Van Rie TB stigma scale in Vietnam

No.	Scale item	Pattern matrix for eigenvalues >1				Component matrix for 1 factor	Mean item score	Cronbach's alpha if item deleted
		1	2	3	4			
9	I choose carefully who I tell about having TB	0.901	−0.003	−0.134	−0.218	0.678	1.595	0.838
6	I am afraid to tell people outside my family that I have TB	0.846	−0.013	0.128	−0.087	0.842	1.31	0.822
1	I feel hurt by how others react to knowing that I have TB	0.762	0.137	−0.119	0.018	0.74	1.155	0.832
5	I am afraid of going to TB clinics because other people may see me there	0.742	−0.2	−0.086	0.136	0.563	0.893	0.844
2	I have lost friends when I shared with them that I have TB	0.738	−0.135	0.113	0.075	0.711	1.024	0.835
12	I am afraid to tell my family that I have TB	0.711	0.171	0.002	0.05	0.806	0.929	0.828
11	I am worried about having HIV/AIDS	−0.134	1.011	−0.121	0.025	0.476	0.833	0.849
7	I am afraid to tell others that I have TB because others may think that I also have HIV/AIDS	0.065	0.865	0.069	−0.073	0.656	0.917	0.838
4	I keep my distance from others to avoid spreading TB germs	−0.116	−0.136	1.04	−0.121	0.444	2.095	0.853
3	I feel alone	0.079	0.236	0.643	0.131	0.708	1.262	0.833
10	I feel guilty for getting TB because of my smoking, drinking, or other careless behaviours	−0.119	−0.044	−0.128	0.955	0.136	1.381	0.868
8	I feel guilty because my family has the burden of caring for me	0.249	0.051	0.13	0.59	0.579	1.548	0.841
Factor eigenvalue	4.897	1.029	1.224	1.381				
Total Cronbach's alpha	0.864	0.496	0.667	0.826	0.852		0.852	

HIV/AIDS, human immunodeficiency virus/acquired immune deficiency syndrome; TB, tuberculosis.

Extraction method: principal axis factoring. Rotation method: Promax with Kaiser normalization. Grey items represent factor loading of >0.4.

**Table 4**  
Pearson's correlation coefficients between the Vietnamese Van Rie TB stigma scale and related constructs

	Sub factors				Total Van Rie TB stigma scale (VTSS)	Hypothesized correlations	
	Factor 1: Disclosure	Factor 2: HIV co-infection	Factor 3: Isolation	Factor 4: Guilt		+/-	<sup>a</sup>
Depression (PHQ-9) (n = 84)	0.15	0.18	0.21	0.09	0.20	+	0.3–0.5
Quality of life (FACT-TB) (n = 81)	-0.12	-0.11	-0.30**	-0.12	-0.21	-	0.3–0.5
Physical wellbeing	0.07	-0.03	-0.21	-0.01	-0.02	-	0.1–0.3
Socioeconomic wellbeing	-0.18	-0.12	-0.18	-0.18	-0.23*	-	0.1–0.3
Emotional wellbeing	-0.34**	-0.18	-0.41**	-0.20	-0.42**	-	0.1–0.3
Functional wellbeing	-0.20	-0.13	-0.17	-0.12	-0.23*	-	0.1–0.3
Spiritual wellbeing	0.15	0.08	0.09	-0.08	0.12	-	0.1–0.3

FACT-TB, Functional Assessment of Chronic Illness Therapy–Tuberculosis; PHQ, patient health questionnaire; TB, tuberculosis. \* $P < 0.05$ , \*\* $P < 0.01$ .  
<sup>a</sup> + = positive correlation, - = negative correlation.

### 3.3.3. Floor or ceiling effects

No floor or ceiling effects were identified. The mean response for each stigma score ranged from 0.83 to 2.10, indicating a varied response for each item. The total VTSS scores ranged from 1 to 35, which is within the minimum and maximum scores possible (0 to 30). The VTSS scores were normally distributed (skewness = 0.20, kurtosis = -0.36) with a mean score of 14.36 (standard deviation 6.92) (Table 5).

## 4. Discussion

This study demonstrated that the VTSS had good internal consistency and content validity, with no floor or ceiling effects, in the Vietnamese context. The VTSS was considered acceptable and comprehensible to the Vietnamese population. However, some items could be considered for removal depending on the purpose of the questionnaire, and the construct validity could be improved.

The use of the VTSS in Vietnam has several important considerations. The HIV-related items could be considered for removal, as they were not reported as relevant for the target population. This is thought to be due to the low prevalence of TB/HIV co-infection in the general population in Vietnam. In Thailand, where the scale was developed, the inclusion of HIV items was indicated, as 11% of people with TB had HIV co-infection (World Health Organization (WHO), 2017a). The cultural adaptation of the Van Rie stigma scale conducted in Brazil in 2016 found that all study participants considered item 7 “I am afraid to tell others that I have TB because others may think that I also have HIV/AIDS” to be relevant, and 83.3% deemed item 11 to be relevant (Almeida Crispim et al., 2016). This relevance could be attributed to the higher prevalence of TB/HIV co-infection in Brazil (13%) (World Health Organization (WHO), 2017b). In comparison, Vietnam has a relatively low proportion of TB/HIV co-infection of 4% (World Health Organization, 2017). Even among people living with HIV in the present study population, several people were unsure how to answer these questions. Therefore, these two items could be considered for removal from the VTSS in Vietnam, depending on the purpose of the data collection.

The VTSS demonstrated a weaker than anticipated correlation between the related constructs of depression and HR-QOL. The correlations between the VTSS and four out of the five HR-QOL subscales were within the hypothesized correlation ( $r = 0.1–0.3$ ), indicating that the VTSS does have some construct validity. The original construct validity of the VTSS also demonstrated a weak correlation with the Chris O'Brien social support scale of  $r = -0.14$  (Van Rie et al., 2008). The weak correlations could indicate that either the original scale may not entirely capture important concepts relating to stigma, or the sample size may not have been large enough to detect a difference [Au23]. This concern could be addressed by including additional items that have a closer connection to stigma, developing a new scale that aligns closer with the patient experiences of stigma, or increasing the sample size.

This study found that the average standardized ( $SS_{50}$ ) TB stigma score in Vietnam (20.08) was lower when compared to Thai (27.6) and Mexican (28.3) populations, the clinically important difference is not known for the VTSS (Moya et al., 2014b; Van Rie et al., 2008). The standard deviation of the VTSS was also larger in Vietnam than in the Thai population. The lower score for the VTSS in Vietnam could be attributed to the smaller sample size used in this study, the use of the first person, or a true lower level of stigma in the Vietnamese population.

The VTSS demonstrated good internal consistency. This is congruent with other settings where the scale has been validated (Almeida Crispim et al., 2017; Lee et al., 2017; Moya et al., 2014b; Van Rie et al., 2008). This study contributes to the growing evi-

**Table 5**  
Summary of scores

Measurement	Mean	Median	SD	Minimum	Maximum	Skewness	Kurtosis
Stigma scale ( <i>n</i> = 84)	14.46	14	6.92	1	35	0.20	-0.36
Factor 1: Disclosure	6.42	7	4.52	0	18	0.22	-0.47
Factor 2: HIV co-infection	1.67	2	1.62	0	6	0.73	-0.26
Factor 3: Isolation	3.31	3	1.72	0	6	-0.37	-0.71
Factor 4: Guilt	2.86	3	1.56	0	6	-0.05	-0.62
Depression (PHQ-9) ( <i>n</i> = 84)	6.64	5	6.36	0	27	1.09	0.74
Quality of life (FACIT-TB) ( <i>n</i> = 81)	104.74	109	21.81	38	137	-0.53	-0.29
Physical wellbeing	44.48	44	12.69	12	64	-0.41	-0.44
Socioeconomic wellbeing	20.73	21	5.18	0	28	-1.21	2.68
Emotional wellbeing	32.79	35	8.12	11	44	-0.81	-0.16
Functional wellbeing	20.88	22	5.66	1	28	-1.18	1.86
Spiritual wellbeing	6.59	7	3.02	0	7	-0.20	-0.97

FACIT-TB, Functional Assessment of Chronic Illness Therapy-Tuberculosis; PHQ, patient health questionnaire; SD, standard deviation.

dence regarding the strong internal consistency of this scale in different settings.

This study has several limitations. Firstly, the use of convenience sampling may not have provided an accurate representation of the study population. Secondly, while the sample size enabled scale validation, it is insufficient to allow subgroup analyses or an exploration of patient factors associated with stigma.

An important strength of this study was its implementation in a variety of populations within Vietnam, with sites in the north and south of the country, including patients from rural and urban locations. Geographic diversity is particularly important to ensure the generalizability of this scale to the diversity of geographic and cultural contexts found across Vietnam.

The study has several important implications for the adoption of the VTSS in other settings. Firstly, this study showed the importance of assessing local interpretations of questions and adapting scales to the local context in order to enable accurate measurement. Secondly, the VTSS could be updated to improve its validity, especially regarding construct validity, by adding more stigma-related items. Finally, considering the high levels of stigma identified among the study population, interventions to address the drivers of stigma and support patients will be essential to the wellbeing of people with TB.

In conclusion, the VTSS performed well for internal consistency and content validity, and had no floor or ceiling effects. However, construct validity was lacking, highlighting an important area that could be strengthened in future versions of the scale. The use of valid, culturally relevant stigma scales that align with local constructs of the disease are essential in accurately measuring stigma in the diverse contexts in which it occurs.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Ethical approval

The Human Research Ethics Committee at the University of Sydney (2017/730) and the Institutional Review Board in Vietnam ap-

proved this study (No. 73/12/CT-HDKH-DD). All participants provided informed written consent.

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