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EVALUATION OF THE SENSITIVITY AND SPECIFICITY OF THE TUBERCULOSIS SIGN AND SYMPTOM (TBSS) SCORE IN COMPARISON WITH CHEST RADIOGRAPHY AND RMT FOR DIAGNOSING TUBERCULOSIS AMONG BRICK KILN WORKERS

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ABSTRACT

Indonesia ranks the second among countries with the highest TB burden. Brick kiln workers are at high risk for developing respiratory illnesses. This cross-sectional study aimed to evaluate the sensitivity and specificity of the Tuberculosis Sign and Symptom (TBSS) score in comparison to chest radiography and the Rapid Molecular Test (RMT) among brick kiln workers. Brick kiln workers are vulnerable to chronic respiratory conditions and TB due to exposure to smoke, heat, and dust, especially when combined with extremely poor environmental conditions. This study employed a total sampling method, involving 92 participants. Data collection was conducted from February to March 2024 in a brick kiln located in Saribumi Village, Gading Rejo District, Pringsewu Regency, Lampung Province. Analyses were performed using the SPSS software to evaluate relationships between variables and identify significant patterns.The majority of participants were female (77.3%), while males accounted for 22.8%. The most common age range was 41–60 years, representing 48.9% of the total sample. Regarding job categories, most workers were employed in the molding section. Screening with the TBSS score and chest radiography showed a sensitivity of 0.25, a specificity of 0.93, a positive predictive value of 0.14, and a negative predictive value of 0.96. The sensitivity and specificity of the RMT compared to the TBSS score could not be assessed, as all RMT results were negative for TB. This limitation may be attributed to suboptimal sputum sample quality. Specimens should be collected in special containers and transported immediately. The study concludes that while the TBSS score demonstrates high specificity and a strong negative predictive value, the diagnostic utility of the RMT could not be evaluated due to uniformly negative results.

Keywords: Tuberculosis, Tuberculosis Sign and Symptom Score, Chest Radiography, Rapid Molecular Test

ABSTRAK

Indonesia menduduki peringkat ke-2 negara dengan beban TBC tertinggi. Pekerja tempat pembakaran batu bata termasuk kelompok yang berisiko tinggi terkena penyakit pernapasan. Studi cross-sectional ini bertujuan untuk mengevaluasi sensitivitas dan spesifisitas skor TBSS dibandingkan dengan radiografi dada dan Tes Cepat Molekular (RMT) di antara pekerja pabrik batu bata. Pekerja batu bata termasuk kelompok yang berisiko tinggi terkena penyakit pernafasan akibat paparan asap panas, dan debu dari tempat pembakaran batu bata. Penelitian ini menggunakan metode total sampling, dengan total 92 sampel. Penelitian dilakukan dari Februari hingga Maret 2024 di pabrik batu bata yang terletak di Desa Saribumi, Kecamatan Gading Rejo, Kabupaten Pringsewu, Provinsi Lampung. Analisis univariabel dan bivariat dilakukan dengan menggunakan perangkat lunak SPSS untuk mengevaluasi hubungan antar variabel dan mengidentifikasi pola signifikan. Mayoritas sampel adalah perempuan, sebesar 77,3%, sementara laki-laki sebesar 22,8%. Rentang usia yang paling umum adalah 41-60 tahun, mewakili 48,9% dari total sampel. Dalam hal kategori pekerjaan, sebagian besar pekerja bekerja di bagian pencetakan. Skrining dengan skor TBSS dan radiografi dada menghasilkan sensitivitas sebesar 0.25, spesifisitas sebesar 0.93, nilai prediksi positif sebesar 0.14, dan nilai prediksi negatif sebesar 0.96. Sensitivitas dan spesifisitas antara RMT dan skor TBSS tidak dapat dinilai karena hasil pemeriksaan RMT menunjukkan bahwa semua responden negatif TB. Ketidaksesuaian ini mungkin disebabkan oleh kualitas sampel dahak yang kurang optimal, sehingga spesimen harus dikumpulkan dalam wadah khusus dan harus segera diangkut. Studi ini menyimpulkan bahwa meskipun skor TBSS menunjukkan spesifisitas tinggi dan nilai prediksi negatif yang kuat, kegunaan diagnostik RMT tidak dapat dievaluasi karena hasil negatif yang seragam.

Kata kunci: Tuberkulosis, Skor *Tuberculosis Sign and Symptom*, Radiografi Dada, Tes Cepat Molekular

INTRODUCTION

Tuberculosis (TB) is one of the leading causes of death worldwide. The bacterium Mycobacterium tuberculosis is the causative agent of this disease, which typically affects the lungs (pulmonary TB) but can also infect other organs (extrapulmonary TB) (Noviyani, Nopsoson, & Pongpirul, 2021). Indonesia is among the eight countries contributing to more than two-thirds of the global tuberculosis cases. The other countries include India, China, the Philippines, Pakistan, Nigeria, Bangladesh, and the Democratic Republic of Congo (WHO, 2023). Indonesia ranks second among countries with the highest TB burden. In 2022, there were 724,309 TB cases in Indonesia, with a death rate of 52 per 100,000 population (Ministry of Health RI, 2022; Ministry of Health RI, 2023)

Early diagnosis and effective treatment of tuberculosis (TB) are critical to preventing the spread of the bacteria and the emergence of drug-resistant strains. However, because the causative agent is a slow-growing organism, it takes at least two weeks (and sometimes 6–8 weeks) for colonies to appear, and symptoms to develop. In individuals infected with TB, several signs and symptoms can assist in establishing a clinical diagnosis. The clinical manifestations of active pulmonary TB may include pleuritic chest pain, mild fever, prolonged productive cough, hemoptysis, fatigue, loss of appetite, night sweats, and weight loss (Alsayed & Gunosewoyo, 2023). The Tuberculosis Signs and Symptoms (TBSS) screening test serves as an initial step in detecting TB cases. If the screening is positive, chest radiography and sputum tests are recommended for further evaluation (Hidayat et al., 2022).

Brick kiln workers are among the groups at high risk for developing respiratory illnesses. One of the primary causes of respiratory diseases and symptoms in this group is exposure to smoke, heat, and dust from the brick kilns (Thomas et al., 2015). Prolonged dust exposure, poor nutrition, and long working hours make this group particularly vulnerable to chronic respiratory conditions and TB, especially when combined with extremely poor environmental conditions (Shriraam et al., 2020). Preventing infections from airborne pathogens and exposure to airborne particulates and aerosols can be achieved by wearing a face mask. However, workers' awareness and knowledge is still lacking regarding the importance of wearing masks and about the dangers of their work (Widodo et al., 2020).

Lampung Province has numerous brick kilns, including one located in Pringsewu Regency. Studies indicate that these sites often lack proper hygiene standards. Additionally, the smoking habits among workers also increase the risk of TB (Gahlot, Rana, & Singh, 2020; Syam et al., 2021). This means that a larger number of people working in the brick industry are also at risk of TB. Consequently, research is needed to determine the incidence of TB among brick kiln workers in Pringsewu Regency using appropriate screening methods. This study aims to evaluate the sensitivity and specificity of the Tuberculosis Signs and Symptoms (TBSS) score in comparison to chest radiography and rapid molecular testing among brick kiln workers in this region.

METHOD

Participant characteristics and research design

This study employs a cross-sectional design to evaluate the sensitivity and specificity of the Tuberculosis Signs and Symptoms (TBSS) score compared to chest radiography and the rapid molecular sputum test. Cross-sectional studies observe the relationship between risk factors and outcomes by collecting data at a single point in time (Point-in-Time Approach). The study includes brick kiln workers with a minimum of five years of work experience and those willing to participate in the study. Workers who refuse to participate are excluded from the study.

Sampling procedures

This study uses a total sampling method, in which all individuals in the population are included as study participants. The study was conducted from February to March 2024 in a brick kiln located in Saribumi Village, Gading Rejo District, Pringsewu Regency, Lampung Province. The brick kiln workers in this area represent the study population. The sample in this study consisted of 92 respondents.

Sample size, power, and precision

The research instruments include a questionnaire, chest radiography equipment, and rapid molecular sputum testing tools. The questionnaire consists of 16 questions related to TB symptoms and risk factors. These questions cover various symptoms and risk factors, including a cough lasting more than two weeks, contact with TB patients, loss of appetite, difficulty sleeping, reduced physical activity, fever, fatigue, hemoptysis, shortness of breath, chest pain, smoking history, alcohol

consumption, history of chronic diseases, previous pulmonary TB treatment, and a feeling of heaviness in the chest. Each question is assigned a score of 1, with the total score calculated at the end of the assessment. A total score greater than seven indicates a potential TB case.

Measures and covariates
The variables in this study were measured using nominal scales, which were used to classify data into distinct categories for analysis.

Data analysis
Univariable and bivariate analyses were conducted using the Statistical Package for the Social Sciences (SPSS) to assess relationships between variables and identify significant patterns.

RESULTS AND DISCUSSION

The sample in this study comprises 92 participants. The characteristics of the subjects were categorized based on gender, age, work unit, and length of employment. The data are summarized in Table 1. The majority of the sample are female (77.3%), while males account for 22.8%. The most common age range is 41–60 years, representing 48.9% of the total. Regarding job categories, the largest proportion of workers (38%) are employed in the molding section.

Table 1
Characteristics of The Samples

Variables	Total	Percentage (%)
Gender		
Male	21	22.8
Female	71	77.2
Age		
21-40	12	13.1
41-60	45	48.9
>60	35	38
Work Unit		
Administration	5	5.5
Kiln	27	29.3
Mixing	17	18.5
Molding	35	38
Drying	8	8.7
Length of Work		
1-5 years	6	6.5
6-10 years	6	6.5
11-15 years	19	20.7
>15 years	61	66.3

Table 2
Tuberculosis Sign and Symptom Score

Questionnaire	Yes		No	
	Total	Percentage	Total	Percentage
Cough> 2 weeks	1	1.1	91	98.9
TB contact	0	0	92	100

Loss of appetite	33	35.9	59	64.1
Weight loss	10	10.9	82	89.1
Insomnia	26	28.3	66	71.7
Low activity	6	6.5	86	93.5
Weakness	46	50.0	46	50.0
Haemoptysis	0	0	92	100
Dyspnea	5	5.5	87	94.5
Chest pain	4	4.3	88	95.7
Smoking	9	9.7	83	90.3
Alcohol consumption	1	1.1	91	98.9
Chronic disease	22	23.9	70	76.1
History of TB	4	4.3	88	95.7
Chest feels full	6	6.5	86	93.5
Fever	15	16.3	77	83.7

The TBSS score questionnaire data show that some of the most common complaints among workers included weakness (50%), loss of appetite (35.9%), and insomnia (28.3%). Meanwhile, chronic cough was reported in only one participant (1.1%), and a history of TB was identified in four participants (4.3%), as presented in Table 2. Research conducted by Thomas et al on brick-making factory workers, 51.5% had two symptoms, while 48.5% had three symptoms, including a cough lasting two weeks, chest pain, increased body temperature at night, weight loss, loss of appetite, hemoptysis, fatigue, or shortness of breath. The most frequent symptoms were cough and pain (Thomas et al., 2015). In this study, most participants had more than two symptoms, with the most common being weakness, followed by loss of appetite.

Table 3
Chest X-ray Findings

Thoracic Photo	Total	Percentage
Lung Overview		
Bronchitis	36	39.1
Emphysema	12	13
Pneumonia	3	3.3
TB	4	4.3
TB scars	4	4.3
Others	2	2.2
Normal	31	33.7
Heart		
Cardiomegaly	44	47.9
Normal	48	52.2

The results of this study revealed that normal chest radiographic findings were observed in 31 participants (33.2%). Abnormal lung findings included bronchitis in 36 participants (39.1%), emphysema in 12 participants (13%), and radiographic features suggestive of tuberculosis (TB) in 4 participants (4.3%), as shown in Table 3.

Table 4
Instrument Examination Results

Instruments	Positive TB	Negative TB
Chest Radiography	4	88

RMT	0	92
TBSS score	7	85

Table 4 presents the results of chest radiography, RMT, and TBSS score examinations for all respondents. Chest radiography identified 4 TB-positive and 88 TB-negative cases. The RMT examination found all respondents to be TB-negative. The TBSS score examination indicated 7 TB-positive and 85 TB-negative cases.

Table 5
TBSS Score and Chest Radiography

TB SS score	Chest Radiography		Total
	+	-	
+	1	6	7
-	3	82	85
Total	4	88	92

Table 5 presents the number of respondents who tested positive and negative for TB in the chest radiography and TBSS score examinations. Screening using the TBSS score and chest radiography yielded a sensitivity of 0.25, specificity of 0.93, a positive predictive value of 0.14, and a negative predictive value of 0.96. The sensitivity and specificity between the RMT test and TBSS score could not be assessed, as all respondents tested negative for TB in the RMT examination. Test results are expressed in a 2×2 table. Sensitivity refers to the proportion of sick individuals who receive a positive diagnostic test result compared to all sick individuals, representing the probability that a diagnostic test correctly identifies a disease. Specificity is the proportion of healthy individuals who receive a negative diagnostic test result compared to all healthy individuals. Sensitivity and specificity are considered stable diagnostic values, as they remain constant regardless of disease prevalence. The positive predictive value (PPV) represents the probability that an individual actually has the disease when the diagnostic test result is positive. The negative predictive value (NPV) indicates the probability that an individual does not have the disease when the test result is negative.

In this study, the TBSS score test and chest radiography demonstrated a sensitivity of 0.25, specificity of 0.93, a positive predictive value of 0.14, and a negative predictive value of 0.96. Ideally, a screening test should have a sensitivity and specificity of 80–90% (APHL, 2018). Previous research reported that the TBSS score achieved a sensitivity of 59.8% and specificity of 67.2%, whereas chest X-ray (CXR) had the highest sensitivity (95.1%) and specificity (86.3%) (Ko, Htet, and Chongsuvivatwong 2021). The negative RMT results for all respondents may be due to suboptimal sample quality. High-quality specimens are essential for accurate TB diagnosis. Sputum, a respiratory secretion from deep within the lungs, is the standard specimen for TB testing. It should be collected in sterile, clear, plastic, leak-proof containers, such as 50-ml screw-cap centrifuge tubes. Proper collection devices should include wide-mouth sterile containers, and specimens should be transported to a public health laboratory within 24 hours. If immediate transport is not possible, refrigeration is necessary to prevent contamination.

Conventional TB screening based solely on signs and symptoms generally has low sensitivity and specificity. However, studies suggest that incorporating additional risk factors—such as smoking, alcohol consumption, and TB contact—can enhance the accuracy of screening tools by improving both sensitivity and specificity (Hidayat et al., 2022).

CONCLUSIONS AND SUGGESTIONS

All sputum examinations conducted using Rapid Molecular Testing (RMT) yielded negative results, making it impossible to assess the sensitivity and specificity of this method. This outcome may be attributed to suboptimal sample quality.

ETHICAL CONSIDERATIONS

Funding Statement.
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Conflict of Interest Statement
The author reports no conflicts of interest in this work.

List of Abbreviations
TB: tuberculosis; TB-SS: tuberculosis sign and symptom; RMT: rapid molecular test.

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