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Self-Screening in the Family Members of Tuberculosis Patients: A Systematic Review

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Abstract
Background: Public awareness and knowledge about tuberculosis (TB) are still limited, which increases the risk of TB spread among vulnerable individuals. This systematic review aimed to identify effectiveness of self-screening in reducing TB transmission among family members of TB patients.
Methods: This systematic review was carried out on articles published between 2008 and 2021. The articles were retrieved from online databases including Scopus, Wiley Online Library, Cochrane Library, PubMed, and Google Scholar. All quantitative studies on household or community based self-screening for TB were included in the study.
Results: eligible articles were included to analysis. Early detection of TB transmission could be done through tuberculosis counselling and household screening, including self-screening for TB household contacts.
Conclusion: The management of self-screening of household contacts of TB patients is very important for reducing TB spread.

Highlights:

What is current knowledge?

TB is still a health problem in almost all of the world, especially developing countries. Although TB is one of the deadliest infectious diseases in the world, public awareness and knowledge about this disease is still lacking.

What is new here?

Lack of health information and living too far from health institutions can also influence or delay early detection of TB transmission

Introduction

Tuberculosis (TB) is an infectious disease with a high mortality rate. It is a major cause of morbidity and mortality in low- and middle-income countries (1, 2). To this date, there has been a lack of public awareness and education concerning TB. Identification of TB can be influenced or delayed by a number of factors, including lack of health information and inaccessibility to health facilities (3–6). Given the high burden of TB and suboptimal case detection, it is essential to perform more screenings in the community. Nevertheless, the World Health Organization (WHO) has advised optimizing interventions and systematic screening of high-risk populations for TB (1, 7, 8).

Contact screening is an important part of the Global TB Program and an active case-finding approach for detecting more cases (9–11). This initiative entailed screening for contacts with known TB patients in a methodical manner to ensure early illness identification and treatment, which could ultimately decrease disease burden, risk of transmission, and poor outcomes (12–15). There are two types of contact screening: passive and active. Symptom screening, chest radiograph (CXR), sputum and culture testing, and diagnostic assays, including the GeneXpert system, tuberculin skin test (TST), and interferon release test (IRT) (IGRA) are some of the methods used for contact screening (16). Active screening can be performed by symptom evaluation or CXR, in tandem or sequentially (12).

The goal of active TB screening is early detection of infection in order to safeguard individual and public health and to prevent TB spread (17). Finland does not currently screen for latent TB infection, despite recent guidelines from the European Centers for Disease Prevention and Control (3).

Identifying and treating latent TB infection (LTBI) in people at risk of acquiring an active illness, especially in high-resource settings, is crucial for lowering incidence rates and eradicating TB (18). In this systematic review, we analyzed studies on pulmonary TB transmission detection among close family members in contact with TB patients.

Methods

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. We included all studies published between 2008 and 2021 on the methods of pulmonary TB transmission detection among close family members in contact with TB patients.

Search strategy

Relevant articles were searched in PubMed, Scopus, the Wiley Online Library, Cochrane Library, and Google Scholar. Search keywords were adjusted according to the MeSH terms for health research. In general, the main syntax for retrieving relevant documents included “Self-screening OR screening OR early detection AND tuberculosis OR TB OR pulmonary TB AND vulnerable OR susceptible AND group OR people OR high-risk Group*” (Table 1, Supplementary).

Eligibility criteria

Titles and abstracts of the identified publications were screened for relevance. Full texts were screened for potentially relevant publications or when there was insufficient information in the abstract to adequately assess the relevance. All quantitative studies on household- or community-based self-screenings for TB were included in the study. Publications were excluded if the laboratory diagnostic service focused on (national) screening campaigns, monitoring of disease progression, or retesting or increasing retesting rates. Reviews, trial

protocols, non-peer-reviewed papers, non-English papers, and publications without data or with only hypothetical data were also excluded.

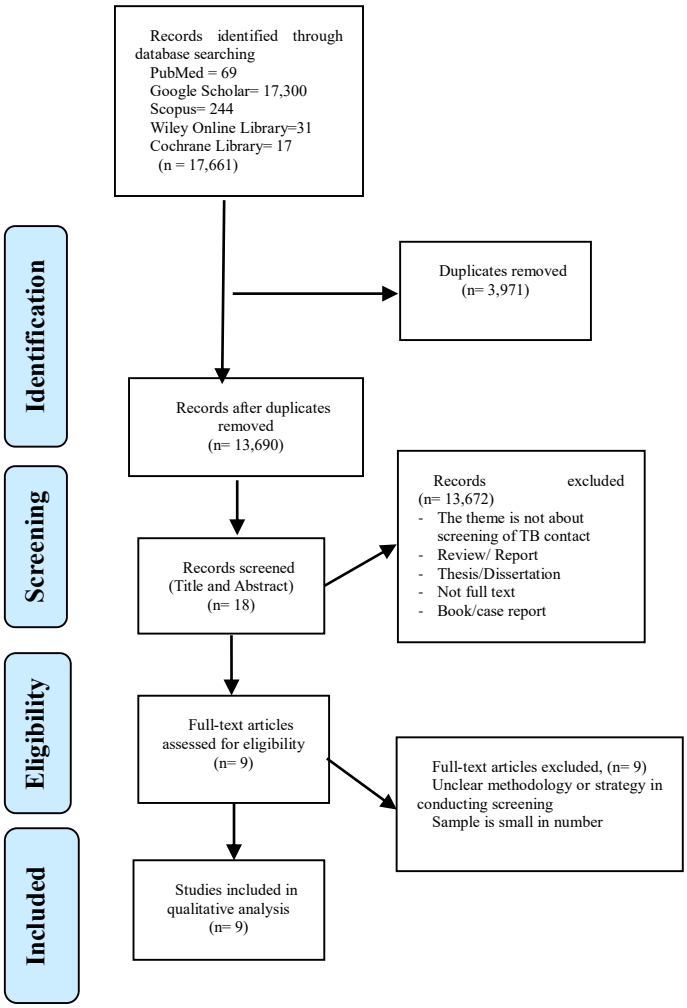

Figure 1. PRISMA flow diagram of the systematic review

Study quality

The retrieved articles were assessed using the National Institutes of Health quality assessment of cross-sectional studies. A scoring sheet wasdeveloped to assess the research methodology and adherence to the scoring criteria for each article that met the inclusion criteria. Two reviewers independently performed quality assessment of primary studies. Articles with scores <30%, 30-70%, and >70% were classified as "poor", "moderate", and "good" quality.

Extraction and analysis

Titles and abstracts were screened on each database. Screening for duplicate articles was carried out using the Mendeley reference manager. Substantive information was extracted from each article into a Microsoft Word table. Full text of the articles were checked for conformity with the inclusion criteria. Two reviewers carried out data extraction independently.

Results

Characteristics of the studies

The reviewed studies were conducted in several countries, including Denmark, Malawi, Pakistan, Cambodia, Vietnam, USA, Uganda, Romania, and Spain. The studies had cross-sectional (n=5), randomized controlled trial (n=1), descriptive (n=1), and cohort (n=2) designs. The sample size varied from 500 to 5,510 participants, including vulnerable and at high-risk individuals including homeless person, person with alcohol and/or substance abuse (19,26,27), family members living with TB patients (20), caregivers (21), TB suspects (22), active contacts (23,25), and immigrants from Mexico, the Philippines, and Vietnam (24). (Table 2, Supplementary).

Screening strategies

The tests conducted for detecting and screening high risk individuals included smear microscopy and culture (19,22), TST (20,24,27), CXR (21–23,26), Gene Xpert MTB/RIF (23), the WHO contact investigation guidelines (25), and interferon-gamma detection techniques (IGRA, QuantiFERON-TB) (27). Overall, the studies included in this review carried out a screening stage starting with registration of all participants with the aim of completing the data and preventing further spread of TB. Sputum samples were taken from the lower respiratory tract and collected by trained nurses (19, 20). The WHO guidelines-based investigations were conducted by clinicians during a visit to the house or the community settings (21, 25). Community health workers, community health volunteers, and community leaders in one study visited household contacts of smear-positive patients who had registered for treatment in the past 2 years, and orally advised them to be present at pre-arranged health centers on the day of the ACF session (22). Trained TB healthcare workers in Vietnam interviewed participants using a social networks questionnaire (23). Experienced clinicians placed and read the TSTs for screening latent TB within immigrant children in the US (24). In Romania, CXR results were checked by chest physicians with 20 years of experience in reading CXRs for TB screening (26). Contact screening in Barcelona, Spain, was conducted by corresponding clinicians according to the epidemiological and clinical characteristics of each person (27).

Screening results

According to a study in Denmark, spot sputum culture was a realistic and promising alternative to mobile X-ray in a community-based screening program (19). A study in Malawi found that children in contact with sputum-smear positive adult TB patients had a high TST positivity rate, highlighting the significance of contact tracing, while CXR might assist identifying high-risk of onward transmission (20). In Pakistan, the proportion of household contacts among TB examined under the National TB program's existing passive screening approach was quite low. It is possible that not all of the symptomatic contacts were seen at the treatment clinics, and some asymptomatic contacts may have contracted TB (21). In Cambodia, community-based ACF was reported to be a cost-effective activity with additional benefits, such as early detection of cases and vulnerable age groups, presumably with long-term benefit of reducing secondary cases in the community (22). By using social network analysis and household contact screening, researchers in Vietnam were unable to discover new MDR-TB patients during a 6-month follow-up period. Refusals hampered the screening of identified contacts (23). In BCG-vaccinated people above the age of 5 years, the CDC recommends IGRA, but in children under the age of 5 years, the CDC recommends TST over IGRA (24). In Uganda, a home-based, SMS-facilitated assessment did not increase family TB contact investigation completeness or yield (25). A study in Romania reported that ACF has the potential to make a significant contribution to TB control and eradication, benefiting both TB risk populations and the broader public (26). The recommended screening tests are TST and IGRA; nevertheless, their sensitivity is not perfect (27).

Discussion

In a low-incidence nation and in high-risk communities, spot sputum cultures can be used as a screening technique for a complete, community-based TB screening program (32, 33). Sputum samples from relevant participants may be collected, TB patients can be identified using sputum culture, and participants can be identified and treated if their sputum culture is positive. Sputum culture remains the gold standard for TB diagnosis where available, and it is frequently employed as such in diagnostic studies. Contamination might rarely result in false positive cultures. In screening programs, smear microscopy is insufficient for identifying TB patients. Although transmission from smear-negative TB patients can be observed, the presence of smear microscopy is a sign of infectiousness (19). The Cambodian community-based ACF method, which focused on TB contacts in impoverished communities with a high TB prevalence, was proven to be cost-effective. Sputum smear microscopy and CXR screenings were performed on all TB suspects who attended the ACF session. Smear-negative TB patients or smear-positive TB cases with poor smear grades might be detected using the ACF method. The method might also discover more TB patients in older age groups, demonstrating ACF's "equalizing function" in TB service provision, especially because the elderly are at danger of dying without any attempt to diagnosing the underlying cause of their symptoms or sickness (22).

The effectiveness of TST in children was demonstrated by a large study in Blantyre, Malawi (20). In addition, CDC states a preference for TST over IGRA for children under 5 years of age (24). According to a research in Spain, TST and IGRA are the recommended screening tests, albeit they do not have optimal sensitivity, and some infected contacts may be misclassified as non-infected, even if they are infected and have a high TB risk (27).

Studies using the WHO guidance investigation showed less than expected results. In Pakistan, household contacts of TB children screened under the current passive screening system of the National TB Program was very low. There could be a possibility that not all symptomatic contacts were brought to the treatment centers. In addition, there might be some asymptomatic contacts with TB infection. Therefore, the entire household contacts of TB patients, regardless of

symptoms, should be screened in order to reduce TB transmission (21). A study in Uganda showed that a home-based, SMS-facilitated evaluation failed to enhance the completion or yield of household TB contact investigations, most likely due to delivery issues. In a real-world public health setting, only around 20% of household eligible contacts completed TB testing, and home sputum collection and automated SMS results reporting were no better than TB testing in a clinic (25).

The CDC guidelines in 2005 suggested to go beyond screening, testing, and treatment, by conducting continuous facility risk assessments to guide infection control policies and practices (16). For clients without documented evidence of LTBI or TB disease, TB risk assessment, symptom evaluation, and Mycobacterium tuberculosis infection test (by IGRA or TST) are necessary. Additional screening is performed for clients with positive test results or symptoms consistent with TB disease. The use of IGRA rather than TST for diagnosing LTBI is not recommended. The first step for early detection of TB transmission is to conduct an initial TB screening, which includes an individual risk assessment (contacts) that is required to interpret any test findings (27). According to the CDC recommendations, test findings provide a baseline for comparison in terms of prospective or known exposure to M. tuberculosis, making it easier to diagnose and treat LTBI or TB illness. When it comes to interpreting test findings, risk assessment and symptom evaluation might be beneficial. Screening and initial testing for people who do not have established TB illness or past LTBI, and individual TB risk assessment are two strategies for early detection of TB transmission. When exposure is detected, post-exposure screening and testing are performed to assess symptoms. When vulnerability is found in a client with an initial negative TB test and no past TB illness or LTBI, IGRA or TST is recommended. In case of negative results, it is suggested to repeat the test 8–10 weeks after the last exposure (9). Screening and serial testing for clients without LTB is usually not suggested, but may be considered for chosen clients. Individuals with untreated LTBI are strongly encouraged to receive TB health education, including information on the client's risk of TB exposure, evaluation, and treatment, unless medically contraindicated (27).

Conclusion

Although TB is one of the most deadly infectious diseases in the world, public awareness and knowledge about this disease are insufficient. Factors such as lack of health information and living too far from health institutions can also influence or delay early detection of TB transmission. Thus, management of self-screening of household contacts of TB patients is essential to break the rope of TB spread. Future studies should focus on TB screening in developing countries with higher TB prevalence rates.

Study limitations

Limited access to good-quality databases and insufficiency of data on TB screening in family members in some studies were some limitations of the present study.

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Ethical statement

The study was approved by the Health Research Ethics Committee of KomisiEtik Penelitian Kesehatan Poltekkes Kemenkes Jambi (Reference numberLB.02.06/2/235/2021).

Conflict of interest

The authors declare that there is no conflict of interest.

Author contributions

AB and AS were responsible for the study conception and design; DMperformed the data collection; DM and UMK performed the data analysis; AS, DM were responsible for the drafting of the manuscript; AS and UMKmade critical revisions to the paper for important intellectual content.

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