Original Research Report

SCREENING OF TUBERCULOSIS INFECTION THROUGH ACID-FAST BACILLI TESTS AMONG WASTE WORKERS IN GRESIK, INDONESIA

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ABSTRACT

Tuberculosis is a significant source of illness and mortality worldwide. Therefore, tuberculosis screening is important to identify active cases within a community. Bacteriological examinations can be used to initiate active community-based case finding. Waste workers are at a high risk of contracting *Mycobacterium tuberculosis* due to their constant exposure to waste. This study aims to conduct bacteriological examinations to identify tuberculosis infection among waste workers in Gresik, Indonesia. An analytical observational study was carried out in September 2023 in Ngipik Village, Gresik, East Java, Indonesia. The primary study was conducted using a cross-sectional design with interviews, measurements, and sputum examinations for all samples. The screening involved a total of 72 waste workers (n = 72) who had daily contact with various types of sewage and waste, including medical waste. The majority of the waste workers were male (65.2%), most were between the ages of 34 and 44 (27.78%), and their educational background was a senior high school degree (40.27%). Most of the waste workers did not have a family history of hypertension (84.72%) or diabetes (97.22%). The acid-fast bacilli examinations were negative in all samples. Nevertheless, this study concluded that it is imperative to carry out mass tuberculosis screening in various settings, specifically in high-risk populations. Mass screening can detect the potential of latent tuberculosis, thereby reducing its transmission.

Keywords: Tuberculosis; screening; respiratory diseases; infectious diseases

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Highlights:
1. This study was the first in Gresik, Indonesia, to conduct mass screening of tuberculosis among waste workers, comprising various demographic profiles.
2. Although the tuberculosis screening of the waste workers showed negative results, mass examination using an acid-fast bacilli smear remains crucial to detect latent infections and prevent transmissions.

INTRODUCTION

The World Health Organization (2018) reported that tuberculosis (TB) is a major global contributor to illness and mortality globally. Current attempts to contain the pandemic were seriously threatened by the rising rates of multidrug-resistant (MDR) and extensively drug-resistant (XDR) tuberculosis, particularly in low- and middle-income countries. Tuberculosis is a dangerous illness brought on by airborne bacteria. Individuals who have active tuberculosis in their lungs can transmit the infection to another person. They can transmit active tuberculosis by sneezing, coughing, singing, or talking (Centers for Disease Control and Prevention 2022).

The three key priorities to be achieved by 2035 are reducing the incidence and mortality rates of tuberculosis, as well as eliminating tuberculosis-related catastrophic costs. For the accomplishment of these goals, it will be necessary to develop and

enhance the research and innovation environment. The likelihood of improved tuberculosis-related policy rises in proportion to the increase in tuberculosis research. Although tuberculosis typically affects the lungs, it may also harm the glands, bones, joints, kidneys, brain, and reproductive systems (World Health Organization 2017). Despite global adoption of the End Tuberculosis Strategy, the trends in tuberculosis infection and mortality have shown relatively modest improvements, falling short of the 2020 target. The global strategy to end tuberculosis was signed by many countries across the world (World Health Organization 2022). However, several obstacles were in the way of worldwide tuberculosis prevention and control efforts. The commitment to eradicate tuberculosis should be deciphered in a simpler form that is suitable for the characteristics of a community. Indonesia, as a tropical country with a vast geographical expanse, has committed to ending tuberculosis through tailored approaches that account for its unique characteristics.

Significant challenges faced by endemic countries, particularly in Asia, include funding shortages, lack of access to diagnostic and treatment services, resource constraints, and the emergence and spread of multidrug-resistant tuberculosis strains. These factors are challenging and should be addressed to accelerate progress in eradicating tuberculosis (Lakoh et al. 2020). Massive efforts have been introduced at national and regional levels to end tuberculosis. These include active case-finding, promotion of health behavior, community approaches, and family approaches.

Despite massive efforts over the past twenty years, Indonesia still has the second-highest prevalence of tuberculosis in the world. This prevalence is responsible for 8.5% of the global burden of tuberculosis (World Health Organization 2022). In regard to the latest data showing a high percentage of tuberculosis, intersectoral collaboration between the government and the community should be established. Indonesia experienced a severe setback in tuberculosis case detection due to the impact of the coronavirus disease (COVID-19) on health services throughout the whole country. Tuberculosis case detection decreased by 30% in 2020, followed by a 12% decline in 2021 (Ministry of Health of the Republic of Indonesia 2022). The data indicate a rise in unreported tuberculosis cases, which might lead to a higher number of tuberculosis fatalities. Unreported tuberculosis cases can be reduced and detected through massive screening in both high- and low-risk groups. Massive screening offers the benefit of revealing a growing number of detected cases. In addition, strategies and coordinated efforts to find new cases can be initiated. Unreported tuberculosis cases could increase the burden on the country as a result of hidden transmission within the community. Timely treatment of tuberculosis patients leads to a greater reduction in community transmission (Chakaya et al. 2021). Waste workers are a high-risk group vulnerable to infectious diseases due to the high intensity of waste exposure. Municipal solid waste may spread human pathogens during collection, transportation, handling, and disposal. Workers, specifically waste pickers, unprotected workers, and locals close to municipal solid waste collection or disposal sites, are particularly vulnerable (Han et al. 2023).

Sputum smear microscopy has been the main technique for diagnosing pulmonary tuberculosis in poor and middle-income countries, where almost 95 % of tuberculosis cases and 98% of tuberculosis-related fatalities occur. The technique is efficient, quick, and affordable, particularly in regions with a high prevalence of tuberculosis (Hopewell et al. 2006). Sputum smear microscopy using acid-fast bacilli examinations can be performed in diverse communities, even with limited resources. The objective of this study was to conduct screening of tuberculosis infection among waste workers as a high-risk group in Gresik, Indonesia.

MATERIALS AND METHODS

This research used an analytical observational study design and was conducted in September 2023 across the Ngipik subdistrict of Gresik, Indonesia. The primary study was conducted cross-sectionally by employing interviews, measurements, and sputum examinations for all samples (Ranganathan & Aggarwal 2019). The screening involved 72 waste workers in everyday contact with various waste materials, including sewage and medical waste. Profiles of the subjects were recorded, encompassing their names, dates of birth, smoking history, disease history, and contact information.

A small sample tube of sputum was collected from the lower respiratory tract of each participant under the supervision of a professionally trained health worker. Since not all of the waste workers had coughs or symptoms, sputum was collected during chest clearing exercises (Nicolini et al. 2018). The participants were instructed to initiate the process by inhaling deeply and slowly, followed by holding their breath for three seconds after their chest had been filled. Afterwards, they were instructed to exhale and relax to let the sputum loosen and release.

The sputum was sent to the Bionas Laboratory in Gresik, Indonesia, to proceed with the laboratory procedure. The acid-fast bacilli smear was conducted using the method described in a previous study by Schluger (2019). The data were subjected

to descriptive analysis and interpretation due to the use of only one constant variable. A table and a figure were utilized to present the data. The geographical map of the sampling location was figured out using ArcGIS for Windows, version 10.6 (Esri, Redlands, CA, USA).

This study received approval from the Ethics Committee of Ibnu Sina Regional General Hospital, Gresik, Indonesia, with registration No. 071/070/437.76.46/2021 on 17/12/2021. All of the subjects were given information regarding the aim of this research. Afterwards, they confirmed their willingness to voluntarily participate by signing the informed consent.

RESULTS

A total of 72 sputum samples were collected from waste workers in the Ngipik subdistrict of Gresik, Indonesia. All of the samples exhibited negative results according to the acid-fast bacilli examinations. The sociodemographic profiles of the waste workers are shown in Table 1.

The results of our study revealed that the majority of the waste workers were male, accounting for 65.2% of the total subjects. Furthermore, most waste workers were between the ages of 34 and 44 (27.78%). We also calculated the percentage of the waste workers' educational level, finding that senior high school graduates (40.27%) comprised the largest proportion. The data on family medical histories of chronic diseases indicated that most of the waste workers did not have a family history of hypertension (84.72%) or diabetes (97.22%). All of the acid-fast bacilli test results showed negative results (100%). The data were collected in Gresik Regency, a neighbour of Surabaya City. The details of the geographical map of the research location are shown in Figure 1.

DISCUSSION

Many cities in developing countries consider waste management to be a serious environmental and public health issue. Solid waste produced by human activities poses threats to human health and causes significant environmental degradation. Waste workers are regularly exposed to various hazardous chemicals and infectious organisms. Additionally, they experience social prejudice and maltreatment at the hands of some members of society, potentially causing societal issues. These waste workers frequently disclose harmful lifestyle choices at work, such as using tobacco, alcohol, or drugs, which raises their health risks (Baral 2018). Previous research conducted by Weber et al. (2000) found that tuberculosis outbreaks among waste workers occurred due to the aerosolization of waste materials, poor facility design, a lack of safety regulations, and misconceptions about the functioning and design of processing equipment. Sewage handling poses dangerous risks due to prolonged inhalation of chemical gases, bioaerosols, and microorganisms, as well as unintentional oral ingestion and penetration to skin or mucous membranes owing to wounds or breaches in personal protective equipment. A massive tuberculosis screening of sewage workers in India revealed that a total of 21% tested positive for tuberculosis. Notably, 92% of the participants had at least one chronic respiratory disorder due to their lifestyle as smokers (Chandra & Arora 2019).

Table 1. Sociodemographic profiles of the waste workers.

Variables	n	%
Sex		
Male	47	65.2%
Female	25	34.7%
Age (y.o.)		
<30	13	18.05%
35–44	20	27.78%
45–54	19	26.38%
55–64	12	16.67%
>65	8	11%
Educational level		
Elementary school	19	26.38%
Junior high school	16	22.2%
Senior high school	29	40.27%
University	4	5.55%
No schooling	4	5.55%
Income (IDR)		
<1 million	12	16.67%
1–2 million	50	69.44%
3–4 million	10	13.8%
Smoking		
Yes	36	50%
No	36	50%
Alcohol consumption		
Yes	4	5.5%
No	68	94.4%
Frequency of physical activity per week		
1–2	35	48.61%
3–4	18	25%
5–6	19	26.38%
Under pressure		
Mild	46	63.8%
Moderate	21	29.16%
Severe	5	6.94%
Family history of hypertension		
Yes	11	15.27%
No	61	84.72%
Family history of diabetes		
Yes	2	2.77%
No	70	97.22%

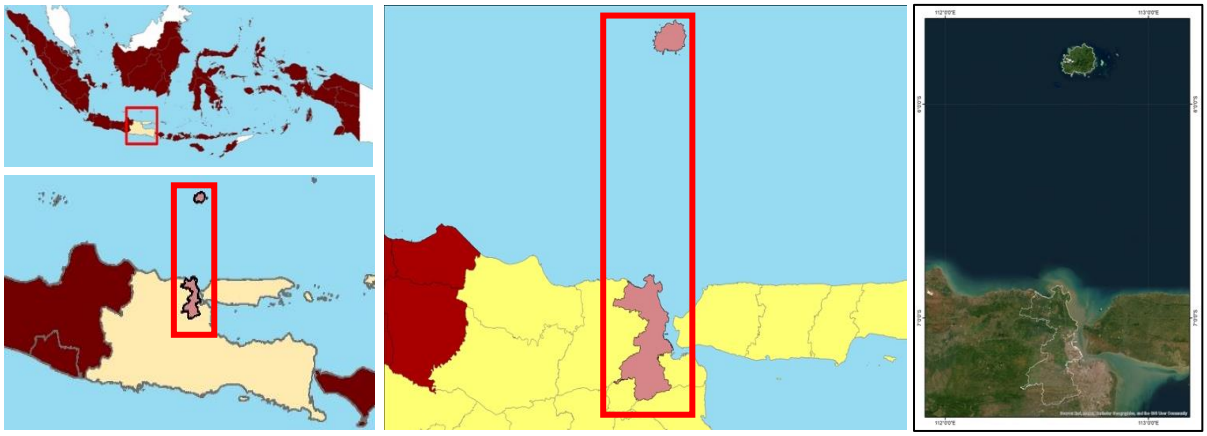

Figure 1. The geographical map of Gresik Regency, the location of this study.

Researchers, doctors, and policymakers have disregarded the infection risk profile of waste workers. Waste workers in Indonesia commonly belong to marginalized populations that are marked by a lack of formal education, poor socioeconomic status, and negative stigma attached to their line of work. The results of our study indicated that all of the waste workers yielded negative results according to the acid-fast bacilli tests. However, there is a possibility of developing active tuberculosis or a tuberculosis infection as a result of exposure at work, which is known as the occupational risk of tuberculosis. The daily exposure received by waste workers may increase the risk of infections such as hepatitis, helicobacter, leptospirosis, respiratory system issues, skin issues, and other chronic diseases (Advisory Committee on Dangerous Pathogens 2003). The workplace can contribute to tuberculosis transmission due to the prolonged time spent in an occupational environment. Tuberculosis-control programs were carried out across five states of the United States (Bagherirad et al. 2014). It was discovered that 29% of the subjects tested positive for tuberculosis. However, the findings showed that 11% had no additional risk factors for tuberculosis. It was challenging to determine, though, whether the infections were caused by recent exposure in the workplace or prior exposure to tuberculosis in other places. One of the key components of the global tuberculosis program is massive screening. Community-based strategies and acid-fast bacilli smears are effective for tuberculosis screening in order to find new cases. On the other hand, regarding hospitalized patients, the GeneXpert *Mycobacterium tuberculosis* and resistance to rifampin (Xpert MTB/RIF) testing performs better in terms of diagnosis. This testing is likely to be less expensive than smear microscopy because it requires less time in the hospital and provides faster test results (Hickey et al. 2022).

The subjects of our study consisted of smoking and non-smoking participants. Smoking and tuberculosis are a dangerous combination that can lead to morbidity. This is because smoking increases the risk of developing tuberculosis, the likelihood of recurrence, and the effectiveness of therapy. Smoking has been known to adversely affect the response to therapy and raise the likelihood of relapse. In addition, it also impacts the risk of contracting tuberculosis and developing an active form of the illness, which ultimately contributes to the mortality risk (World Health Organization 2018). The long-assumed associations between smoking and tuberculosis have been proven. An observational study at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, showed that patients with smoking habits had a higher likelihood of testing positive in the sputum smear test than non-smokers. However, there was a lack of a substantial association between smoking habits and sputum smear positivity. Patients who smoked moderately as opposed to heavily had a higher probability of yielding a positive result in the sputum smear test (Hapsari et al. 2021). Despite the negative acid-fast bacilli results in this study, it is suggested to continuously carry out screening every six months for the prevention of tuberculosis transmission in the workplace, specifically among high-risk groups (e.g., waste workers). Another study in Lima, Peru, found that the transmission of tuberculosis in high-risk groups was facilitated by the use of buses or minibuses (Zamudio et al. 2015). A separate observational study conducted by Andajani (2019) revealed that health workers in Surabaya who had been working for more than five years had the highest incidence of latent tuberculosis. Health education strategies, such as disseminating fundamental knowledge about tuberculosis signs and symptoms to individuals or groups, can shorten the diagnosis process and prevent delayed treatment. This can lower the rate of transmission throughout the community and affect the treatment-seeking

behavior of patients (Sreeramareddy et al. 2009).

Our study showed that most of the participants had no family history of chronic diseases. In tuberculosis screening, it is important to inquire about the family history of chronic diseases, such as hypertension and diabetes. According to Syahputri et al. (2023), having a family history of diabetes increases the risk of developing pulmonary tuberculosis by 70.3% in type 2 diabetes mellitus (T2DM) patients. Mass tuberculosis screening is a preventive method commonly used for tuberculosis detection in developing countries. A previous study on tuberculosis screening in China demonstrated that the rate of tuberculosis detection using mass screening was greater than background detection (Hu et al. 2023). The World Health Organization recommends acid-fast bacilli smears as the most reliable and cost-effective method for initial screening. This method relies on manual microscopic examination for the presence of acid-fast bacilli (Campelo et al. 2021). Smear microscopy is a popular and inexpensive technique. However, its sensitivity in diagnosing pulmonary tuberculosis is only 50% to 60%. Mass screening, especially in high-risk groups such as health workers and sewage workers, can help identify latent tuberculosis cases. On the other hand, acid-fast bacilli smear microscopy is labor-intensive, and its sensitivity is influenced by various factors such as the experience of the examiner, smear quality, and eye fatigue. While some molecular-based techniques (e.g., the Xpert MTB/RIF) can help identify tuberculosis, their high cost makes them inaccessible in numerous countries with high tuberculosis prevalence (Ngabonziza et al. 2016). In countries with limited resources, the directly observed treatment scheme (DOTS) for tuberculosis control programs depends heavily on reliable smear microscopy (Shiferaw et al. 2015). The quality of acid-fast bacilli smear microscopy reading and smearing is often subpar in most health center laboratories. As a result, it is necessary to improve the capacity of laboratory professionals to strengthen external quality assessment (EQA).

Strength and limitations

This study can contribute to the enhancement of tuberculosis control efforts in Gresik, Indonesia. Our study was the first to report on tuberculosis screening, specifically focusing on waste workers as a high-risk group in the regency. This study is also expected to offer insight into the demographic profiles of waste workers. However, this study was limited by its small sample size, which consisted of only waste workers from a single geographical area.

CONCLUSION

Mass tuberculosis screening using sputum smears among waste workers in Ngipik Village, Gresik, Indonesia, yielded negative results for tuberculosis infection. It is noteworthy that mass screening remains crucial in detecting latent tuberculosis and reducing its transmission, particularly in high-risk populations.

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Conflict of interest

None.

Ethical consideration

The Ethics Committee of Ibnu Sina Regional General Hospital, Gresik, Indonesia, issued the ethical approval for this study under registration No. 071/070/437.76.46/2021 dated 17/12/2021.

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Author contribution

BU contributed to the conception and design, analysis and interpretation of the data, drafting of the article, final approval of the article, and statistical expertise. WF contributed to the drafting of the article, critical revision of the article for important intellectual content, and final approval of the article. SS contributed to the final approval of the article, statistical expertise, and the obtainment of funding. SF contributed to the drafting of the article, the provision of administrative, technical, and logistic support, as well as the collection and assembly of data. CCK contributed to the drafting of the article, critical revision of the article, and collection and assembly of the data. NF contributed to the analysis and interpretation of the data, the critical revision of the article for important intellectual content, as well as the collection and assembly of the data. THS contributed to the final approval of the article, the provision of administrative, technical, and logistic support, as well as the collection and assembly of the data.

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