# OCCUPATIONAL RISK FACTORS FOR TUBERCULOSIS AMONG MYANMAR MIGRANT WORKERS IN SONGKHLA PROVINCE, THAILAND

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**ABSTRACT**
Tuberculosis (TB) remains a major global health burden, disproportionately affecting migrant populations. Myanmar migrant factory workers in Southern Thailand may be at elevated occupational risk due to crowded and poorly-ventilated environments. This study aims to describe the socio-demographic characteristics and occupational risk factors for TB among Myanmar migrant factory workers in Songkhla Province, Thailand. We conducted a cross-sectional study among 330 Myanmar migrant workers in six factories. We collected data using a structured self-administered questionnaire covering socio-demographic characteristics and occupational risk factors. We then entered data using KoboToolbox and analyzed data using descriptive statistics. Most participants were female, Bamar, and Buddhist, with a mean age of 31.2 years. Regarding occupational conditions, 63.0% of the participants reported that their main work area had good airflow. Nearly 24.2% experienced visible dust daily, and 59.7% worked in crowded spaces. Most participants (88.2%) were unaware of any co-workers with TB in the past year. Our study findings provide baseline evidence to inform the design of targeted occupational health interventions and TB prevention strategies in factory settings.
**Keywords:** Tuberculosis, Occupational Risk Factors, Migrant Workers, Myanmar, Thailand

## INTRODUCTION

Tuberculosis (TB) remains a significant global public health burden, with an estimated 10.8 million people affected and approximately 1.25 million deaths in 2023 (WHO, 2024). It is predominantly concentrated in low- and middle-income countries (LMICs), which account for 98% of global TB cases (WHO, 2024). Migrants and refugees face a notably higher risk of TB and require accessible, targeted interventions and comprehensive care strategies addressed to their living and working conditions. (Meaza et al., 2022).

Since early 2021, political instability, economic disruptions, and widespread human rights violations in Myanmar have led to a substantial increase in migration to Thailand. The United Nations estimated that 4.1 million Myanmar migrants live in Thailand in January 2025, including 1.8 million unregistered workers (UN Network on Migration in Thailand, 2024). In Southern Thailand, migrant workers are commonly employed at factories, where TB susceptibility may be heightened by occupational risk factors such as overcrowding, inadequate ventilation, and other unfavorable occupational risks (Krairittichai et al., 2012; Luksamijarulkul et al., 2017; Wongkongdech et al., 2015).

Despite the role of occupational risk factors in TB prevention and control among migrants, few studies have described these conditions among Myanmar migrant workers. The findings from such a study can provide essential information for stakeholders in infectious disease control and migrant health. The objective of this study is to describe TB occupational risks among Myanmar migrant factory workers in Songkhla Province, Thailand.

## LITERATURE REVIEWS

Migrant workers in various occupations are exposed to potential risk factors for poor lung health and/or tuberculosis. Migrant construction and mining workers in Saudi Arabia have up to three times higher TB risk due to silica dust exposure, which damages lung tissue, while poor housing conditions further exacerbate susceptibility (Semilan et al., 2021). Seasonal agricultural migrants exhibit TB rates six times higher than the general population, largely due to cramped living conditions and exposure to bovine TB (Semilan et al., 2021). These previous studies underscore the interaction between occupational factors in heightening TB risk among migrant populations.

In factory settings, occupational risk factors include crowding, poor working conditions and limited access to healthcare (Krairittichai et al., 2012; Wongkongdech et al., 2015). In Thailand, Myanmar migrants in seafood processing factories, particularly in Samut Sakhon province, face elevated TB risk from prolonged close contact in poorly ventilated workspaces and overcrowded dormitories, and also garment and textile factory workers are similarly vulnerable due to high worker density and inadequate air circulation (Wongkongdech et al., 2015). Despite these findings, gaps remain regarding occupational risk factors currently faced by Myanmar migrant factory workers. The WHO occupational health and safety standards, OSHA TB guidelines, and HSE workplace ventilation recommendations can enable a more complete assessment of occupational risk factors and environmental controls relevant to TB transmission in factory settings (HSE, 2022; OSHA, 2025a, 2025b; WHO, 2023)

## RESEARCH METHODOLOGY

### Study Design and Setting

This study was a cross-sectional observational survey using a self-administered questionnaire. It was conducted among Myanmar migrant factory workers in Songkhla Province, Thailand, targeting workers at selected factories.

### Population & Sample Size Calculation

The study population included Myanmar migrant factory workers in the selected factories who met the inclusion criteria: 1) aged 18 years or older; 2) employed full-time at the sampled

factories on the day of data collection; 3) able to read and write in Burmese. Exclusion criteria were: 1) Thai citizenship (possession of a valid Thai national ID); 2) Currently receiving TB treatment. Participants were allowed to withdraw at any time without providing a reason and without any impact on their employment or access to healthcare. We added prefer not to say option in every question to emphasize that all answers were optional.

Sample size was calculated using the n4Studies application for estimating a finite population proportion with the following formula:

$$n = \frac{Np(1-p)z_{1-\frac{\alpha}{2}}^2}{d^2(N-1) + p(1-p)z_{1-\frac{\alpha}{2}}^2}$$

$$n_{adjust} = n * design\_effect$$

Where:

$$design\_effect = [1 + \rho(m-1)]$$

Where:

N = 47,404 (population size) (Provincial Labour Office Songkhla, 2025),

P = 0.064 (estimated proportion of TB-suspicious symptoms) (Naing et al., 2012),

d = 0.03 (margin of error),

z $1-\alpha/2$ = 1.96 (for 95% confidence),

$\rho$ = 0.010 (intra-cluster correlation coefficient), the arbitrarily defined conservative estimate for intra-cluster correlation level in human studies (Killip, 2004).

m=30 (average cluster size).

Based on the n4Studies output:

Unadjusted sample size (n) = 254.33

Design effect = 1.29

Adjusted sample size (cluster design) = 328.09

Therefore, the final required sample size was 330 participants.

**Study Variables and Data Collection**

We collected data using a paper-based structured self-administered questionnaire comprising six sections: A) Socio-Demography & Migration Information; B) Environmental Risk Factors; C) Occupational Risk Factors; D) Biomedical Risk Factors; E) Behavioral Risk Factors; and F) Intended Care-Seeking Behaviors if Developing TB-like Symptoms. For this analysis, only data from Sections A and C were used, focusing on participants' socio-demographic characteristics and occupational risk factors for tuberculosis.

**Data Collection**

A list of factories in Songkhla Province was compiled, prioritizing workplaces with 100 or more workers, a high proportion of Myanmar migrant employees, and locations in Songkhla Province. Official letters were sent to factory administrators to request permission to collect data and schedule data collection.

Investigators collected data between 14 September to 5 October 2025. Investigators visited the factory (study site) at the designated time and date for data collection. We met the workers with the help of the factory administrator, introduced ourselves, explained to the workers about the study in Myanmar language, provided information sheets, and obtained verbal or action-based informed consent to protect the participants' privacy and confidentiality. Participation was voluntary, anonymous, and free of employer influence. No names, IDs, or immigration details were collected. Workers completed the self-administered questionnaire (30 to 45 minutes) in a designated space and returned it in sealed envelopes or opaque boxes.

Participants received a Myanmar-language TB education brochure and 50 THB as compensation upon submitting the questionnaire. Data collection was conducted once per factory, primarily during break times or on holidays.

**Data Management**

Completed questionnaires were securely stored and subsequently entered into the KoboToolbox platform. All data were kept on a password-protected server without any personally identifiable information. To ensure quality, we checked questionnaires for completeness, coded categorical variables numerically, and performed double-entry verification to minimize errors. The cleaned dataset was exported into R software for further processing and analysis.

**Data Analyses**

Descriptive statistics were used to summarize the characteristics of study participants and their occupational risk factors for tuberculosis. Categorical variables, including sex assigned at birth, gender minority status, ethnicity, marital status, religious affiliation, education level, personal monthly income, ventilation conditions, use of fans or air conditioning, perceived air movement, frequency of visible dust, crowded workspaces, and co-worker TB status, were summarized as frequencies and percentages. Continuous variables, such as age, were reported as mean ± standard deviation (SD). All data analyses were performed using RStudio (2025.05.1 Build 513), and the results are presented in Tables 1 and 2.

## RESEARCH RESULTS

We contacted 24 factories in Songkhla Province, 6 of which agreed to allow data collection. The number of workers in these factories ranged from 48 to 72 years of age. All Myanmar migrant workers present during the visits were invited to participate, and 330 out of 340 invited workers agreed, resulting in a participation rate of 97%. Participant characteristics (Table 1) show that the majority of participants were female (61.2%), with a mean age of 31.2 ± 7.6 years. Most identified as Bamar (69.7%) and were Buddhist (98.2%). Regarding marital status, 46.4% were single, and 42.1% were married. Regarding the highest level of education, most participants had completed some middle school (23.3%), followed by some high school (20.6%), with smaller proportions having some university/college (5.5%) or completed college/university (3.9%). The majority of participants reported a personal monthly income of 5,000-9,999 THB (54.8%), followed by 10,000-14,999 THB (32.4%).

**Table 1** Characteristics of the study participants (n=330 Myanmar migrant factory workers, Songkhla Province)

| Characteristic | Frequency (%) or Mean ± SD |
|---|---|
| **Sex assigned at birth** | |
| Male | 126 (38.2) |
| Female | 202 (61.2) |
| Prefer not to say | 2 (0.6) |
| **Gender minority status**: Yes | 5 (1.5) |
| Age in years (mean ± SE) | 31.2 ± 7.6 |
| **Ethnicity (four most common)** | |
| Bamar | 230 (69.7) |
| Rakhine | 42 (12.7) |
| Dawei | 23 (7.0) |
| Karen | 19 (5.8) |
| Others | 16 (4.8) |
| **Marital status** | |
| Single | 153 (46.4) |
| Married | 139 (42.1) |
| Divorced | 18 (5.5) |
| Widower/Widow | 7 (2.1) |

| Characteristic | Frequency (%) or Mean ± SD |
|---|---|
| Separated | 8 (2.4) |
| Prefer not to say | 5 (1.5) |
| **Religious affiliation**: Buddhist | 324 (98.2) |
| **Highest level of education** | |
| No formal education | 8 (2.4) |
| Some primary school (not completed) | 30 (9.1) |
| Primary school completed | 40 (12.1) |
| Some middle school (not completed) | 77 (23.3) |
| Middle school completed | 45 (13.6) |
| Some high school (not completed) | 68 (20.6) |
| High school completed | 29 (8.8) |
| Some university/college (not completed) | 18 (5.5) |
| College/University completed | 13 (3.9) |
| Prefer not to say | 2 (0.6) |
| **Personal monthly income (including overtime and bonus) in Thai Baht** | |
| 5,000 to 9,999 THB | 181 (54.8) |
| 10,000 to 14,999 THB | 107 (32.4) |
| 15,000 to 19,999 THB | 17 (5.2) |
| 20,000 THB or more | 5 (1.5) |
| Prefer not to say | 20 (6.1) |

Occupational risk factors for tuberculosis among the participants are summarized in Table 2. Less than half of the workers reported that windows or doors were opened for at least 30 minutes daily (43.0%), while 25.8% had no openable windows or doors. Most participants reported using fans or air conditioning daily (75.2%) and perceived good airflow in the main work area (63.0%). Visible dust was reported daily by 24.2% of workers, and nearly 60% worked in crowded spaces (<1 meter apart) every day. The majority were not aware of any co-workers with TB in the past 12 months (88.2%).

**Table 2** Occupational risk factors for tuberculosis among the study participants (n=330 Myanmar migrant factory workers, Songkhla Province)

| Characteristic | Frequency (%), unless otherwise indicated |
|---|---|
| **Openable windows/doors for ventilation** | |
| Yes, and they are opened for at least 30 minutes daily | 142 (43.0) |
| Yes, but they are opened for less than 30 minutes daily | 20 (6.1) |
| No openable windows or doors | 85 (25.8) |
| Not sure | 52 (15.8) |
| Prefer not to say | 31 (9.4) |
| **Use of fans or air conditioning** | |
| Never | 60 (18.2) |
| Less than once a month | 1 (0.3) |
| At least once a month but not every week | 1 (0.3) |
| At least once a week but not daily | 0 (0) |
| Daily | 248 (75.2) |
| I'm not sure | 8 (2.4) |
| Prefer not to say | 12 (3.6) |
| **Perceived air movement in the main work area** | |

| Characteristic | Frequency (%), unless otherwise indicated |
|---|---|
| Good airflow (can feel air movement) | 208 (63.0) |
| Limited airflow (little noticeable air movement) | 75 (22.7) |
| Stagnant air (no noticeable air movement) | 21 (6.4) |
| I don't know | 13 (3.9) |
| Prefer not to say | 13 (3.9) |
| **Frequency of visible dust in work area** | |
| Never | 163 (49.4) |
| Less than once a month | 16 (4.8) |
| At least once a month but not every week | 11 (3.3) |
| At least once a week but not daily | 13 (3.9) |
| Daily | 80 (24.2) |
| I'm not sure | 35 (10.6) |
| Prefer not to say | 12 (3.6) |
| **Frequency of working in crowded spaces (<1 meter apart)** | |
| Never | 81 (24.5) |
| Less than once a month | 4 (1.2) |
| At least once a month but not every week | 4 (1.2) |
| At least once a week but not daily | 11 (3.3) |
| Daily | 197 (59.7) |
| I'm not sure | 15 (4.5) |
| Prefer not to say | 18 (5.5) |
| **TB status among co-workers in the past 12 months** | |
| Not aware of any co-workers with TB | 291 (88.2%) |
| Had co-worker(s) with TB present, did not work in the same room before diagnosis | 21 (6.4%) |
| Had co-worker(s) with TB present, worked in the same room before diagnosis | 0 (0%) |
| Incomplete information | 19 (5.8%) |

## DISCUSSION & CONCLUSION

This cross-sectional study explored the sociodemographic characteristics and occupational risk factors for tuberculosis (TB) among 330 Myanmar migrant factory workers in Songkhla Province, Thailand, with confidentiality ensured regardless of documentation status. Although the majority of the participants reported that their workplace had "good airlow in the main work area", nearly three-fifths reported working in crowded spaces less than one meter apart from others. None of the workers reported working in the same room with a TB-infected person while they were undiagnosed. These findings offer valuable baseline insights to help public health authorities and factory management design targeted occupational health measures and strengthen TB prevention among migrant factory workers.

The most concerning part of our findings was that 88.2% of the participants not being aware of co-workers with TB, which means that the remaining 11.8% were. Considering that the prevalence of TB in the general population of Thailand is measured per 100,000 population, the prevalence of such awareness among our participants was very concerning, despite not being exposed to the infected person before diagnosis. However, the prevalence in our study was actually lower than what was reported in another study in Samut Sakhon Province, where 20.8% of the participants reported recent TB in their family or close contacts and crowded workspaces (Luksamijarulkul et al., 2017).

The occupational conditions observed in our study are consistent with previous research on migrant worker health in Thailand and other countries, which consistently highlight crowded living and working environments as major contributors to TB risk (Naing et al., 2012; Wongkongdech et al., 2015; Shrivastava et al., 2024). Systematic reviews have also found that poor ventilation is strongly linked to the spread of infections such as tuberculosis (Li et al., 2007), and outbreak investigations show that improving indoor airflow can effectively help reduce transmission (Du et al., 2020).

This study has many strengths, particularly a high participation rate among eligible workers within participating factories, which helps reduce selection bias from non-response. However, some limitations should be noted. Only 6 out of 24 selected factories agreed to allow data collection, which could introduce selection bias if the non-participating factories had better or worse working conditions. Secondly, data were self-reported without triangulation through direct observation of the factories, which might have introduced information bias to the study findings. Lastly, the findings may not be generalizable to migrant workers in other industries or regions of Thailand.

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