The characteristics of occupational tuberculosis risk in healthcare workers

by Ratna Dwi Wulandari

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The characteristics of occupational Tuberculosis risk in healthcare workers

ABSTRACT

Tuberculosis remains to be one of the most common causes of morbidity worldwide, but the discourse of its prevention has disproportionately singled out the occupational risks that affect healthcare workers. In this research, we aimed to: (1) investigate the underlying factor structure of risk characteristics, specifically the risk of nosocomial TB transmission in health care facilities; (2) estimate the effects of work-related determinants and risk characteristics on risk perception; and (3) compare occupational risk perception of contracting TB with expert risk assessment. A paper-based questionnaire was administered to 179 HCWs working at ten public health centres and two hospitals in Surabaya, Indonesia. We analysed our data using exploratory factor analysis (EFA) to unravel the latent structure of risk characteristics and structural equation modelling (SEM) to identify determinants of risk perceptions. EFA revealed a two-factor solution for nine qualitative risk characteristics: controllability of damage and knowledge-evoked dread. Our SEM analysis found evidence that the controllability aspect of the TB risk was a more profound determinant in predicting risk perception than knowledge-evoked dread, implying that HCWs might benefit from training aims to increase their beliefs on the controllability of TB risk despite its severity. Although further research is necessary, our study highlights the importance of addressing occupational risk perceptions in health facilities, encouraging HCWs to become more active in advocating for the necessary allocation of resources for their workplaces, and raising communities' awareness of TB transmissions.

Keywords: healthcare workers, nosocomial TB, psychometric paradigm, risk characteristics, risk perceptions.

92 **Research Highlights**

93 1. TB prevention in healthcare settings has often ruled out risk perceptions.

94 2. Risk characteristics of nosocomial TB risks were condensed into two-factor solutions.

95 3. Believing that TB risk is dreadful but possible to control predicted risk perceptions.

96 4. Increasing the beliefs on the controllability of TB risk should be a priority.

97

INTRODUCTION

The eradication of lung tuberculosis (TB) in Indonesia, albeit its remarkable progress, is still far from over. Being ranked second as the country with the highest TB burden globally, the Indonesian government has a lot to think about controlling the spread of TB. World Health Organization (WHO) recorded that in 2018, TB incidence fell globally at 2 per cent[1] and remained the cause of the highest mortality worldwide from any infectious diseases[2,3] until 2019. In addition to this, there was a gap of 3.6 million cases between the estimated actual number of TB cases and the case notification rate (CNR), of which almost a half of the number comes from India, Indonesia, and Nigeria[1]. In Indonesia, TB incidence has been trending downward from 2000 to 2020, but in 2016 alone, the total incidence of active TB was doubled the 2015 estimated number of TB incidents, reaching a million new cases[4]. In 2020, Indonesia was ranked second as the country with the highest burden of TB, accounting for approximately 8.5 per cent of the total case globally[3].

The discourse of TB control is often too focused on the patient while lacking proper attention to preventing nosocomial infection, which affects health care workers (HCWs). Initially, nosocomial TB infection was not a priority due to the impressive progress of antibiotics therapy and declining TB incidence, mainly in high-income countries[5]. However, since around 1980, nosocomial infection as an occupational risk has been a global concern, following a multi-drug resistant (MDR) TB epidemic commonly transmitted in health care facilities from people living with HIV/AIDS[5,6]. For this context alone, 200 new TB cases had developed with mortality rates reaching 50-80 per cent[5]. A meta-analysis study further demonstrated the urgency of preventing transmission to HCWs by showing that HCWs are three times more likely to be infected with active TB than the general population due to occupational exposure to patients with active TB[7].

120 According to the hierarchy of control[8], the most effective strategy is eliminating the risk, albeit the
121 cost-effectiveness of such procedure, especially in low-resource settings, has been called into
122 question[5]. Other less powerful alternatives include using personal protective equipment and
123 performing administrative control. Although implementing a hierarchy of control has effectively
124 held down TB transmission in health care facilities, the effect of each stage in the hierarchy is
125 difficult to investigate[5]. Moreover, in developing countries with heavy TB burden, increasing
126 HCWs adherence to guidelines of TB treatment, expanding access to health care service, reducing
127 the cost of treating TB patients, achieving cost-effectiveness of implementing a hierarchy of
128 control, and increasing HCWs' efficacy to manage and to control TB infection are still daunting
129 tasks to deliver[5,9–12].

130

131 *Occupational TB risk perception*

132 Research in developing countries on occupational TB risk provided evidence that HCWs are prone
133 to contract active and latent TB due to intense interaction with TB patients since the prevalence of
134 TB cases in developing countries is often much higher. A meta-analytic study concluded that
135 HCWs, in general, are two to three times more likely to be infected with TB than the general
136 population[7]. Additionally, most hospital wards in developing countries do not meet the minimum
137 standards, and the costs of minimising and controlling the risk of TB transmission are often
138 unaffordable[13]. Prior research on TB transmission risk in HCWs also showed worrying trends –
139 confirming that in countries with high-prevalence TB cases, there is an increasing trend of TB
140 transmission risk, albeit inconsistent, that HCWs have to deal with as a part of their daily duties[9–
141 11,13–15].

142 In Indonesia, a study was conducted in 6 districts of 3 provinces and concluded that 2 out of 509
143 HCWs working at public health centres were contracting active TB. Their disease was suspected
144 to be primarily related to their occupation as an HCW[16]. Another study at a hospital in Medan,
145 North Sumatra, showed that, after a mandatory tuberculin screening test, 53 out of 100 HCWs
146 were positively diagnosed with latent TB[17]. Therefore, our study is relevant to the context in
147 Indonesia, especially TB transmission is long considered one of the most dangerous risks for
148 HCWs[5,11,13]. Preventive measures are undeniably urgent, especially in health care facilities[13].
149 Protecting HCWs from the risk of TB transmission is also morally imperative since HCWs play
150 an essential role in treating patients. Furthermore, should HCWs be contracted with TB, it would
151 also increase the possibility of spreading the disease further and infecting healthy people[18].

152 Much previous research on occupational TB risk has focused on risk reduction and assessment
153 using workplace risk analysis[19], while risk assessment is inseparable from its subjective
154 component, risk perception[20,21]. Risk perception is the less-rational, more intuitive dimension of
155 risk, of which, according to a few decades of risk perception research, has been profound in
156 affecting human reactions to imminent danger[22–24]. Health risk perception is undeniably an
157 essential factor that drives protective health behaviours since risk perception works as a "cue" for
158 individuals to immediately adopt preventive behaviours that aim to avoid or debilitate the health
159 risk. However, to bring about behavioural change, individuals must be *aware* of the health risk
160 and feel *personally* at risk[22]. In addition to this, risk perception can be deemed *absolute* or
161 *comparative*. The former posits that risk is a guesstimate of probability, ranging from low to high,
162 whether one is likely to be affected with a specific risk. On the other hand, comparative risk
163 perception evaluates how people guesstimate their likelihood of being exposed to a particular risk
164 relative to the risk others face[22].

There is a stark difference between how experts and laypeople evaluate the risk. Experts, in general, would judge the risk based on its likelihood to happen and the severity of the devastating consequences[24]. This process tends to be rational, deliberative, analytical, driven by logic and numbers, and most often, requires effortful and slower time-processing. On the other hand, laypeople would use a more complex route that involves experiential and affective elements when experiencing the risk. When one relies on an intuitive system to guesstimate certain risks, their evaluation is profoundly regulated by associations, metaphors, personal narratives attached to these risks and is bound to be self-evident. The intuitive route entails a less-cumbersome endeavour and substantially slower processing time[21,23–25].

A vast array of previous studies on the nosocomial risk of TB-affected HCWs primarily focus on identifying the risk factors while neglecting the domains where people subjectively *perceive* the risk. Studies on estimating TB nosocomial risks provided consistent pieces of evidence that HCWs who are living with people with HIV[11], have frequent interaction with people with TB[11,13], have a more extended period of years of service[6,13], work in the outpatients, wards, ER or intensive care unit[13], are more likely to contract lung TB. Furthermore, apart from appraising risk factors of TB nosocomial infection, a rare study tapped into how medical students and HCWs approximated their likelihood of contracting TB and showed that only 16.1 per cent of medical students and 52.9 per cent of HCWs in South Africa thought that it is likely or highly likely that they are at risk of developing active TB[26]. However, research investigating the determinant of TB risk perception, let alone its characteristics, among HCWs has been too scarce to be deemed conclusive.

In a workplace context, risk perception and personal evaluation of the workplace environment would determine how individuals mitigate the risk and affect the lethality of the risk and workplace safety as a whole[19]. Therefore, if workers misjudged the risk, especially when there is a gap

between risk perception and its actual danger, individuals would be reluctant to adopt preventive behaviour[20,24]. We, therefore, were interested in investigating; (a) the underlying structure of risk characteristics of TB nosocomial transmission; (b) determinants of the TB risk perception; and (c) comparing HCWs' risk perception of contracting TB with expert risk assessment.

METHODS

Participants

We planned the study in 2017, started to collect data in February 2018, and completed the data collection process by the end of 2018. We selected ten public health centres and two hospitals with the highest number of confirmed TB patient visits (>100 patients per year) in 2016 based on records provided by the Surabaya Public Health Office (*Dinas Kesehatan Kota Surabaya*) as our research sites. Our research was a cross-sectional survey involving 179 HCWs ($M_{age} = 38.04, SD_{age} = 9.31$, Female = 67.03%) who returned our questionnaires. We asked the research participants who were working at those selected health facilities, had direct interactions with TB patients at least once a week, and had worked at least six months to fill out a paper-based questionnaire after requiring them to consent to participation by signing a consent form. Before filling out the self-administered paper-based questionnaire, we provided participants with detailed information regarding the study and offered to raise any questions. Accessible records of HCWs working at all health facilities in Surabaya was not available, and therefore, we were unable to excerpt the sampling frame to allow probability sampling. Demographics data of research participants are

available in Table 1. Raw data, analysis codes, and materials of this study is available at https://osf.io/um9gk/?view_only=a7859c039b0d4d288dda60f37fe34aff.

The research was also conducted in accordance with the Helsinki Declaration and the Indonesian Psychological Association Code of Conduct (2010), and ethical clearance was obtained from the local Institutional Review Board.

Table 1. Demographics of Participants (N=179)

Demographics	%
Highest obtained education	
High school/vocational high school	5.03
Diploma	51.40
Undergraduate	19.55
Residency/professional training	21.23
Postgraduate	2.79
Occupation	
Registered Nurse	25.14
General Practitioner	15.08
Laboratory Technician	11.17
Midwives	7.82
Dentist	7.26
Nutritionist	7.26
Apothecary Assistant	5.59
Dental Nurse	5.59
Dentist Specialist	5.03
Specialist	3.91
Radiologic Technician	3.35
Apothecary	1.12
Health Promotion Officer	1.12
Environmental Health Officer	0.56
Gender	
Female	67.03
Male	32.97
Working at	
Hospital	54.49
Public Health Centre	45.51
Tuberculin screening test	
Never	93.85
At least once	6.15

Measurement

Risk Characteristics (RC) and Risk Perception. We measured RC and risk perception using the psychometric paradigm of risk perception[24]. The psychometric paradigm is a well-known framework to quantify risk perception by assuming that laypeople actively define the risk, and their perception of risk intertwines with psychological, cultural, institutional, and social factors[20,24,27]. A fundamental predicate of the psychometric paradigm is that human perception of risk works as a cognitive map that contains quantitative assessments of actual and expected dangerousness of a particular hazard and its desired control of each hazard[28,29]. Our study included nine qualitative risk characteristics commonly used in risk perceptions research: personal knowledge, expert knowledge, dread, vulnerability, severity, avoidability, controllability, catastrophic potential, and immediacy[28–30]. We asked participants to rate their occupational TB risks based on these characteristics.

The RC scale was a seven-point extreme-labelled Likert scale with options ranging from 'very low' to 'very high'. The scale contained nine items, represented nine different RCs, and was inspired and previously validated by Portell *et al*. (2014) 's study (see Table 2). However, we changed the wording to fit the context of assessing TB risks in healthcare facilities.

Table 2. Characteristics for which the Occupational TB Risk was Rated (N=179)

Risk Characteristics	*M*	*SD*
Personal Knowledge To what extent do you know the occupational risk of contracting TB as a part of your job as a health care worker? (1: Don't know at all; 7: Know very well)	1.78	1.06
Expert Knowledge To what extent you would say the health & safety officer at your health care facility knows the occupational risk of contracting TB that is likely to impact	2.68	1.54

Risk Characteristics	*M*	*SD*
health care workers in your health facility? (1: Don't know at all; 7: Know very well)		
Dread When you consider the risk of contracting TB as a part of your job, what is your level of fear? (1: No fear at all; 7: Very fearful)	4.16	2.01
Vulnerability How do you evaluate the possibility of you suffering from TB (despite severe or not, now or later) due to your occupation? (1: Very unlikely; 7: Very likely)	4.72	1.84
Severity If you were contracting TB as a part of your occupation, the severity of the illness could that be caused for you is… (1: Very mild; 7: Very serious)	4.4	1.69
Avoidability What is the possibility of you avoiding contracting TB due to your occupation as a health care worker? (1: Extremely impossible; 7: Extremely possible)	4.66	1.73
Controllability What is your level of control in terms of avoiding or reducing the possibility of contracting TB as part of your occupational risk? (1: Very low; 7: Very high)	4.98	1.68
Catastrophic Potential What is the possibility of TB transmission causing personal harm to many people at the same time? (1: Very unlikely; 7: Very likely)	5.33	1.5
Immediacy When you are exposed to TB patients, when would the most severe consequences be suffered? (1: Very much later; 7: Immediately)	3.41	1.72
Overall risk perception On a scale of 0-100, how do you assess the possibility of your risk of contracting active pulmonary TB owing to your work as a health worker? Please also consider that pulmonary TB can have a negative impact on your health that cannot be fully restored, both in the short term (immediately after exposure to risk factors) and long term. (0: Very small; 100: Very high)	66.2	18.85

Workplace Safety Questionnaire (WSQ). The WSQ is a specific instrument for measuring individuals' opinions of the risk they might have to deal with in their workplace[31,32]. The WSQ consists of eight subscales, but we only employed the relative risk and perception of safety condition subscales for this research. The relative risk scale was a three-point Likert scale consisting of 11 items asking the participants to compare the possibility of them suffering from TB to other health care workers in health care facilities. The options ranged from 'less possible' and 'equally possible' to 'much more possible'. The reliability was estimated using bootstrapped McDonald's ω[33] with 1000 iterations, and it yielded a satisfying reliability coefficient ($\omega_t = 0.98$,

245 *SE* = 0.02, 95% CI [0.93, 1.00]). We performed a reliability analysis using MBESS package in
246 R[34,35].

247 The safety condition scale was also a three-point Likert scale ranging from 'unavailable',
248 'available but in poor condition' and 'available with good conditions', which comprised eight
249 items. We requested participants evaluate the availability and condition of safety infrastructures
250 and facilities related to TB control in health care settings, such as room ventilation, exposure to
251 sunlight, washing basins with flowing water, separation of infection and non-infection wards,
252 disposable masks, particulate respirators, and medical bins with lids. The reliability was estimated
253 using the same technique and yielded a moderate reliability coefficient ($\omega_t = 0.77$, $SE = 0.04$, 95%
254 CI [0.66, 0.83]).

255 *TB Risk Assessment*. To estimate the risk of contracting TB in a health care setting, we interviewed
256 health and safety (H&S) officers of public health centres and hospitals using the modified
257 Tuberculosis Risk Assessment Worksheet (TRAW)[36]. We modified the worksheet to suit the
258 context of Indonesia's healthcare service. The worksheet was applied to aid the H&E officer
259 performs initial and ongoing evaluations of TB transmission control in health care facilities. We
260 designed two separate scales for hospitals and public health centres by adjusting the wording to
261 suit the context of different types of health care facilities. We conducted structured interviews with
262 H&S officer of each health care facility by asking questions surrounding the number of TB
263 inpatients and outpatients (including TB MDR cases), managerial control, administrative and
264 environmental control, the availability of TB control guidelines in the health care facility as well
265 as the H&S officer's understanding of the guidelines, availability of training for preventing TB
266 infection for HCWs, health care facilities' policy on regular TB screening for HCWs, the condition

of health care facility infrastructure and the availability and use of personal protective equipment (PPE).

After the interviews, we passed the worksheets to an independent risk expert and asked them to estimate the likelihood of HCWs contracting active TB in two ways. First, the risk expert estimated aggregated risk of contracting TB for each health care facility – if the risk would differ across facilities. Second, the expert estimated the risk of contracting TB for each health care worker profession working in the health care facility – assuming that the risk would be unequal for different professionals even though they worked at the same health care facility (for example, the risk of contracting TB would be different between GPs and nurses). The first risk assessment was dubbed aggregated risk of contracting TB in health care facilities ($M = 60.35$, $SD = 2.79$), and the second was labelled profession-based risk of contracting TB ($M = 65.45$, $SD = 12.76$). The expert assessed risk by allocating a score ranging from 0 (no identifiable risk of TB transmission) to 100 (very high risk of TB transmission).

Data analysis

Our first research aimed to identify the factor structure of RC. Thus, we performed exploratory factor analysis on nine RC with varimax rotation and minimum residual as a factoring method. This analysis was purely exploratory because different risks might lead to different RC factors[28,37], and the common findings in previous risk perceptions research are that risk characteristics can be reduced into a few numbers of factors, often two or three factors[28]. The next step was to enter the newly identified factors of RC into the structural equation model (SEM).

SEM model parameters were estimated using the diagonally weighted least squares (DWLS) method with the lavaan package[38] in R, since we included ordinal observed variables in our model. To estimate the model parameter, DWLS estimator requires a polychoric correlation matrix and thus is superior to the standard maximum likelihood estimation under the condition of including ordinal indicator variables in the model[39]. The corrected version of DWLS estimator available in the lavaan package produces robust standard errors and fit statistics even though the predictors do not follow a normal distribution[40]. We assessed the model's overall fit using absolute (X^2 and SRMR) and incremental (RMSEA, CFI, and TLI) fit indices[40,41]. The relative risk and perceived safety conditions were latent variables, and we specifically declared that all of its indicators were ordinal. Finally, we compared risk perception ($W = 0.927, p < .001$) with the aggregated risk of contracting TB ($W = 0.865, p < .000$) and profession-based risk of contracting TB ($W = 0.770, p < .001$) via Mann-Whitney comparison testing as all variables do not follow a normal distribution.

RESULTS

Factor Structure of Risk Characteristics (RC)

Before performing the factor analysis, we conducted several assumption tests to verify whether factor analysis was necessary. The Bartlett test of sphericity ($X^2(36) = 404.212, p < .001$) showed that our variables were related and suitable for factor reduction. KMO of sampling adequacy (KMO = 0.741) and overall MSA (MSA = 0.74) indicated that underlying latent factors might cause a considerable variance in our variables. Thus, this supported that factor analysis was suitable for data reduction.

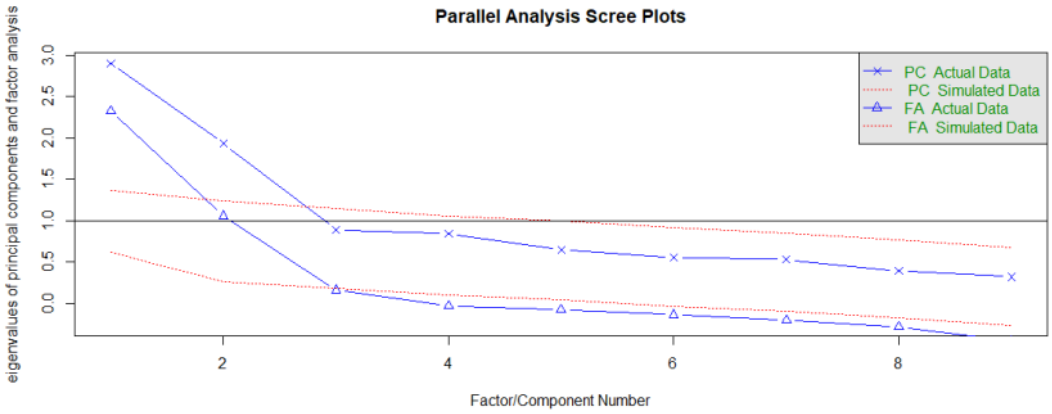

Figure 1. Parallel Analysis Scree Plot of Risk Characteristics (N=179)

We conducted a parallel analysis using a maximum likelihood estimation (MLE) as the factoring method to determine how many factors should be extracted. The analysis subsequently showed that two factors were adequate and yielded eigenvalues more than one (see Figure 1). Two factors were reliably identified in the subsequent exploratory factor analysis using the minimum residual factoring method (Tucker-Lewis Index of factoring reliability = 0.918, RMSEA = 0.06 [95% CI $0.02, 0.11]$, $X^2(19) = 34.87, p = .014$) and those latent factors are *controllability of damage* (Factor 1) which accounted for 26% of the variance. In contrast, *knowledge-evoked dread* (Factor 2) accounted for 15% of the variance.

Vulnerability, avoidability, controllability, and catastrophic potential were grouped into *controllability of damage*, while personal and expert knowledge and immediacy were in *knowledge-evoked dread* factor. On the other hand, severity and dread were highly loaded in both Factor 1 and 2 and yielded the highest communalities, signalling that these risk characteristics are more profound than the rest. Participants inclined to higher controllability of damage would perceive nosocomial TB risks as more dreadful and severe but are more assured to control and

avoid it. On the other hand, a higher knowledge-evoked dread implied that participants were more knowledgeable about the severity and the dreadfulness of nosocomial TB risks, believed that their H&S experts in the facilities were, too, proficient in handling the risks, and thought that the worst consequences of contracting TB risk would emerge immediately.

We subsequently examined the reliability of RC scale using McDonald's ω and yielded a somewhat satisfying coefficient ($\omega_t = 0.77$). Factor loadings of all RC are presented in Table 3.

Table 3. Exploratory Factor Analysis Across Nine Risk Characteristics (RC) (N=179)

RC	Controllability of Damage (Factor 1)	Knowledge-evoked Dread (Factor 2)	Communality
Personal Knowledge		0.590	1.2
Expert Knowledge		0.615	1.0
Dread	0.395	0.513	1.9
Vulnerability	0.499		1.2
Severity of consequences	0.749	0.397	1.5
Avoidability	0.600		1.1
Controllability	0.659		1.1
Catastrophic potential	0.760		1.0
Immediacy		0.346	1.0
% Variance accounted for	26%	15%	41%

Note: An exploratory factor analysis with varimax rotation and minimum residual as a factoring method was employed. Only factor loadings ≥ 0.3 are reported.

Identifying Determinants of Risk Perception

We performed structural equation modelling (SEM, see Figure 2) to test our hypotheses. Initially, our model was poorly fitted. Thus, we made a few modifications by allowing observed variables that were indicators of relative risk to co-vary. After examining absolute and incremental goodness-of-fit indices, the modified model was overall a close fit ($X^2(536) = 1030.09$, $p < .001$,

CFI = 0.961, TLI = 0.964, RMSEA = 0.072 [90% CI 0.066, 0.079], p RMSEA < .001, SRMR=0.113).

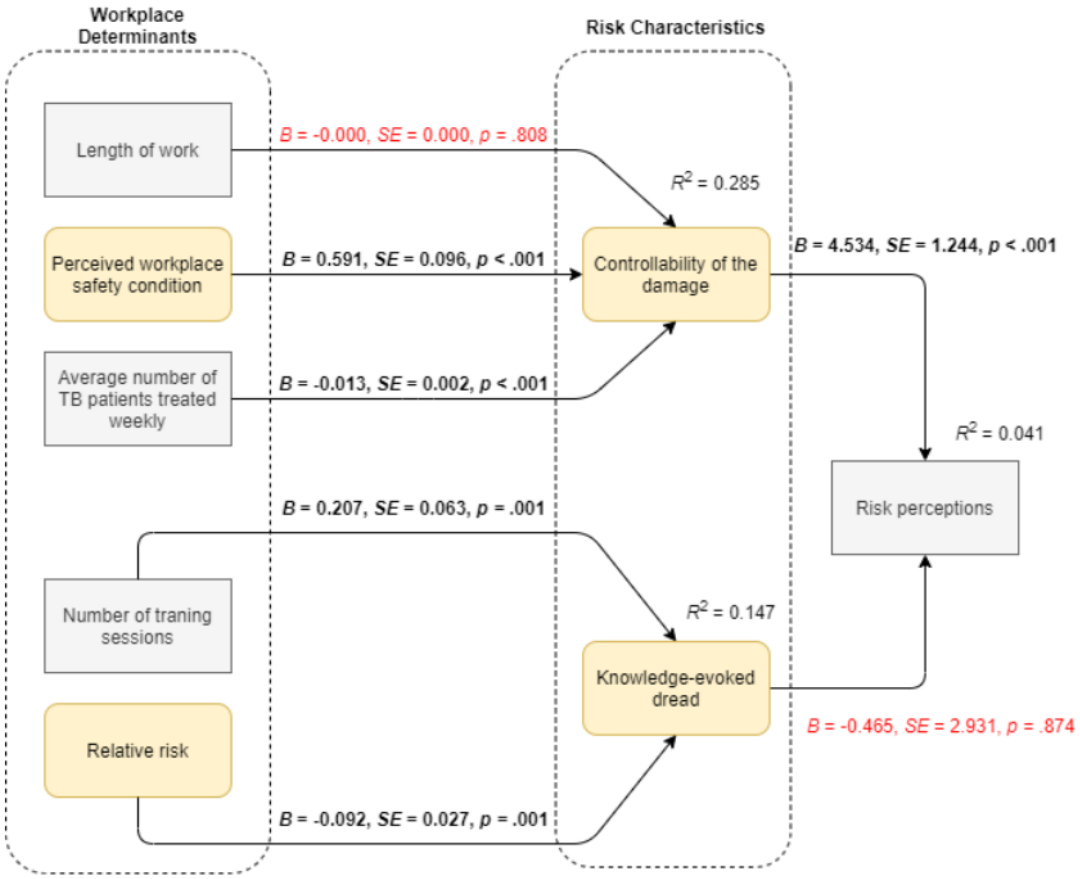

Figure 2. Structural Model of Risk Perceptions Determinants (N=179). Notes: yellow boxes are latent variables; grey boxes are observed variables.

Our model indicated that the controllability of damage (B = 4.534, SE = 1.244, p < .001) was positively related to overall risk perceptions, while we failed to find evidence that knowledge-evoked dread (B = -0.465, SE = 2.931, p = .874) predicted risk perceptions. Additionally, perceived

safety conditions (B=0.306, p=.006) yielded a positive and moderate association to the controllability of damage. At the same time, the average number of TB patients treated per week (B=-0.362, p=.003) was negatively correlated to the controllability of damage, which means that a higher number of treating TB patients was associated with less controllability of damage. The number of training sessions (B=-0.150, p=.259) nor relative risk (B=0.128, p=.150) substantially explained knowledge-evoked dread.

Before testing our main hypotheses, we failed to plan our sample size *a priori* while this process is essential to justify the sample size in detecting an effect size optimally. In SEM analysis, the size of an effect stems from the degree of discrepancy between the saturated, more restrictive model with the general, hypothesised model[42]. Therefore, we carried out a *post hoc* power analysis which aims to estimate the achieved power of our model given to the sample size by accounting for the observed model effect size, which is the root mean squared error approximation (RMSEA), the model degree of freedom, a specified α error probability (0.05), and the sample size. We ran the analysis using semTools[43] package in R, and the observed power was 0.9997, which implied that the probability of falsifying our model when it is actually wrong in the population was 99.97 per cent. However, we can only obtain information about *observed* power, and it often does not reflect the true power of detecting the actual, true effect size in the population, so that cannot be translated as such[44].

Comparing Expert Risk Assessment with Risk Perception

After carrying out a Mann-Whitney test, we found no evidence to confirm a significant difference (W = 15180, p = .385) between HCWs self-rated risk perceptions (Mdn = 65) and profession-based actual risk assessed by our risk expert (Mdn = 70) with a trivial effect size (r = 0.045 [95% CI

0.002, 0.157]). However, there was a suggestive difference ($W = 18338$, $p = .016$) between HCWs' risk perceptions and aggregated actual risk of contracting TB in health care facilities according to our risk expert (*Mdn* = 58), albeit only via relatively small effect size ($r = 0.127$ [95% CI 0.014, 0.253]).

DISCUSSION

Prior research on the relationship between risk perception and self-protective behaviour highlighted an essential conclusion that individuals' beliefs are critical determinants to their actions towards risk[45–47]. We, therefore, aimed to investigate the determinants of HCW's risk perception of contracting TB as an occupational risk. We identified RC's underlying factors since risk perceptions are generally based on RC[21,37,47]. Thus, we hypothesised that RC would mediate the relationship between work-related determinants and risk perceptions.

Our exploratory factor analysis yielded a two-factor solution and was supported by prior research that argues the factor structure of RC can differ depending on the hazard[28,48] but most often are condensed into two or three-factor solutions[28,49]. In our findings, dread and severity were loaded in both latent factors, indicating that these risk characteristics are more pivotal than other characteristics. Interestingly, the immediacy showed a similar pattern to the previous research by appearing in the same factor as an expert and personal knowledge, indicating that the unknown risk is expected to have a more long-term impact. In contrast, better-known risk tends to be associated with more immediate consequences.

Factor 2 (controllability of damage) consisted of not only preventive-related (avoidability, controllability, and vulnerability) but also protection-related characteristics (dread, severity of consequences, and catastrophic potential). Preventive-related characteristics reflect the degree of efficacy in controlling the risk of TB transmission, while protection-related characteristics focus

398 on the likelihood of mitigating the damage caused by TB transmission. In the context of
399 nosocomial TB transmission, this pattern seems sensible because HCWs understand that TB can
400 cause severe damage to their health in the long run but believe that there are many ways to
401 control and avoid it.

402 After performing the structural equation modelling, we found that the number of training does
403 not significantly affect knowledge-invoked dread, indicating insufficient evidence to support the
404 positive association between the number of training and knowledge-related RC. We expected the
405 relative risk to be positively associated with knowledge-related RC because we assumed that it
406 could be a cue for HCWs to gain knowledge related to TB transmission risk that they have to
407 handle. We indeed found a substantial, albeit tiny and negative, effect of relative risk to
408 knowledge-related RC. Our findings suggest that when participants believed that other HCWs
409 are exposed to a higher occupational TB risk than themselves, they would be less likely to think
410 that the TB risks are severe, dreadful, and immediate; and less motivated to gain knowledge
411 regarding the TB risks. Our conclusion aligns with prior findings in risk research that, when
412 assessing their risks, individuals who are too favourably comparing themselves against others
413 show evidence of unrealistic comparative optimism[22,23,50], and potentially leads to
414 underestimating risk. However, interestingly, we did not find convincing evidence that
415 knowledge-evoked dread could affect risk perception, which implied that HCWs relied on a
416 more intuitive judgment than what they or H&S officers know about the risk of TB transmission
417 or the dreadfulness of being infected with TB when assessing their likelihood of suffering from
418 TB infection.

419 A systematic review provides evidence that a longer duration of employment leads to a higher
420 risk of contracting TB in health care settings[51]. However, our research demonstrated that the

length of work did not significantly contribute to HCW's perceived hazard control. On the other hand, we anticipated a positive correlation between more intense contact with TB patients (more TB patients to be treated) and controllability of damage, but it yielded a negative yet moderate correlation. Thus, HCWs with higher exposure to TB patients believed that TB risk is dreadful and severe but were less confident in avoiding the risk of TB transmission by seeing it as less controllable. Based on our findings, it would be safe to assume that the more an HCW retains contact with a TB patient, the more likely they feel less confident of avoiding the risk. Repeated and daily exposure of TB patients makes HCWs more vulnerable to the risk of TB transmission and, simultaneously, leads to the fatalism beliefs that TB risks are somehow uncontrollable and unavoidable. Compared to knowledge-evoked dread, controllability of damage seemed to be a more critical aspect predicting risk perceptions. Therefore, assuring HCWs that TB risks are controllable despite their severity and having all the resources should be the cornerstone of any workplace interventions.

We asked participants to rate the condition of safety infrastructure in their workplace and the availability of personal protective equipment for reducing the possibility of TB transmission. Aligning with our hypothesis, participants who reported better safety infrastructure were more likely to feel confident in controlling or avoiding the risk of TB transmission. We assumed that safety infrastructure and the availability of protective equipment might be helpful to limit hazard exposure and serve as a nudge against the presence of a hazard. Therefore, providing protective equipment and better safety infrastructure might indirectly arouse higher risk perception and lead to the higher motivation to avoid the hazard.

We compared the expert assessment of TB transmission for each health care facility with (subjective) risk perception. We found no substantial difference between HCWs' self-rated risk

perception and profession-based risk, implying that our participants might have almost accurately estimated the risk of contracting TB. However, there was a slight difference between the aggregated risk of TB transmission assessed by our risk expert and HCWs self-rated risk perceptions, where the median of participants' risk perception was higher than assessed by our risk expert. Our findings concluded that HCW might overestimate the risk of TB transmission if the actual risk was aggregated at the health care facility level. We, nonetheless, believe that further research is necessary to improve the accuracy of risk assessments. The risk expert only relied on secondary data to estimate the TB transmission risk in this study. In contrast, a more comprehensive risk assessment that includes the detection of the prevalence of latent TB infections could improve the accuracy of risk estimation.

Our study has several limitations. First, the limitation is not to compare the TB transmission risk with other occupational hazards. Although we were only interested in investigating TB transmission, allowing other hazards in the model might result in multivariate analyses, leading to a more convincing finding[48]. Second, while investigating how HCW perceive the risk of TB nosocomial transmission is helpful to infer how they respond by performing or not performing preventive behaviours[52], risk perception and safety efficacy beliefs are very dependent on the context[28]. Performing systematic procedures to obtain information on HCW risk perception might be helpful to H&S safety officers to characterise the perception of a specific hazard in a particular workplace context. Addressing HCW risk perception can be a good start to encourage HCW to be more involved in advocating a necessary resource allocation or even helping to raise laypeople awareness of TB transmission[53], especially in the context of high TB burden countries such as Indonesia. At last, due to the nature of our research context, obtaining a sampling frame and thus performing probability sampling was not technically possible since there were no

accessible records on HCWs who worked at all health facilities in Surabaya. For this reason, the representativeness of our sample, as well as the generalisability of our findings, are not warranted.

REFERENCES

1. World Health Organisation (WHO). *Global Tuberculosis Report 2018*. World Health Organization; 2018. doi:10.1016/j.pharep.2017.02.021

2. Harding E. WHO global progress report on tuberculosis elimination. *Lancet Respir Med*. 2020;8(1):19. doi:10.1016/S2213-2600(19)30418-7

3. Chakaya J, Khan M, Ntoumi F, et al. Global Tuberculosis Report 2020 – Reflections on the Global TB burden, treatment and prevention efforts. *Int J Infect Dis*. 2021;113:S7-S12. doi:10.1016/j.ijid.2021.02.107

4. Bimantara JG. Tuberkulosis di Indonesia Terbanyak Kedua di Dunia. Kompas. Published 2016. Accessed September 16, 2016. http://print.kompas.com/baca/sains/kesehatan/2016/03/24/Tuberkulosis-di-Indonesia-Terbanyak-Kedua-di-Dunia

5. Menzies D, Joshi R, Pai M. Risk of tuberculosis infection and disease associated with work in health care settings. *Int J Tuberc Lung Dis*. 2007;11(6):593-605.

6. Mirtskhulava V, Kempker R, Shields K, et al. Prevalence and risk factors for latent tuberculosis infection among health care workers in Georgia. *Int J Tuberc Lung Dis*. 2008;12(5):513-519. doi:10.1371/journal.pone.0066412

7. Uden L, Barber E, Ford N, Cooke GS. Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. *Open Forum Infect Dis*. 2017;4(3):1-7. doi:10.1093/ofid/ofx137

8. de Castro AB. "Hierarchy of controls." *Am J Nurs*. 2003;103(12):103-104.

9. Cuhadaroglu C, Erelel M, Tabak L, Kilicaslan Z. Increased risk of tuberculosis in health care workers: A retrospective survey at a teaching hospital in Istanbul, Turkey. *BMC Infect Dis*. 2002;2:14. doi:14

10. Evans TG, Bekker LG. Tuberculosis and Healthcare Workers in Underresourced Settings. *Clin Infect Dis*. 2016;62(Suppl 3):S229-S230. doi:10.1093/cid/ciw015

11. Tudor C, Van Der Walt ML, Margot B, et al. Occupational Risk Factors for Tuberculosis among Healthcare Workers in KwaZulu-Natal, South Africa. *Clin Infect Dis*. 2016;62(Suppl 3):S255-S261. doi:10.1093/cid/ciw046

12. Verkuijl S, Middelkoop K. Protecting Our Front-liners: Occupational Tuberculosis Prevention Through Infection Control Strategies. *Clin Infect Dis*. 2016;62(Suppl 3):231-237. doi:10.1093/cid/civ1184

13. Alonso-Echanove J, Granich R, Laszlo A, Chu G, Borja N, R B. Occupational transmission of Mycobacterium tuberculosis to health care workers in a university hospital in Lima, Peru. *Clin Infect Dis*. 2001;33(5):589-596.

14. Escombe AR, Huaroto L, Ticona E, et al. Tuberculosis transmission risk and infection control in a hospital emergency department in Lima, Peru. *Int J Tuberc Lung Dis*. 2010;14(9):1120-1126. doi:10.1016/S0140- 6736(10)62173-3

15. Apriani L, McAllister S, Sharples K, et al. Latent tuberculosis infection in healthcare workers in low- and middle-income countries: an updated systematic review. *Eur Respir J*. 2019;53(4). doi:10.1183/13993003.01789-2018

16. Tana L. Gambaran TB Paru pada Pekerja Puskesmas di Enam Kabupaten Kota di Indonesia (Pulmonary Tuberculosis among Primary Health Center Workers in 6 Districts in Indonesia). *Bul Penelit Sist Kesehat*. 2014;177(3):319-325.

17. Martin U, Hasibuan P. Prevalens TB Laten Pada Petugas Kesehatan Di RSUP H. Adam Malik Medan. *J Respirasi Indones*. 2010;30(2):113-118.

18. Boulanger RF, Hunt MR, Benatar SR. Where Caring Is Sharing: Evolving Ethical Considerations in Tuberculosis Prevention among Healthcare Workers. *Clin Infect Dis*. 2016;62(Suppl 3):S268-S274. doi:10.1093/cid/ciw013

19. Arezes PM, Miguel AS. Risk perception and safety behaviour: A study in an occupational environment. *Saf Sci*. 2008;46(6):900-907. doi:10.1016/j.ssci.2007.11.008

20. Slovic P, Fischhoff B, Lichtenstein S, Roe F. Perceived risk: psychological factors and social implications. In: *Proceeding of the Royal Society of London*. Vol 376. The Royal Society; 1981:17-34.

21. Slovic P, Peters E. Risk Perception and Affect. *Curr Dir Psychol Sci*. 2006;15(6):322-325. doi:10.1111/j.1467-8721.2006.00461.x

22. Schmälzle R, Renner B, Schupp HT. Health Risk Perception and Risk Communication. *Policy Insights Behav Brain Sci*. 2017;4(2):163-169. doi:10.1177/2372732217720223

23. Ferrer R, Klein WM. Risk perceptions and health behavior. *Curr Opin Psychol*. 2015;5:85-89. doi:10.1016/j.copsyc.2015.03.012

24. Slovic P. Perception of Risk. *Science*. 1987;236(4799):280-285.

25. Slovic P, Finucane ML, Peters E, MacGregor DG. Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality. *Risk Anal*. 2004;24(2):311-322. doi:10.1111/j.0272-4332.2004.00433.x

26. Van Rie A, McCarthy K, Scott L, Dow A, Venter WDF, Stevens WS. Prevalence, risk factors and risk perception of tuberculosis infection among medical students and healthcare workers in Johannesburg, South Africa. *S Afr Med J*. 2013;103(11):853. doi:10.7196/samj.7092

27. Slovic P. Risk Perception and Risk Analysis in a Hyperpartisan and Virtuously Violent World. *Risk Anal*. 2020;40(S1):2231-2239. doi:10.1111/risa.13606

28. Portell M, Gil RM, Losilla JM, Vives J. Characterising Occupational Risk Perception: the Case of Biological, Ergonomic and Organisational Hazards in Spanish Healthcare Workers. *Span J Psychol*. 2014;17:E51. doi:10.1017/sjp.2014.55

29. Siegrist M, Keller C, Kiers HAL. A New Look at the Psychometric Paradigm of Perception of Hazards. *Risk Anal*. 2005;25(1):211-222. doi:10.1111/j.0272-4332.2005.00580.x

30. Fischhoff B, Slovic P, Lichtenstein S, Read S, Combs B. How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sci*. 1978;9(2):127-152. doi:10.1007/BF00143739

31. Leiter MP, Zanaletti W, Argentero P. Occupational risk perception, safety training, and injury prevention: testing a model in the Italian printing industry. *J Occup Health Psychol*. 2009;14(1):1-10. doi:10.1037/1076-8998.14.1.1

32. Leiter MP, Robichaud L. Relationships of occupational hazards with burnout: an assessment of measures and models. *J Occup Health Psychol*. 1997;2(1):35-44. doi:10.1037/1076-8998.2.1.35

33. Kelley K, Pornprasertmanit S. Confidence intervals for population reliability coefficients: Evaluation of methods, recommendations, and software for composite measures. *Psychol Methods*. 2016;21(1):69-92. doi:10.1037/a0040086

34. Kelley K. *MBESS: The MBESS R Package*.; 2018. https://CRAN.R-project.org/package=MBESS

35. R Core Team. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing; 2019. https://www.R-project.org/

36. Jensen PA, Lambert LA, Iademarco MF, Ridzon R. *Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Settings, 2005*. Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention; 2005. Accessed March 10, 2022. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm?s_cid=rr5417a1_e

37. Marris C, Langford I, Saunderson T, O'Riordan T. Exploring the "psychometric paradigm": Comparisons between aggregate and individual analyses. *Risk Anal*. 1997;17(3):303-312. doi:10.1111/j.1539-6924.1997.tb00868.x

38. Rosseel Y. lavaan: An R Package for Structural Equation Modeling. *J Stat Softw*. 2012;48(2):1-36. doi:10.18637/jss.v048.i02.

39. Li CH. The performance of ML, DWLS, and ULS estimation with robust corrections in structural equation models with ordinal variables. *Psychol Methods*. 2016;21(3):369-387. doi:10.1037/met0000093

40. Beaujean AA. *Latent Variable Modeling Using R: A Step-by-Step Guide*. Routledge; 2014. doi:10.4324/9781315869780

41. Iacobucci D. Structural equations modeling: Fit Indices, sample size, and advanced topics. *J Consum Psychol*. 2010;20(1):90-98. doi:10.1016/j.jcps.2009.09.003

42. Jobst L, Bader M, Moshagen M. A Tutorial on Assessing Statistical Power and Determining Sample Size for Structural Equation Models. *Psychol Methods*. Published online June 9, 2021. doi:10.1037/met0000423

43. Jorgesen TD, Pornprasertmanit S, Schoemann AM, Rosseel Y. *SemTools: Useful Tools for Structural Equation Modeling*.; 2021. https://CRAN.R-project.org/package=semTools

44. Zhang Y, Hedo R, Rivera A, Rull R, Richardson S, Tu XM. Post hoc power analysis: is it an informative and meaningful analysis? *Gen Psychiatry*. 2019;32(4):e100069. doi:10.1136/gpsych-2019-100069

45. Slovic P. Perception of Risk: Reflection on the Psychometric Paradigm. In: Krimsky S, Golding D, eds. *Social Theories of Risk*. Praeger Publisher; 1992.

46. Zein RA, Suhariadi F, Hendriani W. 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. *Psychol Res Behav Manag*. 2017;10:187-194. doi:10.2147/PRBM.S134034

47. Kouabenan DR, Dubois M, Gaudemaris R De, Scarnato F, Mallaret MR. Methicillin-Resistant Staphylococcus Aureus Risk Perception By Healthcare Personnel in a Public Hospital. *Soc Behav Personal Int J*. 2007;35(1):89-100. doi:http://dx.doi.org/10.2224/sbp.2007.35.1.89

48. Kraus NN, Slovic P. Taxonomic Analysis of Perceived Risk: Modeling Individual and Group Perceptions Within Homogeneous Hazard Domains. *Risk Anal*. 1988;8(3):435-455. doi:10.1111/j.1539-6924.1988.tb00508.x

49. Bronfman NC, Cifuentes LA. Risk Perception in a Developing Country: The Case of Chile. *Risk Anal*. 2003;23(6):1271-1285. doi:10.1111/j.0272-4332.2003.00400.x

50. Edmonds KA, Rose JP, Aspiras OG, Kumar MS. Absolute and comparative risk assessments: evidence for the utility of incorporating internal comparisons into models of risk perception. *Psychol Health*. Published online July 19, 2021:1-17. doi:10.1080/08870446.2021.1952585

51. Alele FO, Franklin RC, Emeto TI, Leggat P. Occupational tuberculosis in healthcare workers in sub-Saharan Africa: A systematic review. *Arch Environ Occup Health*. 2018;8244:1-14. doi:10.1080/19338244.2018.1461600

52. Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein ND. Meta-analysis of the relationship between risk perception and health be havior: The example of vaccination. *Health Psychol*. 2007;26(2):136-145. doi:10.1037/0278-6133.26.2.136

53. Nathavitharana RR, Bond P, Dramowski A, et al. Agents of change: The role of healthcare workers in the prevention of nosocomial and occupational tuberculosis. *Presse Med*. 2017;46(2):e53-e62. doi:10.1016/j.lpm.2017.01.014

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