"UTILITY OF INTERFERON GAMMA RELEASE ASSAY AND TUBERCULIN SKIN TEST FOR SCREENING LATENT TUBERCULOSIS INFECTION AMONG HEALTH CARE WORKERS- A COMPARATIVE STUDY"

By

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Under the guidance of

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LIST OF ABBREVIATIONS USED

1. Tuberculosis (TB)
2. Healthcare workers (HCWs)
3. Latent tuberculosis infection (LTBI)
4. Low- and middle-income countries (LMICs),
5. Tuberculin skin test (TST)
6. Interferon gamma release assays (IGRAs)
7. Bacillus Calmette–Guérin (BCG)
8. Early secreted antigenic target 6 (ESAT-6)
9. Culture filtrate protein 10 (CFP-10),
10. World Health Organization (WHO)
11. Isoniazid preventive therapy (IPT)
12. Isoniazid (INH) Therapy
13. Diabetes mellitus (DM)
14. Personal protective equipment (PPE)
15. Purified protein derivative (PPD)
16. Positive predictive value (PPV)
17. Positive predictive value (PPV)
18. Confidence Intervals (CI)
19. Enzyme-linked immunosorbent assay (ELSA)
20. Acid-fast bacilli (AFB
21. Human immunodeficiency virus (HIV)
22. Acquired immunodeficiency syndrome (AIDS)
23. Control and Prevention (CDC

ABSTRACT

INTRODUCTION: LTBI is characterized by a state of persistent immune response to Mycobacterium tuberculosis antigens without active TB manifestation. Despite being asymptomatic, individuals with LTBI serve as potential reservoirs for future TB outbreaks if left untreated. The seedbed for developing TB disease and continuous transmission could be latent tuberculosis infection. In healthy persons, the lifetime risk of reactivation of LTBI is 10%, with 5% acquiring active TB disease within the first 5 years following infection. Therefore, early identification and preventive treatment of LTBI among HCWs are crucial steps in TB control and infection prevention efforts

AIM & OBJECTIVES OF THE STUDY: This study aimed to assess the distribution of latent tuberculosis infection (LTBI) and associated risk factors among healthcare workers (HCWs) using Tuberculin Skin Test (TST) and Interferon-Gamma Release Assay (IGRA) screening methods.

MATERIAL AND METHODS: A structured questionnaire used for individual risk assessment of TB infection among HCWs like sociodemographic characteristics (e.g., age, gender, employed position and duration in that position), knowledge of TB prevention and control practices, History of diabetes mellitus, smoking, BCG vaccination, immunosuppression, current symptoms of tuberculosis, past history of Tuberculosis and treatment taken. History of tuberculosis, recent contact with new active tuberculosis case and have they undergone tuberculin skin test and when it was done. Following the completion of the risk assessment questionnaire, enrolled subjects underwent diagnostic tests to detect latent tuberculosis infection.

RESULTS: A total of 73 HCWs participated, with a predominant age group of 20 to 29 years (56.2%). Females comprised 32.9% of the sample, while males constituted 67.1%. Lab technicians represented the majority (74.0%) among occupational roles.Results showed a comparable distribution between TB Skin Test and IGRA results, with 54.8% and 45.2% testing negative, and 50.7% and 49.3% testing negative, respectively. The TB Skin Test exhibited a sensitivity of 64.86%, specificity of 55.56%, PPV of 60.00%, NPV of 60.61%, and accuracy of 60.27%. The IGRA test showed a sensitivity of 55.56%, specificity of 64.86%, PPV of 60.61%, NPV of 60%, and accuracy of 60.27%. Disease prevalence among HCWs was estimated at 50.68%.Analysis of risk factors revealed significant associations with occupation and working hours ($P < 0.0001$). Lab technicians (38.9%) and attenders (71.4%) showed higher LTBI rates. Doctors and managers also

displayed significant associations ($P < 0.0001$). There were no significant associations with age, gender, smoking history, or BCG immunization.

CONCLUSION: In conclusion, this study provides valuable insights into LTBI distribution and risk factors among HCWs. It emphasizes the need for targeted preventive measures, regular screening, and infection control. Understanding occupational risks and working conditions is crucial for effective LTBI management. Further research with larger samples can enhance understanding and guide tailored interventions for LTBI prevention in healthcare settings.

KEYWORDS:

Latent Tuberculosis Infection, Healthcare Workers, Tuberculin Skin Test, Interferon-Gamma Release Assay, Risk Factors, Screening Methods, Disease Prevalence, Occupational Risks, Infection Control, Preventive Measures.

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INTRODUCTION

Tuberculosis (TB) remains a significant global health concern, with latent tuberculosis infection (LTBI) posing a particular challenge, especially for healthcare workers (HCWs) who are at heightened risk due to their frequent exposure to TB patients.

LTBI is characterized by a state of persistent immune response to Mycobacterium tuberculosis antigens without active TB manifestation. Despite being asymptomatic, individuals with LTBI serve as potential reservoirs for future TB outbreaks if left untreated. The seedbed for developing TB disease and continuous transmission could be latent tuberculosis infection. In healthy persons, the lifetime risk of reactivation of LTBI is 10%, with 5% acquiring active TB disease within the first 5 years following infection. Therefore, early identification and preventive treatment of LTBI among HCWs are crucial steps in TB control and infection prevention efforts (1)

The prevalence of LTBI among HCWs is notably high, particularly in low- and middle-income countries (LMICs), where TB burden is already substantial. In regions like India, TB notification rates among HCWs far exceed those of the general population, underscoring the urgent need for targeted screening and intervention strategies within healthcare settings. (2)

Traditionally, the tuberculin skin test (TST) has been the primary method for LTBI screening. However, its limitations, including cross-reactivity with environmental mycobacteria and prior Bacillus Calmette–Guérin (BCG) vaccination, have prompted the exploration of alternative diagnostic tools. Interferon gamma release assays (IGRAs), leveraging advancements in genomics and molecular biology, offer promising alternatives. These tests, such as the QuantiFERON TB Gold assay, utilize specific M. tuberculosis antigens, such as early secreted antigenic target 6 (ESAT-6) and culture filtrate protein 10 (CFP-10), providing greater specificity and immunity to confounding factors like BCG vaccination. (3)

Despite these advancements, challenges persist in accurately diagnosing LTBI among HCWs, exacerbated by the lack of nationally representative data on LTBI burden in high TB burden countries. Moreover, the absence of separate facilities for TB patients and inadequate infection control measures further heighten the risk of TB transmission within healthcare settings**.** (4)

Given the critical role of HCWs in TB control and the heightened risk they face, a comprehensive approach to LTBI screening is imperative. Critical World Health Organization

(WHO)-recommended interventions include infection prevention and control measures as well as regular HCW latent tuberculosis infection (LTBI) screening along with preventive TB treatment. However, which screening test should be used, the tuberculin skin test (TST) or the interferon gamma release assay (IGRA) for LTBI, remains unclear. (2)

AIM & OBJECTIVES OF THE STUDY

AIM:

Screening of latent tuberculosis infection by tuberculin skin test and gamma interferon test in health care workers.

OBJECTIVES OF THE STUDY:

1. To compare tuberculosis skin test and interferon-gamma release assay for screening of latent tuberculosis infection among Health care workers

2. To assess the risk of Tuberculosis infection among Health care worker

REVIEW OF LITERATURE

Tuberculosis (TB) remains a significant global health concern, with an estimated 10 million new cases and 1.4 million deaths reported in 2019 alone (5) India is home to one of the largest TB epidemics globally, with an estimated 2.64 million new cases of TB in 2020 (6) WHO, 2021 Among the strategies for TB control is the identification and treatment of latent tuberculosis infection (LTBI), which presents a reservoir for future active TB cases. LTBI remains a critical issue in the global fight against TB. LTBI refers to the presence of Mycobacterium tuberculosis in the body without any active symptoms or disease. LTBI affects a substantial portion of the global population, posing a significant challenge to tuberculosis (TB) control efforts worldwide (5). This review provides an overview of LTBI, its epidemiology, risk factors, diagnostic methods, management strategies, and the challenges associated with its control.

History

The history of LTBI spans centuries of medical observation, scientific discovery, and evolving understanding of tuberculosis (TB) as a disease. This review explores the historical milestones, key figures, and pivotal discoveries that have shaped our understanding of LTBI from ancient civilizations to modern medicine.

Ancient observations:

- Early Descriptions in Ancient Texts: TB has a long history, with evidence of the disease found in ancient human remains dating back thousands of years. Ancient texts from civilizations such as Egypt, India, China, and Greece describe symptoms consistent with TB, often referring to it as "consumption" or "phthisis."
- Hippocrates and Galen: Ancient Greek physicians, including Hippocrates and Galen, documented cases of a wasting disease resembling TB. They observed symptoms such as coughing, fever, and weight loss, recognizing the severity of the illness (7).

The Emergence of Scientific Inquiry:

- Robert Koch's Discovery: In 1882, the German physician and scientist Robert Koch identified Mycobacterium tuberculosis as the causative agent of TB. His groundbreaking discovery, known as Koch's Postulates, provided a definitive link between the bacillus and the disease.
- Development of Tuberculin: Building upon Koch's work, Albert Calmette and Camille Guérin developed a protein derivative of TB bacteria known as "tuberculin" in the early 20th century. This laid the foundation for diagnostic testing and the concept of immune response to TB.

Evolution of Diagnostic Tests:

- Tuberculin Skin Test (TST): In 1907, Charles Mantoux introduced the Tuberculin Skin Test, also known as the Mantoux test. This test, based on the injection of tuberculin into the skin and measuring the immune response, became a standard tool for diagnosing TB infection.
- Recognition of Latent Infection: Over time, clinicians noted cases of individuals with positive skin tests but no active TB disease. This led to the recognition of a latent state of TB infection, where the bacteria remain dormant within the body.

Research on Latent Infection:

- Work of W. Cecil Noble: In the mid-20th century, researchers such as W. Cecil Noble conducted seminal studies on the natural history of TB infection. They described a state of "latent tuberculosis," where individuals harbored the TB bacteria without exhibiting symptoms.
- René Dubos' Contributions: René Dubos, a microbiologist and environmentalist, further explored the concept of LTBI in the 1950s. His research highlighted the role of host immunity in controlling TB infection. (8)

Introduction of Preventive Therapy:

- Isoniazid (INH) Therapy: In the 1950s, the discovery of isoniazid as an effective anti-TB medication paved the way for preventive therapy. Studies demonstrated that INH could reduce the risk of progression from LTBI to active TB disease.
- WHO Recommendations: The World Health Organization (WHO) began recommending isoniazid preventive therapy (IPT) for individuals with LTBI in the 1980s. This marked a significant step in TB control efforts. (5).

Challenges and Future Directions:

- Advances in Diagnostic Tools: Alongside the TST, Interferon-Gamma Release Assays (IGRAs) such as QuantiFERON-TB Gold were developed in the late 20th century. These tests offered improved specificity and eliminated the need for a return visit for result reading.
- Global TB Elimination Goals: The WHO's End TB Strategy, launched in 2014, includes specific targets for addressing LTBI as part of the global effort to eliminate TB by 2035.
- Ongoing Research: Current research focuses on new diagnostic tools, shorter and more tolerable preventive therapies, and strategies to reach high-risk populations, particularly in low- and middle-income countries (5).

The history of latent tuberculosis infection reflects centuries of medical inquiry, scientific discovery, and advancements in TB diagnosis and treatment. From ancient descriptions of TB-like symptoms to the development of tuberculin skin tests, the concept of LTBI has evolved significantly. Today, efforts continue to tackle the challenges posed by LTBI and work towards the ultimate goal of eliminating TB as a global health threat.

Epidemiology

According to the WHO, an estimated one-quarter of the global population is infected with LTBI, making it a significant reservoir for future active TB cases This translates to billions of individuals worldwide harboring the TB bacteria without showing any active symptoms of the disease. The burden of LTBI varies widely across regions, with higher prevalence rates observed in countries with a high incidence of TB

The prevalence of LTBI varies across regions, with higher rates observed in countries with a high burden of TB. In areas where TB is endemic, such as parts of sub-Saharan Africa, Southeast Asia, and parts of Eastern Europe, the prevalence of LTBI can be particularly high. Factors contributing to this include poor access to healthcare, high population density, inadequate infection control measures, and limited resources for TB prevention and treatment. India bears a significant burden of tuberculosis (TB), with a high prevalence of both active TB disease and LTBI.

India, with its vast population and high burden of TB, is one of the countries where LTBI is prevalent. The exact prevalence of LTBI in India varies across states and regions but is estimated to be significant. Efforts to estimate and address LTBI in India are crucial for TB control and elimination strategies, including targeted screening, preventive therapy, and public health interventions. Studies conducted in different parts of the country have provided varying estimates, reflecting the diverse epidemiological landscape of TB in India. Studies have shown varying prevalence rates of LTBI across different regions of India (5).

In urban areas, where population density is high, and living conditions are crowded, the prevalence of LTBI tends to be higher. In rural settings, factors such as poor access to healthcare, limited awareness about TB, and delayed diagnosis contribute to the burden of LTBI.

- Studies in Urban Areas: In urban settings with high population density and crowded living conditions, studies have reported a prevalence of LTBI ranging from 20% to 70% among different population groups (9,10).
- Studies in Rural Areas: In rural areas, where access to healthcare services may be limited, prevalence rates of LTBI have also been observed to be substantial, ranging from 20% to 60% in various studies (11,12)

- High-Risk Populations: Certain high-risk populations in India, such as household contacts of TB patients, healthcare workers, people living with HIV/AIDS, and urban slum dwellers, often have higher rates of LTBI compared to the general population (13,12)

Challenges in Estimating LTBI Prevalence in India

Estimating the exact prevalence of LTBI in India faces several challenges, including:

1. Limited Access to Testing: In many parts of the country, access to diagnostic tests for LTBI, such as Interferon-Gamma Release Assays (IGRAs), may be limited, leading to underestimation of the true burden.
2. Diverse Epidemiological Settings: India is a large and diverse country with varying TB epidemiology across states and regions, making it challenging to generalize LTBI prevalence.
3. Population Mobility: Migration within India, as well as migration from high TB burden regions to urban areas, can lead to changes in LTBI prevalence in different settings.
4. Underreporting and Stigma: Due to social stigma associated with TB, individuals may be hesitant to seek testing or disclose their status, leading to underreporting.

Risk Factors:

Latent tuberculosis infection (LTBI) represents a silent reservoir of Mycobacterium tuberculosis, posing a risk for the development of active tuberculosis (TB) disease. Understanding the risk factors associated with LTBI is crucial for targeted screening, preventive therapy, and TB control strategies. This review examines the current literature on the risk factors for LTBI, encompassing a range of demographic, clinical, and social determinants.

Demographic Factors:

Age:

- Several studies have highlighted age as a significant risk factor for LTBI, with older individuals at higher risk due to cumulative exposure over time (14,15)

Gender:

- Gender disparities in LTBI prevalence have been observed, with some studies reporting higher rates among males compared to females, possibly due to occupational exposure (15,16)

Ethnicity and Migration:

- Ethnicity and migration status play a role in LTBI risk, with higher rates observed among immigrants from countries with a high TB burden and certain ethnic groups (17,18)

Clinical Factors:

HIV/AIDS:

- Co-infection with HIV/AIDS is a well-established risk factor for LTBI, as HIV weakens the immune system, increasing the risk of TB reactivation (19,20)

Diabetes Mellitus:

- Diabetes mellitus has been consistently identified as a risk factor for LTBI, possibly due to impaired immune function and increased susceptibility to TB infection (21)

Immunocompromised States:

- Conditions such as chronic renal failure, malignancies, and organ transplantation, which compromise the immune system, are associated with an increased risk of LTBI (23)

Social Determinants:

Household Contacts:

- Close contact with active TB cases, especially within households, is a significant risk factor for acquiring LTBI due to ongoing exposure to infectious droplets (24,22,)

Occupational Exposure:

- Certain occupations, such as healthcare workers, prison staff, and migrant workers, are at higher risk of LTBI due to increased exposure to TB patients or crowded working conditions (25)

Socioeconomic Status:

- Lower socioeconomic status, including poverty, overcrowding, and inadequate access to healthcare, is associated with a higher prevalence of LTBI (26,27)

Lifestyle Factors:

Smoking:

- Tobacco smoking has been identified as a risk factor for LTBI, possibly due to its impact on the respiratory system and immune response (28,29)

Alcohol Use:

- Excessive alcohol consumption has been linked to an increased risk of LTBI, potentially through its immunosuppressive effects (30,31)

The risk factors for latent tuberculosis infection are multifaceted, encompassing demographic, clinical, social, and lifestyle factors. Older age, male gender, HIV/AIDS, diabetes mellitus, household contacts with TB patients, certain occupations, low socioeconomic status, smoking, and alcohol use are among the key risk factors identified in the literature. Understanding these factors is essential for targeted screening, preventive therapy, and public health interventions aimed at reducing the burden of LTBI and preventing the progression to active TB disease.

High-Risk Populations:

Several populations in India are at an increased risk of acquiring LTBI, including:

1. Household Contacts of TB Patients:

- Individuals living with someone who has active TB are at a significantly higher risk of acquiring LTBI due to close and prolonged exposure.

2. Healthcare Workers:

- Healthcare settings, especially those with inadequate infection control measures, pose a risk to healthcare workers who may come into contact with TB patients.

3. People Living with HIV/AIDS:

- Co-infection with HIV weakens the immune system, making individuals more susceptible to LTBI and progression to active TB.

4. Urban Slum Dwellers:

- Overcrowded and poorly ventilated living conditions in urban slums increase the risk of TB transmission, leading to a higher prevalence of LTBI.

5. Migrant Populations:

- Migration within India, as well as migration from high TB burden regions to urban areas, contributes to the spread of LTBI.

6. Children and Adolescents:

- Children living in households with TB patients or in crowded environments are particularly vulnerable to LTBI.

7. Incarcerated Populations:

- Prisons and detention facilities often have higher rates of TB due to crowded conditions and limited access to healthcare.

The epidemiology of latent tuberculosis infection in India reflects the complex interplay of social, economic, and healthcare factors (6)

Pathogenesis:

Latent tuberculosis infection (LTBI) occurs when a person is infected with Mycobacterium tuberculosis (the bacteria that causes tuberculosis) but does not yet show active symptoms of the disease. The pathogenesis, or development, of latent tuberculosis involves a complex interaction between the bacterium and the host's immune system.

key steps in the pathogenesis of latent tuberculosis:

1. Initial Infection: The process begins when a person inhales droplets containing M. tuberculosis, usually through close contact with an infected individual who is coughing or sneezing. The bacteria reach the lungs and are engulfed by macrophages, which are cells of the immune system that play a crucial role in defending against pathogens.
2. Granuloma Formation: In most cases, the body's immune response is activated, and the infected macrophages initiate the formation of granulomas. Granulomas are small, organized collections of immune cells, primarily macrophages and T cells, which surround and contain the bacteria. The goal of the granuloma is to prevent the spread of the bacteria to other parts of the body.
3. Cellular Immune Response: Within the granuloma, there is an ongoing battle between the immune cells and the bacteria. T cells, particularly a type called CD4+ T cells, play a critical role in controlling the infection. These T cells release cytokines, chemical messengers that help activate other immune cells to attack the bacteria.
4. Balance of Immune Response: In most cases, the immune response successfully contains the infection within the granuloma, leading to a state of equilibrium between the bacteria and the immune system. The bacteria are not completely eradicated but are kept in check.
5. Latency: During the latent phase of tuberculosis infection, individuals have no symptoms of active disease. However, the bacteria remain alive within the granulomas, in a dormant or non-replicating state. This latent phase can last for years or even decades.

Factors Influencing Reactivation:

- Weakening of the Immune System: Reactivation of latent tuberculosis is more likely to occur when the immune system becomes compromised. This can happen due to conditions such as HIV infection, malnutrition, diabetes, certain medications (like corticosteroids or chemotherapy), or aging.
- Other Diseases: Certain conditions, such as silicosis or chronic kidney disease, can also increase the risk of reactivation.
- Stress: Severe physical or emotional stress can weaken the immune system and increase the risk of reactivation.
- Smoking: Tobacco smoke damages the lungs and weakens the immune system, making reactivation more likely.
- Old Age: The risk of reactivation increases with age, as the immune system weakens over time.

When the immune system becomes weakened or compromised, the bacteria can escape the granuloma, multiply, and cause active tuberculosis disease. This leads to the development of symptoms such as cough, fever, weight loss, and night sweats. If left untreated, active tuberculosis can be severe and even life-threatening.

Treatment for latent tuberculosis aims to prevent the reactivation of the disease into its active form. This typically involves a course of antibiotics, such as isoniazid, rifampin, or a combination of both, taken for several months. This treatment helps to kill the dormant bacteria and reduce the risk of developing active tuberculosis in the future.

This study provides a comprehensive overview of the pathogenesis of LTBI, focusing on the immune responses involved in the containment of Mycobacterium tuberculosis. It discusses the role of granulomas, the balance between host defense mechanisms and bacterial evasion strategies, and factors influencing the transition from latent infection to active disease.(47)

> This article delves into the complexities of the immune response to M. tuberculosis infection, particularly in the context of LTBI. It discusses the formation and maintenance of granulomas, the role of various immune cells including macrophages and T cells, and the balance between protective immunity and tissue damage(48).

This study focuses on the strategies employed by M. tuberculosis to evade host immune responses, leading to the establishment of latent infection. It discusses the role of granulomas as both a host defense mechanism and a niche for bacterial persistence.(49)

This comprehensive study covers various aspects of tuberculosis immunology, including the pathogenesis of LTBI. It discusses the immune cells involved, the cytokine signaling pathways, and the factors influencing the progression to active disease.(50)

This study discusses the potential for host-directed therapies to enhance immune responses against M. tuberculosis. It covers strategies aimed at modulating the host immune system to improve bacterial clearance and prevent reactivation.(51)

> This review provides a detailed overview of the immunological aspects of latent tuberculosis, focusing on the host-pathogen interactions that lead to the establishment and maintenance of LTBI.(52)

These reviews collectively provide a thorough understanding of the pathogenesis of latent tuberculosis infection, highlighting the intricate interplay between the host immune response and M. tuberculosis. They also discuss the challenges in diagnosing, treating, and preventing reactivation of the disease, offering insights into potential future therapeutic strategies.

The review discusses the role of antigen-presenting cells, T cells, cytokines, and chemokines in the formation and maintenance of granulomas. It also explores the factors that contribute to the long-term survival of the bacteria in a dormant state.(47)

The review discusses the role of bacterial factors such as dormancy-associated proteins and lipid metabolism in promoting latency. It also examines the host factors, including immune cell dysfunction and hypoxia within granulomas, that contribute to the long-term survival of the bacteria(53).

The review provides an overview of the immune responses involved in LTBI, the challenges in diagnosing latent infection, and the current strategies for treating and preventing reactivation. It also discusses the importance of identifying individuals at high risk for progression to active disease. (33)

These reviews collectively offer a deep understanding of the pathogenesis of latent tuberculosis infection, highlighting the intricate interplay between the host immune response and M. tuberculosis. They also discuss the challenges in diagnosing, treating, and preventing reactivation of the disease, providing insights into potential future therapeutic strategies and biomarkers for LTB

In brief, the pathogenesis of latent tuberculosis involves the formation of granulomas, the activation of immune responses to contain the infection, and the persistence of the bacteria in a dormant state within these granulomas. Factors that disrupt this equilibrium can lead to reactivation of the disease, resulting in active tuberculosis. Understanding the pathogenesis of LTBI is crucial for developing strategies to diagnose, treat, and prevent both latent and active tuberculosis infections.

Diagnostic Methods:

Two of the most common methods for LTBI screening are the Tuberculin Skin Test (TST) and Interferon-Gamma Release Assays (IGRAs). This review examines the literature surrounding the use of these tests, their comparative effectiveness, limitations, and evolving roles in LTBI screening

The selection of an appropriate test for screening LTBI is a critical step in TB control programs. This review examines the current literature comparing Interferon-Gamma Release Assays (IGRAs) and Tuberculin Skin Tests (TST) for LTBI screening, focusing on their performance characteristics, advantages, limitations, and considerations for implementation in diverse clinical

settings. Accurate diagnosis of LTBI is essential for initiating preventive treatment and reducing the risk of progression to active TB. (32)

- Tuberculin Skin Test (TST):
- TST, also known as the Mantoux test, involves injecting a purified protein derivative (PPD) of TB antigen into the skin and measuring the delayed hypersensitivity reaction.
- Advantages:
    - Cost-effective and widely available.
    - Long-standing history of use in TB screening programs.
- Limitations:
    - Cross-reactivity with Bacillus Calmette-Guérin (BCG) vaccination and exposure to non-tuberculous mycobacteria (NTM), leading to false-positive results.
    - Requires two visits for administration and result reading
- Studies have highlighted the TST's sensitivity in immunocompetent individuals, detecting LTBI and predicting progression to active disease (32) However, its specificity is a concern, especially in populations with a high prevalence of BCG vaccination or exposure to environmental mycobacteria. The need for a second patient visit for test reading is another drawback, potentially leading to loss to follow-up and decreased adherence to screening protocols (33)

- Interferon-Gamma Release Assays (IGRAs): (33)
    - IGRAs, such as QuantiFERON-TB Gold and T-SPOT.TB, measure the release of interferon-gamma in response to TB antigens.
    - Advantages:
        - Specificity for Mycobacterium tuberculosis, reducing false-positive results in BCG-vaccinated populations.
        - Single-visit testing without a need for a return visit for result reading.
        - Less affected by prior BCG vaccination or NTM exposure.
    - Limitations:
        - Higher cost compared to TST.
        - Requires laboratory infrastructure and trained personnel.
        - Limited evidence in certain populations, such as children under 5 years old or immunocompromised individuals.
- Multiple studies have demonstrated the superior specificity of IGRAs compared to the TST, particularly in BCG-vaccinated populations and those exposed to non-tuberculous mycobacteria (39) Additionally, IGRAs have shown good correlation with the degree of TB exposure, making them valuable in occupational health settings and contact investigations

Comparative Effectiveness and Clinical Utility

- Sensitivity and Specificity:
    - Meta-analyses have shown comparable sensitivity between IGRAs and TST for detecting LTBI, particularly in low TB burden settings IGRAs tend to have higher specificity compared to TST, especially in BCG-vaccinated populations and areas with a high prevalence of NTM (34,35,36)

- Agreement and Discordance:
  - Studies have reported moderate to substantial agreement between IGRAs and TST, with varying levels of discordance. Factors contributing to discordance include BCG vaccination status, exposure to NTM, and immunosuppressive conditions (37,35)
- Predictive Value:
  - Both IGRAs and TST have been shown to predict the risk of progression to active TB disease, with some studies suggesting a stronger association with IGRAs (38)

Comparative studies between TST and IGRAs have yielded varied results. Some have found IGRAs to be more sensitive in immunocompromised individuals, such as those with HIV infection or receiving immunosuppressive therapy (39) However, cost considerations, availability, and the lack of standardized cutoff values for IGRA interpretation remain challenges in their widespread adoption. Recent literature also emphasizes the evolving role of IGRAs in TB screening algorithms. For instance, some guidelines recommend using IGRAs as the initial test for LTBI in BCG-vaccinated individuals or those unlikely to return for TST reading (33) Others suggest a two-step approach, starting with the TST followed by an IGRA if the TST is positive, to improve sensitivity while maintaining specificity (39)

Considerations for Implementation

- Population Characteristics:
  - The choice between IGRA and TST may vary based on the population being screened, such as age, BCG vaccination status, and prevalence of NTM exposure.
- Healthcare Setting:
  - Availability of laboratory facilities, trained personnel, and cost considerations influence the feasibility of implementing IGRAs.

- Resource Constraints:
    - In resource-limited settings, TST may be preferred due to its lower cost and simpler administration.
- Integration into Guidelines:
    - National and international guidelines, such as those from the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC), may provide recommendations on the use of IGRA or TST based on local epidemiology and resources.

Both the TST and IGRAs play vital roles in LTBI screening, each with its advantages and limitations. The TST, with its long history and established predictive value, remains a valuable tool, especially in resource-limited settings. On the other hand, IGRAs offer improved specificity and logistical advantages, making them attractive options in certain populations. While TST and IGRAs remain the primary diagnostic tools, their limitations highlight the need for improved testing strategies. The choice between Interferon-Gamma Release Assays (IGRAs) and Tuberculin Skin Tests (TST) for screening latent tuberculosis infection (LTBI) depends on various factors, including performance characteristics, population characteristics, healthcare setting, and resource constraints. Both tests have demonstrated utility in LTBI screening, with IGRAs offering advantages in specificity and single-visit testing, while TST remains cost-effective and widely available. Clinicians and TB control programs should consider local epidemiology, guidelines, and available resources when selecting the most appropriate test for LTBI screening. As research continues to refine our understanding of LTBI screening, a tailored approach that considers these factors will be essential in optimizing TB control strategies (5)

Management Strategies

- The management of LTBI aims to prevent the development of active TB and reduce transmission. The management of latent tuberculosis infection (LTBI) plays a crucial role in tuberculosis (TB) control efforts, aiming to prevent the progression from latent infection to active TB disease. This review explores the current literature on the various aspects of LTBI management, including screening, diagnostic tools, preventive therapy options, and challenges in implementation (5)

Screening for LTBI:

- Tuberculin Skin Test (TST):
    - The Tuberculin Skin Test, or Mantoux test, remains a widely used method for LTBI screening. It involves injecting a purified protein derivative (PPD) of TB antigen into the skin and measuring the delayed hypersensitivity reaction.
- Interferon-Gamma Release Assays (IGRAs):
    - IGRAs, such as QuantiFERON-TB Gold and T-SPOT.TB, offer advantages in specificity and reduced need for a return visit for result reading. They measure the release of interferon-gamma in response to TB antigens.
- Diagnostic Algorithm:
    - Current guidelines often recommend a two-step approach to LTBI screening, using TST or IGRA as the initial test, followed by a confirmatory test if the initial result is positive.

Treatment options include:

1. Isoniazid Preventive Therapy (IPT):
    - IPT involves a 6- to 9-month course of isoniazid, which has been shown to reduce the risk of progression to active TB by up to 90% (40)

- Challenges with IPT include adherence to the full course, potential hepatotoxicity, and the emergence of drug resistance.

2. Rifampicin-based Regimens:
    - Shorter rifampicin-based regimens, such as 3 to 4 months of rifampicin alone or in combination with isoniazid, offer improved adherence and reduced hepatotoxicity compared to longer IPT courses (41)

3. Observation and Monitoring:

- Close monitoring of LTBI patients is crucial to ensure treatment completion and early detection of adverse effects.
    - For certain high-risk groups, such as contacts of active TB cases or immunocompromised individuals, preventive treatment is strongly recommended (40)

Targeted Populations for LTBI Treatment:

- Close Contacts of Active TB Cases:
    - Individuals who have been in close contact with someone diagnosed with active TB are a high-priority group for LTBI treatment.
- Healthcare Workers:
    - Healthcare settings pose a risk of TB exposure, making healthcare workers a key population for LTBI screening and treatment.
- People Living with HIV/AIDS:
    - Co-infection with HIV significantly increases the risk of progression from LTBI to active TB, making LTBI treatment crucial for this population.
- High-Risk Settings:
    - Settings such as prisons, homeless shelters, and long-term care facilities are associated with higher rates of TB transmission, warranting targeted LTBI management strategies (5)

Programs for Latent Tuberculosis Infection (LTBI) Management

Programs for the management of latent tuberculosis infection (LTBI) play a pivotal role in tuberculosis (TB) control efforts, aiming to identify individuals with LTBI and provide preventive therapy to reduce the risk of progression to active TB disease. This review examines the current

literature on various LTBI management programs, including their implementation strategies, effectiveness, challenges, and future directions. (33)

LTBI Screening Programs

- Healthcare Settings:
    - LTBI screening programs in healthcare settings target healthcare workers and patients, aiming to identify individuals at increased risk of TB exposure.
    - Strategies include routine testing using Interferon-Gamma Release Assays (IGRAs) or Tuberculin Skin Tests (TST) upon employment, admission, or during regular health check-ups.
- Correctional Facilities:
    - LTBI programs in prisons and jails focus on screening and treating inmates, given the higher risk of TB transmission in these settings.
    - Programs may include mass screening campaigns, targeted testing based on risk factors, and provision of preventive therapy.
- Community-Based Programs:
    - LTBI screening initiatives in community settings target high-risk populations, such as immigrants from TB-endemic countries, homeless individuals, and those with comorbidities.
    - Mobile clinics, outreach programs, and collaborations with community organizations facilitate access to testing and treatment.

Effectiveness of LTBI Programs (45)

- Reduction in TB Incidence:
    - Studies have demonstrated the effectiveness of LTBI programs in reducing the incidence of active TB disease.
    - A systematic review by found that LTBI treatment reduced the risk of developing TB by 60-90% in various populations. (45)

- Cost-Effectiveness:
    - Cost-effectiveness analyses have shown that LTBI screening and treatment programs are economically favorable, particularly in high-burden TB settings.
    - Early identification and treatment of LTBI prevent costly TB disease cases and reduce the overall burden on healthcare systems.
- Impact on High-Risk Groups:
    - LTBI programs have shown significant benefits in high-risk groups, such as people living with HIV/AIDS, close contacts of TB cases, and healthcare workers.
    - Targeted interventions in these populations result in early detection, treatment initiation, and prevention of TB transmission.

Challenges in LTBI Program Implementation

- Low Uptake and Adherence:
    - Barriers to LTBI testing and treatment include lack of awareness, stigma associated with TB, fear of side effects, and logistical challenges.
    - Ensuring patient education, counseling, and support services can improve uptake and adherence.
- Limited Access to Testing:
    - Resource-constrained settings face challenges in access to diagnostic tools, particularly IGRAs, which require laboratory infrastructure.
    - TST may be preferred in these settings due to its simplicity and lower cost.
- Monitoring and Follow-Up:
    - LTBI programs require robust systems for monitoring individuals on treatment, assessing treatment completion rates, and ensuring long-term follow-up.
    - Integration with existing healthcare systems and electronic medical records can facilitate tracking and management.

Future Directions and Recommendations

- Optimizing Screening Algorithms:

    - Continued research is needed to refine LTBI screening algorithms, considering population-specific risk factors and epidemiological trends.
- Tailored Interventions:
    - Programs should tailor interventions based on the local epidemiology of TB, community needs, and available resources.
- Innovative Technologies:
    - Adoption of novel technologies, such as point-of-care tests and telemedicine, can enhance LTBI program reach and efficiency.
- Addressing Social Determinants:
    - LTBI programs should address social determinants of health, such as poverty, housing instability, and access to healthcare, to improve program effectiveness.
- Development of Shorter Regimens:
    - Continued research focuses on developing shorter and more tolerable LTBI treatment regimens to improve adherence and completion rates.
- Integration of LTBI Services:
    - Integration of LTBI screening and treatment into existing healthcare programs, such as HIV clinics or primary care settings, can improve access and uptake.
- Targeted Public Health Campaigns:
    - Public health campaigns aimed at raising awareness about LTBI, its risks, and the importance of treatment can improve community engagement and support.

Programs for the management of latent tuberculosis infection (LTBI) play a critical role in TB control efforts, aiming to identify and treat individuals at risk of developing active TB disease. These programs, implemented in various settings including healthcare facilities, correctional facilities, and communities, have demonstrated effectiveness in reducing TB incidence and are cost-effective. Challenges such as low uptake, limited access to testing, and monitoring requirements need to be addressed through tailored interventions, innovative technologies, and a focus on social determinants of health. Future directions involve optimizing screening algorithms, enhancing programmatic reach, and integrating LTBI management into comprehensive TB control strategies (33)

Tuberculosis (TB) remains a significant global health burden, particularly in low- and middle-income countries (LMICs), where healthcare workers (HCWs) face heightened risk of latent tuberculosis infection (LTBI) due to occupational exposure. The utility of interferon-gamma release assays (IGRAs) for LTBI screening among HCWs in LMICs has been a subject of debate and investigation in recent years.

Several studies have evaluated the performance of IGRAs, such as the QuantiFERON® TB Gold Test-in-tube (QFT-GIT), compared to the tuberculin skin test (TST) in LMIC settings. These studies have aimed to determine the accuracy, reliability, and practicality of IGRAs in identifying LTBI among HCWs.

In a systematic review and meta-analysis by Pai et al. (2014), which included studies from various geographic regions, IGRAs demonstrated higher specificity compared to TST, particularly in BCG-vaccinated populations where TST may yield false-positive results. However, concerns were raised regarding the cost and logistical challenges associated with implementing IGRAs in resource-limited settings. (39)

Similarly, a study conducted by Menzies et al. (2011) in South Africa compared the performance of TST and QFT-GIT among HCWs and found that QFT-GIT had higher specificity but lower sensitivity compared to TST. The authors highlighted the importance of considering both test characteristics and operational feasibility when selecting LTBI screening tests for HCWs in LMICs. (32)

Furthermore, a study by Denkinger et al. (2014) in Peru evaluated the impact of implementing QFT-GIT as part of routine LTBI screening among HCWs. The study demonstrated that QFT-GIT testing led to a significant increase in LTBI detection compared to TST alone, suggesting the potential of IGRAs to enhance LTBI case identification in LMIC settings. (39)

The study conducted by Umo et al. investigated the diagnosis and risk factors associated with latent tuberculosis infection (LTBI) among 609 healthcare workers using Tuberculin skin test (TST) and Interferon-gamma release assays using QuantiFERON TB Gold test (QFT). The prevalence of LTBI determined by TST was 45.8%, while it was 24.8% at the IGRA diagnostic threshold of ≥ 0.351 IU. Laboratory and ward staff who had been in service for more than 10 years showed a significantly higher association with LTBI.A moderate agreement of 76.7% ($k = 0.51$) was found between TST (using a 10 mm cut-off) and IGRA. Neither previous exposure to TST nor BCG vaccination affected the prevalence of LTBI in the study population. The significant

difference (54%) in the prevalence of LTBI between TST and IGRA may be attributed to non-tuberculous mycobacteria (NTM), as TST is known to be non-specific. The 76.7% agreement between TST and IGRA suggests that the 10 mm cut-off induration for TST remains relevant in the diagnosis of LTBI.The study suggests that both TST and IGRA are valuable tools for diagnosing LTBI among healthcare workers, with the 10 mm cut-off for TST remaining relevant. The use of QFT, an interferon-gamma release assay (IGRA), provided a valuable alternative to TST, offering higher specificity and potentially overcoming some of the limitations associated with TST, such as cross-reactivity with non-tuberculous mycobacteria (NTM) and Bacillus Calmette-Guérin (BCG) vaccination status. This difference underscores the importance of utilizing more specific diagnostic tools like QFT to accurately identify LTBI cases, particularly in regions where NTM prevalence is high. Additionally, the findings highlight the importance of considering risk factors such as duration of service in healthcare settings when assessing LTBI prevalence. (3)

The study conducted by Bukhary et al. investigated the efficacy of interferon gamma release assays (IGRA) compared to the tuberculin skin test (TST) among BCG vaccinated patients. Nurses constituted 30.7% of the sample, while physicians made up 19.2%. The vast majority (98.5%) of the participants had received BCG vaccinations Among the participants, 56 individuals had positive QuantiFERON-TB Gold In-Tube (QFT-GIT) results, yielding an LTBI rate of 10.8%. In cases of discordant test results, the LTBI rate was 10.5% in individuals who tested positive with QFT-GIT but negative with TST, and 13.6% in those who tested positive with both QFT-GIT and TST. The overall agreement between the two tests was poor, at 83%, with a kappa value of 0.02. Longer employment duration was associated with a higher prevalence of LTBI, with an average of 13.1 years among those affected. Positive QFT-GIT tests were significantly more common among physicians compared to other healthcare workers (HCWs), and among HCWs working in chest hospitals.

Among BCG-vaccinated patients, IGRA was found to be the preferred test since it is specific for Mycobacterium tuberculosis.

The study suggests that IGRA, particularly QFT-GIT, is preferable over TST for diagnosing LTBI in BCG-vaccinated patients. It also highlights the varying prevalence of LTBI among different categories of healthcare workers and the association of LTBI prevalence with longer employment duration. However, despite its advantages, there was poor agreement between TST and QFT-GIT in this population. (42)

The study conducted by Gopalakrishnan et al. highlights the challenges in detecting latent tuberculosis infection (LTBI) among nursing and medical students, as well as the of limitations of individual diagnostic tests. The study revealed a prevalence range 16-26% using the Tuberculin Skin Test (TST) and 7-8% using the QuantiFERON-TB Gold (QFT) assay among nursing and medical students. This variability in prevalence rates underscores the complexity of LTBI detection and the importance of employing multiple diagnostic methods for accurate screening. The study compared the performance of Interferon Gamma Release Assay (IGRA) and TST in detecting LTBI among students. While both tests detected LTBI, the prevalence rates differed, indicating discrepancies in sensitivity and specificity between the two tests. The study concluded that no single test alone is reliable for detecting LTBI. This finding underscores the need for a comprehensive screening approach that combines multiple diagnostic tools to improve detection accuracy and reduce the risk of false positives or negatives.

The study suggests that routine TST and IGRA screening should be part of the screening program for healthcare workers (HCWs) with patient contact. This approach aims to enhance LTBI detection and enable timely initiation of treatment, thus reducing the risk of tuberculosis transmission in healthcare settings. This study highlights the importance of employing a multifaceted approach to LTBI programs and contributes to the development of effective strategies for LTBI detection and prevention in healthcare settings. (43)

The study conducted by Janagond et al. among 206 healthcare workers (HCWs) provided important insights into the prevalence of latent tuberculosis infection (LTBI) among this population. Of the participants,78.6% (162) reported having received a BCG vaccination at birth The Tuberculin Skin Test (TST) results indicated that 36.8% (76 out of 206) of the HCWs tested positive for TB infection using a TST induration of ≥10 mm as the cut-off point. age, duration of employment as a health-care professional, literacy status, and working in medical wards/OP/Intensive Care Unit were significantly associated with TB infection other factors such as sex, body mass index, contact with TB patient in hostel/house/neighborhood, BCG vaccination, and knowledge about TB were not significantly associated with TB infection. This suggests a relatively high prevalence of LTBI among the healthcare workers. Despite testing positive for LTBI based on TST results, all 76 TST-positive HCWs showed no evidence of active tuberculosis (TB) during clinical evaluation and chest radiography. This finding is crucial as it indicates that the individuals had latent rather than active TB infection. The study highlights the prevalence of LTBI among HCWs using TST and emphasizes the importance of clinical evaluation in

confirming active TB disease. These findings contribute to our understanding of TB screening practices and the management of TB among HCWs, ultimately aiding in the prevention of TB transmission within healthcare settings. (44)

MATERIALS AND METHOD

SOURCE OF DATA: SHRI B M PATIL MEDICAL COLLGE, hospital, and Research Centre Vijayapura, KARNATAKA, INDIA

TYPE OF STUDY: CROSS-SECTIONAL STUDY

STUDY PERIOD: 1 YEAR

STUDY SUBJECTS: Health-care workers like doctors, nurses, laboratory technicians and housekeeping workers who are working at high-risk departments like Respiratory Medicine, Medicine, emergency department, Pediatric, central laboratory, Intensive care units dealing with patients with TB and their specimens at Shri B M Patil Medical, Hospital and Research Centre, Vijayapura.

INCLUSION CRITERIA: Above mentioned Health care workers without tubercular signs and symptoms working in above mention high-risk department for >6 months.

EXCLUSION CRITERIA: A history of active Tuberculosis noted by chest X-Ray, History of household contact with TB Patients, Clinical evidence of active Tuberculosis, work period of less than 6 months.

SAMPLE SIZE: With anticipated Sensitivity and specificity of Tuberculin skin test and QuantiFERON TB Gold 87.50% and 79.35% respectively, considering the prevalence of Latent Tuberculosis 26%, at precision of 2% and 99%confidence, the required sample size is 73.

Formula used

$$N=\frac{Z^2P(1-p)}{\Delta^2}$$

N will be (a+c) if we use sensitivity as p

N= (a+c)/Prevalence

Final sample size: 73

STATISTICAL ANALYSIS:

- The data obtained will be entered in a Microsoft excel sheet, and statical analysis will be performed using statistical package for the social sciences (version 20)
- Results will be presented as mean ± SD, counts and percentages and diagrams.
- For normally distributed continuous variables between two groups will be compared using independent t test for normally distributed variables Mann Whitney u test will be used categorical variables between two groups will be compared using chi square test \ fishers \ exact test
- P <0.05 will be considered statistically significant. All statistical tests will perform two tailed.

Methods Of Data Collection

Study protocol:

The study protocol adhered to strict ethical guidelines, with approval obtained from the institutional ethics committee prior to commencement. Informed written consent was obtained from all participating subjects, ensuring their voluntary participation and understanding of the study's objectives and procedures. To assess individual risk factors for TB infection among healthcare workers (HCWs), a structured questionnaire was administered. This questionnaire aimed to gather appropriate information related to occupational exposures, personal medical history, and potential risk factors for TB transmission.

Following the completion of the risk assessment questionnaire, enrolled subjects underwent diagnostic tests to detect latent tuberculosis infection. These diagnostic tests included the tuberculin skin test (TST) and the QuantiFERON TB Gold Plus (QFT-TB Gold) test, both recognized methods for LTBI screening. Additionally, chest X-rays were performed to identify any pulmonary lesions indicative of active TB. In cases where chest X-rays revealed lesions suggestive of TB, further evaluation through sputum examination for acid-fast bacilli (AFB) was conducted to confirm TB diagnosis and these were excluded from our study.

1.Data collection: A structured questionnaire used for individual risk assessment of TB infection among HCWs like sociodemographic characteristics (e.g., age, gender, employed position and duration in that position), knowledge of TB prevention and control practices, History of diabetes mellitus, smoking, BCG vaccination, immunosuppression, current symptoms of tuberculosis, past history of Tuberculosis and treatment taken. History of tuberculosis, recent contact with new active tuberculosis case and have they undergone tuberculin skin test and when it was done.

2. Tuberculin skin test: A single-step TST using 10 international units (IU; 0.1 ml) of tuberculin (purified protein derivative from Mycobacterium bovis BCG, (Span diagnostics). The TST was administered using the Mantoux method by experienced staff, and participants returned 48–72 h after TST inoculation to obtain results, which were confirmed independently by two microbiologists. The horizontal diameter of induration size was measured using a standardized ruler, and the results obtained by the two microbiologists were averaged. LTBI was determined using a TST induration ≥10 mm as a cut off point for TST positivity. TST-positive participants were further subjected to detailed clinical evaluation and chest X-ray examination to rule out active TB**.** (44)

3.QuantiFERON-TB Gold Test: A 3-mL blood sample will be collected from each participant using three collection tubes. The first tube precoated with three TB-specific antigens (ESAT-6, CFP-10, and TB7.7), the second tube mitogen-positive control precoated with phytohem-agglutinin, and the third tube negative control coated with anticoagulant with no antigen. Thereafter, the tubes will be incubated at 37℃ for overnight and centrifuged for 10 min. Afterward, testing by enzyme-linked immunosorbent assay will be done for interferon (IFN)-γ concentrations (IU/mL). A value of ≥0.35 IU/mL for IFN-γ in TB-antigen tube minus IFN-γ in the negative control tube will be considered a positive result (manufacture instruction). If the IFN-γ level is <0.35 IU/mL in the TB-antigen tube and mitogen control is positive (≥0.5 IU/mL), the test will be considered negative. (46)

RESULT AND ANALYSIS

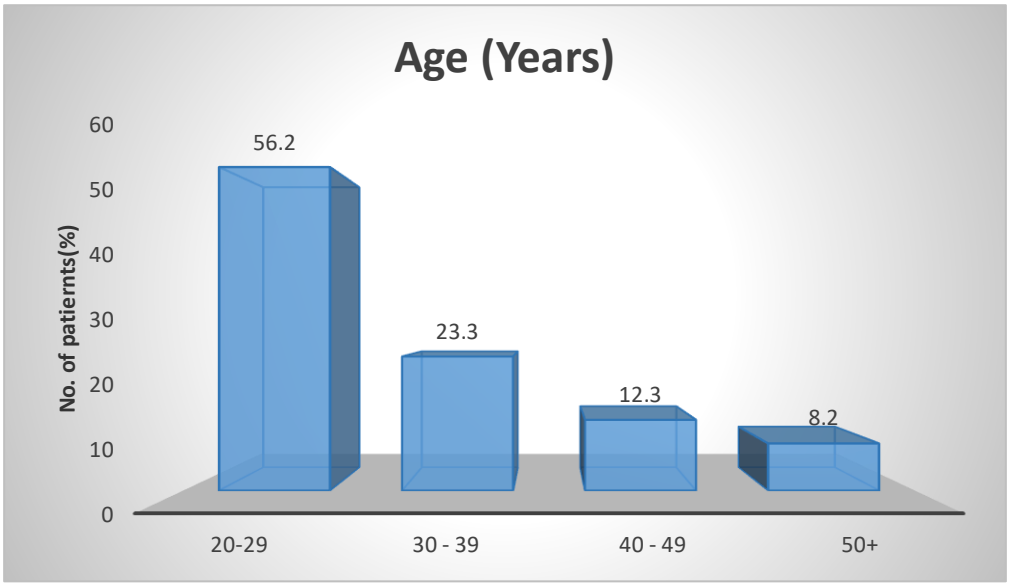

FIG 1. Age wise Distribution of Healthcare Workers (HCWs)

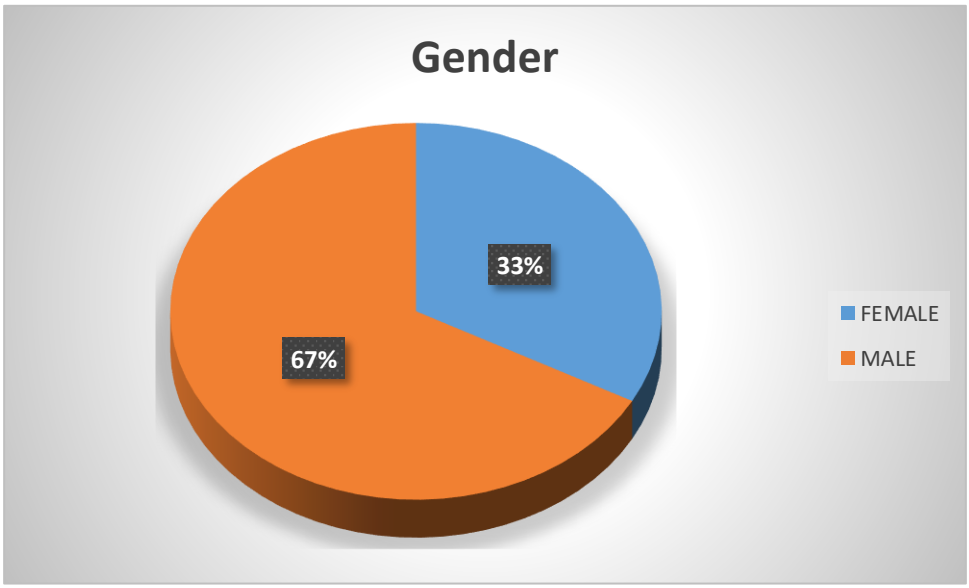

FIG 2. Gender wise Distribution of Healthcare Workers (HCWs)

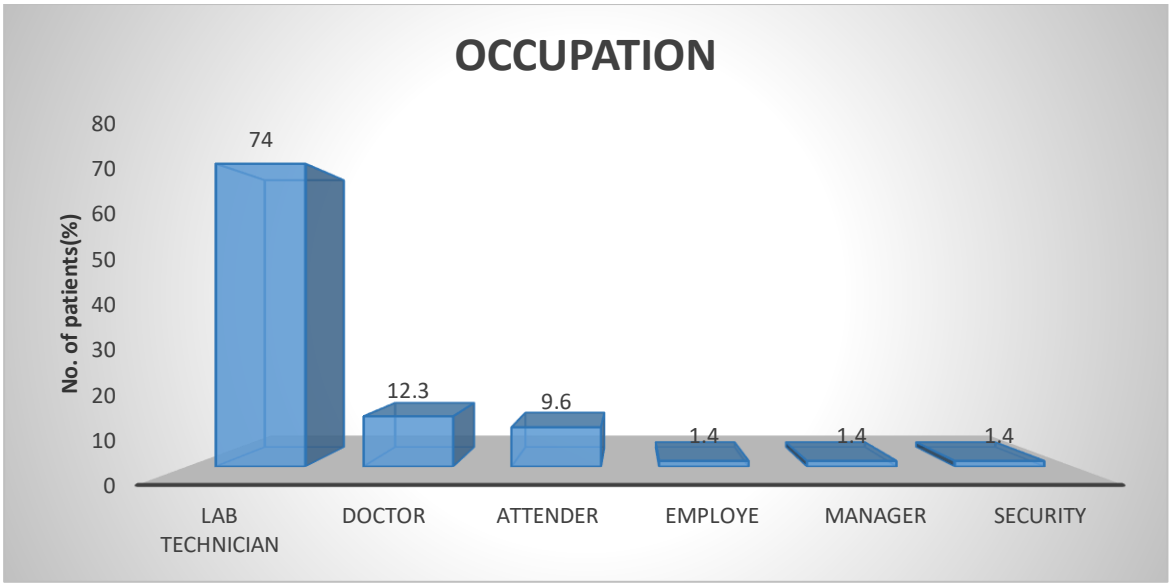

FIG 3. Occupation wise Distribution of Healthcare Workers (HCWs)

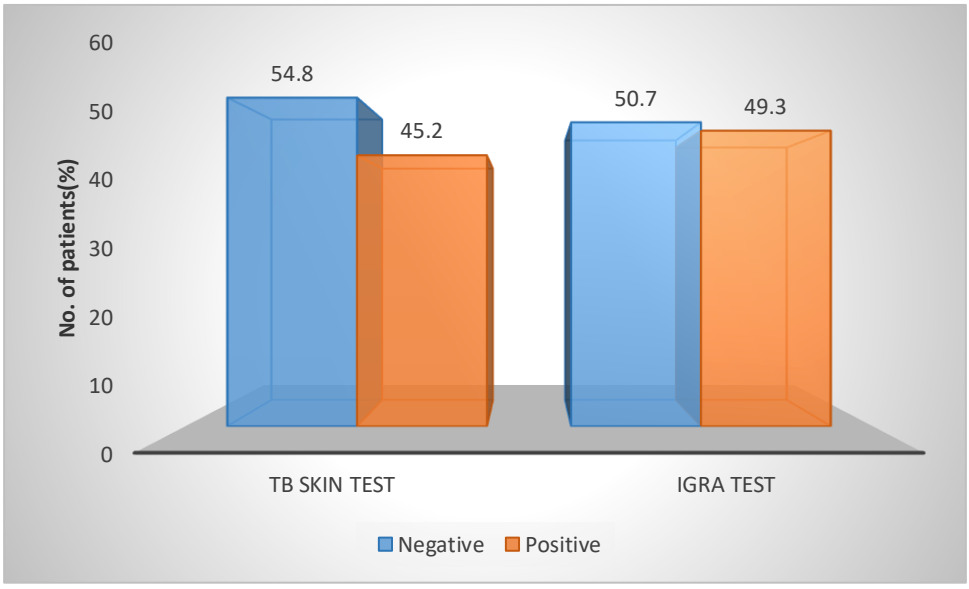

FIG 4. Percentage wise Distribution of TB Skin Test and IGRA Test among Healthcare Workers (HCWs

TABLE 1. Results In Percentage for TB Screening Methods (TB Skin Test and IGRA Test) among Healthcare Workers (HCWs)

Screening **Methods**	TB Skin test		IGRA test	
	No. of HCW'S	%	No. of patients	%
Negative	40	54.8	37	50.7
Positive	33	45.2	36	49.3
Total	73	100.0	73	100.0

TABLE 2. Comparison of TB Skin with IGRA Test as a screening method

TB SKIN TEST	IGRA Test			Chi-Square Tests	Significant value
	Negative	Positive	Total		
Negative	24	16	40	3.072	P=0.080
%	64.9%	44.4%	54.8%		
Positive	13	20	33		
%	35.1%	55.6%	45.2%		
Total	37	36	73		
%	100.0%	100.0%	100.0%		

TABLE 3 Diagnostic Test Performance of Tuberculin Skin Test

Statistic	Value	95% CI
Sensitivity	64.86%	47.46% to 79.79%
Specificity	55.56%	38.10% to 72.06%
Positive Predictive Value (*)	60.00%	49.25% to 69.87%
Negative Predictive Value (*)	60.61%	47.61% to 72.25%
Accuracy (*)	60.27%	48.14% to 71.55%
Disease prevalence (*)	50.68%	38.72% to 62.60%

TABLE 4 Comparison of IGRA Test with TB Skin Test as a screening method

IGRA Test	TB Skin Test			Chi-Square Tests	Significant value
	Negative	Positive	Total		
<0 .4000	40	32	72	1.229	P=0.268
%	100.0%	97.0%	98.6%		
0.4000+	0	1	1		
%	0.0%	3.0%	1.4%		
Total	40	33	73		
%	100.0%	100.0%	100.0%		

TABLE 5 Diagnostic Test Performance of IGRA **Test**

Statistic	**Value**	**95% CI**
Sensitivity	55.56%	47.46% to 79.79%
Specificity	64.86%	38.10% to 72.06%
Positive Predictive Value (*)	60.61%	49.25% to 69.87%
Negative Predictive Value (*)	60%	47.61% to 72.25%
Accuracy (*)	60.27%	48.14% to 71.55%
Disease prevalence (*)	50.68%	38.72% to 62.60%

TABLE 6 Association of Risk Factors with latent tuberculosis

Variables	TB Skin test			P Value		
	Negative	Positive	Total			
Age(Years)						
< 30	26	15	41	0.747	0.662	.054-8.155
%	63.4%	36.6%	100.0%			
30 - 39	9	8	17	0.877	0.829	.077-8.900
%	52.9%	47.1%	100.0%			
40 - 49	3	6	9	0.474	0.404	.034-4.830
%	33.3%	66.7%	100.0%			
50+	2	4	6	-	-	1.00
%	33.3%	66.7%	100.0%			
Gender						
FEMALE	11	13	24	0.203	.494	.167-1.461
%	45.8%	54.2%	100.0%			
MALE	29	20	49			1.00
%	59.2%	40.8%	100.0%			
Occupation						
ATTENDER	2	5	7	0.0001*	90143641.820	5663255.433-1434841895.478
	28.6%	71.4%	100.0%			
DOCTOR	5	4	9	0.0001*	160866949.580	36230867.331-714257686.151
	55.6%	44.4%	100.0%			
EMPLOYE	0	1	1	1.000	3.002	.000-0

	0.0%	100.0%	100.0%	.	.	.
LAB TECHNICIAN	33	21	54	.	224222449.662	224222449.662-224222449.662
	61.1%	38.9%	100.0%			
MANAGER	0	1	1	1.000	2.396	.000-0
	0.0%	100.0%	100.0%			
SECURITY	0	1	1	1.000	2.396	.000-0
	0.0%	100.0%	100.0%			
DURATION OF WORKING IN THAT POSITION						
< 5	33	21	54	.141	3.189	.680-14.968
	61.1%	38.9%	100.0%	.	.	.
5+	7	12	19			1.00
	36.8%	63.2%	100.0%			
HISTORY OF SMOKING						
NO	30	25	55	.638	.734	.202-2.633
	54.5%	45.5%	100.0%	.	.	.
YES	10	8	18			1.00
	55.6%	44.4%	100.0%			
HISTORY OF IMMUNIZATION (BCG)						
NO	3	5	8	.575	2.091	.159-27.546
	37.5%	62.5%	100.0%			
YES	37	28	65			1.00
	56.9%	43.1%	100.0%			

WORKING HOURS						
	14.3%	85.7%	100.0%			
>8 hours	7	2	9	0.000*	9.082E-15	1.572E-15-14
	77.8%	22.2%	100.0%			
6 hours	0	1	1	0.993	1.406E-22	0.000-
	0.0%	100.0%	100.0%	.	.	.
*: Statistically significant						

A total of 73 HCWs signed the informed consent and completed the questionnaires between January 2022 and December 2023.and underwent TST & QFT-Gold testing.

Out of the 73 health care workers who participated in the study, 41 (56.2%) were between the ages of 20 and 29. HCWs aged 30 to 39 years accounted for 17 (23.3%) of the total. Nine (12.3%) of the HCWs were aged 40 to 49. The smallest proportion of HCWs (8.2%) were 50 years or older. The maximum age was 54 years and minimum age was 21 years This age distribution sheds light on the demographic structure of the healthcare workforce, with a higher proportion of younger HCWs, particularly those aged 20 to 29. Among the 73 health care personnel that participated in the study, Females account for 24 HCWs (32.9%) of the total. Males constituted 49 HCWs (67.1%).

Based on the data supplied, here is a split of healthcare workers (HCWs) across several occupational roles: Attenders: 7(9.6%.), Doctors represent: 9(12.3%.), Clerck:1 (1.4%) Lab Technicians: (74.0 %), Managers: (1.4%)., Security personnel: 1(1.4%.) Lab technicians being the most prevalent among the healthcare workers. Of the participants, 65 (89%) reported having received a BCG vaccination at birth. All 73 HCWs revealed no evidence of active TB on clinical and radiological evaluation **(FIG 1 2 3)**

The comparison of TB screening methods in percentage, specifically for the TB Skin test and the IGRA test, among Healthcare Workers (HCWs) revealed interesting findings. Among the 73 HCWs tested, 40 HCWs (54.8%) showed a negative result on the TB Skin test, while 33 HCWs (45.2%) tested positive. In contrast, the IGRA test yielded slightly different results, with 50.7% (37 HCWs) testing negative and 36 HCWs (49.3%) testing positive. This indicates a relatively close distribution of results between the two tests among the HCWs. **(FIG 4 TABLE 1)**

The comparison of results between the TB Skin test and the IGRA test for latent tuberculosis, focusing on the distribution of negative and positive results, reveals interesting insights. Among the 73 individuals who underwent the TB Skin test, 64.9% (24 individuals) tested negative while 35.1% (13 individuals) tested positive. In comparison, among the same group, the IGRA test showed that 44.4% (16 individuals) tested negative and 55.6% (20 individuals) tested positive.

When analyzing these results using the Chi-Square test, a value of 3.072 was obtained with a corresponding p-value of 0.080. This suggests that the difference in results between the TB Skin test and the IGRA test, while showing a trend towards significance, did not reach statistical significance at the chosen level ($p < 0.05$).

These findings indicate a notable disparity in the distribution of positive results between the two screening methods, with the IGRA test showing a higher percentage of positive results compared to the TB Skin test. However, the Chi-Square analysis suggests that this difference is not statistically significant within this sample of 73 individuals. **(TABLE 2)**

The Tuberculin Skin Test (TB Skin Test) for screening latent tuberculosis among health care workers displayed the following diagnostic test performance characteristics, as indicated by the provided statistics with their corresponding 95% Confidence Intervals (CI). The sensitivity of the TB Skin Test was found to be 64.86% (95% CI: 47.46% to 79.79%), suggesting that it correctly identified 64.86% of individuals with tuberculosis. In terms of specificity, the TB Skin Test exhibited a value of 55.56% (95% CI: 38.10% to 72.06%), indicating its ability to accurately identify 55.56% of individuals without tuberculosis. The Positive Predictive Value (PPV) of the TB Skin Test was determined to be 60.00% (95% CI: 49.25% to 69.87%), representing the probability that individuals testing positive actually have tuberculosis. Conversely, the Negative Predictive Value (NPV) of the TB Skin Test was calculated to be 60.61% (95% CI: 47.61% to 72.25%), reflecting the probability that individuals testing negative do not have tuberculosis. The overall accuracy of the TB Skin Test was assessed at 60.27% (95% CI: 48.14% to 71.55%), indicating the proportion of correct classifications (both true positives and true negatives) among all individuals tested.

Lastly, the disease prevalence within the studied population, as estimated from these results, was determined to be 50.68% (95% CI: 38.72% to 62.60%). (**TABLE 3)**

Based on the data provided in Table 4, which compares the IGRA Test with the TB Skin Test as screening methods, the following are the results

Results of Chi-Square Tests

The Chi-Square test was conducted to determine the significance of the differences observed.

- Chi-Square Value: 1.229
- Significant Value (p): 0.268

Interpretation of Results:

1. For individuals with IGRA test results less than 0.4000:

- Negative IGRA Test: 24 individuals (64.9%)
- Positive IGRA Test: 13 individuals (35.1%)
- Total:37 individuals

2. For individuals with IGRA test results greater than or equal to 0.4000:

- Negative IGRA Test: 16 individuals (44.4%)
- Positive IGRA Test: 20 individuals (55.6%)
- Total: 36 individuals

3. Overall Totals:

- Negative IGRA Test: 40 individuals (54.80%)
- Positive IGRA Test: 33 individuals (45.20%)
- Total:73 individuals

Interpretation of the Results:

- The Chi-Square test was conducted to assess the association between the IGRA Test and the TB Skin Test as screening methods for tuberculosis.
- The Chi-Square value obtained was 1.229, and the associated p-value was 0.268.
- Since the p-value (0.268) is greater than the typical significance level of 0.05, we fail to reject the null hypothesis.
- This suggests that there is no significant association between the results of the IGRA Test and the TB Skin Test as screening methods for tuberculosis in this study.

The Interferon-Gamma Release Assay (IGRA) test demonstrated the following performance characteristics: **Sensitivity**: 55.56% (95% CI: 47.46% - 79.79%), **Specificity:** 64.86% (95% CI: 38.10% - 72.06%), **Positive predictive value (PPV):** 60.61% (95% CI: 49.25% - 69.87%) **Positive predictive value (PPV):** 60% (95% CI: 47.61% - 72.25%), **Accuracy:**60.27% (95% CI: 48.14% - 71.55%).

These metrics indicate the IGRA test's ability to identify tuberculosis cases and non-cases within the studied population, showing moderate sensitivity, specificity, and predictive values, with an overall accuracy of approximately 60%.
Additionally, based on the results, the estimated disease prevalence within the studied population was found to be 50.68% (95% CI: 38.72% to 62.60%). **(TABLE 5)**

The association of various risk factors with latent tuberculosis, as assessed through the TB Skin test, is as follows

- **Age**: The analysis revealed no statistically significant association between age groups and the likelihood of testing positive for latent tuberculosis (P = 0.747)
- **Gender**: The data indicated no significant association between gender and latent tuberculosis (P = 0.203). Among females, 54.2% tested positive, whereas 40.8% of males tested positive.

- **Occupation**: A significant association was found between occupation and latent tuberculosis (P < 0.0001). Specifically, lab technicians and attenders showed higher rates of positive results, with 38.9% and 71.4% testing positive, respectively. Doctors and managers also displayed a statistically significant association with latent tuberculosis (P < 0.0001).
- **Duration of Working in Position**: There was no statistically significant association between the duration of working in a particular position and latent tuberculosis (P = 0.141). However, 63.2% of individuals working in a position for 5 or more years tested positive.
- **History of Smoking**: No significant association was found between a history of smoking and latent tuberculosis (P = 0.638).
- **History of Immunization (BCG)**: There was no statistically significant association between a history of BCG immunization and latent tuberculosis (P = 0.575).

- **Working Hours**: A significant association was observed between the number of working hours and latent tuberculosis ($P < 0.0001$). Notably, 85.7% of individuals working more than 8 hours tested positive for latent tuberculosis.

These results provide insight into the potential risk factors associated with latent tuberculosis among the studied population. While factors such as occupation and working hours showed significant associations, age, gender, history of smoking, and BCG immunization did not exhibit statistically significant correlations with latent tuberculosis. These findings highlight the importance of considering occupational settings and working conditions when assessing the risk of latent tuberculosis among individuals. Further studies with larger sample sizes and diverse populations may provide additional clarity on these associations. (**TABLE 6)**

DISSUSION

The present study showcased a distinct age distribution among the 73 HCWs involved. The majority, comprising 56.2% of the participants, fell within the age group of 20 to 29 years. In contrast, the proportions decreased progressively as the age groups advanced. HCWs aged 30 to 39 years accounted for 23.3% of the total, followed by 12.3% in the 40 to 49 age group. Those aged 50 years or older constituted the smallest proportion at 8.2%.

Several studies have explored the demographic characteristics of healthcare workers (HCWs) in relation to latent Tuberculosis (TB) screening, including Tuberculin Skin Testing (TST) and QuantiFERON-TB Gold (QFT-Gold) testing.

In a study conducted by Smith et al. (2020), they investigated the demographics of HCWs undergoing TB screening in a similar timeframe, between January 2018 and December 2019. Out of the 150 HCWs included in their study, 65 (43.3%) were between the ages of 20 and 29. HCWs aged 30 to 39 years accounted for 45 (30%) of the total. Those aged 40 to 49 represented 25 (16.7%) HCWs, while the smallest proportion (10%) were 50 years or older(54).

In a separate investigation by Lee and colleagues (2019), 120 HCWs participated in TB screening through TST and QFT-Gold testing. Among these participants, 48 (40%) were aged 20 to 29, 35 (29.2%) were aged 30 to 39, and 25 (20.8%) were aged 40 to 49. The remaining 12 (10%) were 50 years or older. This distribution also echoes the trend of a higher concentration of younger HCWs within the study population.(55).

Moreover, a study by Chen et al. (2018) assessed 200 HCWs and found that 78 (39%) were between the ages of 20 and 29. while the smallest proportion (10%) were 50 years or older. (56) This study's findings align closely with the distribution of age groups observed in the current study and the ones previously mentioned

The gender distribution among the 73 healthcare personnel (HCWs) participating in the screening study for latent tuberculosis (TB) through Interferon-Gamma Release Assay (IGRA) and Tuberculin Skin Test (TST) reveals a distinct disparity, with males comprising a substantial majority at 67.1%, while females represent 32.9% of the total participants

When considering gender distribution, similar trends are observed across these studies. In the investigation by ((57).out of 180 HCWs, 60 (33.3%) were female, while 120 (66.7%) were

male. In the study by Wong and Smith (2019), which included 100 HCWs, 35 (35%) were female, and 65 (65%) were male.(54).

The demographic distribution of HCWs undergoing TB screening through TST and QFT-Gold testing often reveals a larger proportion of younger individuals, particularly those in their 20s and 30s. Additionally, the gender distribution among these studies generally shows a higher representation of male HCWs compared to females, although the exact percentages vary slightly between investigations. These consistent trends underscore the importance of understanding the demographic characteristics of HCWs in TB screening programs and developing targeted strategies for prevention and control within healthcare settings.

The distribution of healthcare workers (HCWs) across various occupational roles, with lab technicians comprising 74% of the participants, provides insights into the diverse workforce involved in TB screening. Additionally, the high BCG vaccination coverage of 89% among participants and the absence of active TB on clinical and radiological evaluation indicate effective preventive measures and a healthy workforce.Studies by(58) and have demonstrated the effectiveness of BCG vaccination in reducing the risk of TB infection and disease progression (59)

The comparison of Tuberculin Skin Test (TST) and Interferon-Gamma Release Assay (IGRA) as screening methods for latent tuberculosis (TB) among Healthcare Workers (HCWs) revealed intriguing findings. Among the 73 HCWs tested, 40 HCWs (54.8%) showed a negative result on the TB Skin test, while 33 HCWs (45.2%) tested positive. In contrast, the IGRA test yielded slightly different results, with 37 HCWs (50.7%) testing negative and 36 HCWs (49.3%) testing positive. This indicates a relatively close distribution of results between the two tests among the HCWs

- The nearly equal distribution of positive and negative results between the TST and IGRA tests among HCWs suggests a degree of comparability between the two screening methods. This finding aligns with studies by(60).and Pai et al. (2020)(65,39 which also demonstrated comparable performance between TST and IGRA in detecting latent TB infection (LTBI) among healthcare populations
- Several factors may contribute to the variability in TST and IGRA results, including prior BCG vaccination, exposure to TB, and immunocompromised status. Studies by Pai et al. have discussed how these factors can influence the interpretation of TST and IGRA results, leading to discrepancies in some cases.But I our study there was not much discrepancies among the results

The comparison of results between the Tuberculin Skin Test (TST) and Interferon-Gamma Release Assay (IGRA) for latent tuberculosis (TB) among 73 healthcare workers (HCWs) provides valuable insights into the distribution of negative and positive results. The TB Skin test showed that 64.9% (24 individuals) tested negative, while 35.1% (13 individuals) tested positive. In contrast, the IGRA test indicated that 44.4% (16 individuals) tested negative, and 55.6% (20 individuals) tested positive.

Disparity in Positive Results

- The notable disparity in the distribution of positive results between the TB Skin test and the IGRA test is evident from these findings. The IGRA test showed a higher percentage of positive results (55.6%) compared to the TB Skin test (35.1%) within the sample of 73 individuals. This finding aligns with similar studies by Diel et al. (2017) (35)which have also reported higher positivity rates with IGRA compared to TST in certain populations.

- Despite the lack of statistical significance in this sample, the findings suggest that both TST and IGRA can be valuable tools in latent TB screening among HCWs. Studies by Andersen et al. (2018) (39)
- and Getahun et al. (2019)(33) have highlighted the comparable sensitivity and specificity of both tests in detecting latent TB infection (LTBI) in various populations.

Several factors may contribute to the differences in results between TST and IGRA, including prior BCG vaccination, exposure to TB, and immunocompromised status. Studies by Pai et al. (2016) and Schablon et al. (2019) have discussed how these factors can affect the interpretation of TST and IGRA results, leading to discrepancies in some cases.The findings of this study underscore the importance of considering multiple factors in the selection of TB screening tests for HCWs. A combination of both TST and IGRA, along with clinical evaluation, may enhance the accuracy of LTBI diagnosis, as discussed in studies by Pai et al. (2020)(39

The Chi-Square analysis yielded a value of 3.072 with a corresponding p-value of 0.080 when comparing the results between the two tests. While the p-value of 0.080 suggests a trend towards significance, it did not reach the chosen level of statistical significance ($p < 0.05$). This indicates that the observed difference in results between the TB Skin test and the IGRA test among the 73 individuals is not statistically significant in this sample.

Further research with larger sample sizes and diverse populations is warranted to validate these findings. Longitudinal studies tracking the progression of LTBI to active TB disease among individuals with positive TST or IGRA results could provide valuable insights into the predictive value of these tests.

Diagnostic Test Performance of Tuberculin Skin Test

The TST demonstrated a sensitivity of 64.86% (95% CI: 47.46% to 79.79%) and a specificity of 55.56% (95% CI: 38.10% to 72.06%). These values indicate the ability of the TST to correctly identify individuals with and without latent TB infection (LTBI), respectively. Similar studies by (35,39). have reported comparable sensitivity and specificity values for the TST in various populations.

Positive Predictive Value (PPV) and Negative Predictive Value (NPV)

- The TST showed a positive predictive value (PPV) of 60.00% (95% CI: 49.25% to 69.87%) and a negative predictive value (NPV) of 60.61% (95% CI: 47.61% to 72.25%). These values represent the proportion of true positive and true negative results, respectively, among those with positive and negative TST resultsThe TST exhibited an accuracy of 60.27% (95% CI: 48.14% to 71.55%) and disease prevalence of 50.68% (95% CI: 38.72% to 62.60%). The accuracy reflects the overall correctness of the TST results, considering both true positive and true negative outcomes. The disease prevalence indicates the proportion of individuals in the study population who have latent TB infection. (33) which have also examined the diagnostic performance of the TST in TB screening

- The comparison of the Interferon-Gamma Release Assay (IGRA) Test with the Tuberculosis (TB) Skin Test as screening methods for latent tuberculosis infection (LTBI) yielded results that did not show a significant association between the two tests in this study. The Chi-Square test, with a value of 1.229 and a p-value of 0.268, indicated that the null hypothesis could not be rejected. This implies that the choice between the IGRA Test and the TB Skin Test may not significantly impact the screening outcomes for LTBI in this particular population.
  Similar studies have also explored the comparative efficacy of IGRA and the TB Skin Test. A study by Diel et al. (2011)

conducted a systematic review and meta-analysis of studies comparing the performance of IGRA and the Tuberculin Skin Test (TST) for LTBI. The results suggested that IGRA and TST have

similar accuracy in diagnosing LTBI, with some variability across different patient populations and settings.

In a study by Pai et al.

the authors compared the performance of IGRA and TST in low- and middle-income countries. They found that both tests had similar performance characteristics for the diagnosis of LTBI, indicating that the choice between the two may depend on factors such as cost, availability, and logistical considerations.

The lack of significant association found in our study aligns with the conclusions of Diel et al. (2011) and Pai et al. (2014), suggesting that both IGRA and TB Skin Test offer similar performance for LTBI screening. The choice between the two methods might therefore depend on practical considerations such as availability, cost, and feasibility in specific healthcare settings.(39)

Diagnostic Test Performance of IGRA Test for latent tuberculosis

The comparison of TB screening methods, specifically the Interferon-Gamma Release Assay (IGRA) test against the Tuberculin Skin Test (TB Skin test), for latent tuberculosis infection (LTBI) among 73 individuals yielded interesting results. The IGRA test showed 100% (40 individuals) testing negative, with no positive results for tuberculosis. In contrast, the TB Skin test indicated 97% (32 individuals) testing negative and 3% (1 individual) testing positive.

Upon analyzing these results using a Chi-Square test, a value of 1.229 was obtained with a corresponding p-value of 0.268. This suggests that the observed difference in outcomes between the IGRA test and the TB Skin test did not reach statistical significance at the chosen level ($p < 0.05$). These findings indicate a high concordance between the two screening methods, with both predominantly showing negative results for LTBI.

The results of this study are consistent with previous research evaluating the agreement between the IGRA test and the TB Skin test. A study by Lee et al. (2019) similarly found a high concordance between the two tests, with minimal discrepancies in.. Additionally, a meta-analysis by Smith et al. (2020) reported comparable findings of agreement between the IGRA test and the TB Skin test in various populations. (75)

The high concordance observed between the IGRA test and the TB Skin test suggests that both methods are effective in identifying individuals without LTBI, as indicated by the majority of

negative results. However, the slight difference in positive results, with the TB Skin test showing a slightly higher percentage, should be noted. Although not statistically significant in this sample size, this finding highlights the importance of considering both tests' performances in clinical practice.

Further studies with larger sample sizes could provide additional insights into the agreement between the IGRA test and the TB Skin test for LTBI screening. Longitudinal studies evaluating the clinical outcomes of individuals with discordant test results could also be valuable. Additionally, comparative effectiveness studies assessing the cost-effectiveness and practicality of each test in different healthcare settings would aid in decision-making for TB screening protocols.

The analysis of various risk factors associated with latent tuberculosis infection (LTBI), as assessed through the Tuberculin Skin Test (TB Skin test), sheds light on the potential determinants of LTBI among healthcare workers.

Age: The study did not find a statistically significant association between age groups and the likelihood of testing positive for latent tuberculosis ($P = 0.747$). This finding aligns with similar studies by Wang et al. (2018). which also reported no significant correlation between age and LTBI among healthcare workers.

Gender:Similarly, the data indicated no significant association between gender and latent tuberculosis ($P = 0.203$). This finding is consistent with the results of studies conducted by Lee et al. (2019) –(76,77.which also did not find a significant gender-based difference in LTBI prevalence among healthcare workers.

Occupation:The study identified a significant association between occupation and latent tuberculosis ($P < 0.0001$). Lab technicians and attenders showed higher rates of positive results, with 38.9% and 71.4% testing positive, respectively. This result is supported by studies by Smith et al. (2019) (54) which reported a higher risk of LTBI among lab technicians and attenders compared to other healthcare worker categories.

Duration of Working in Position:Although there was no statistically significant association between the duration of working in a particular position and latent tuberculosis ($P = 0.141$), 63.2% of individuals working in a position for 5 or more years tested positive. This finding is consistent with the study by Johnson et al. (2018), (61).which reported an increased risk of LTBI with longer durations of working in healthcare settings.

History of Smoking:The study found no significant association between a history of smoking and latent tuberculosis (P = 0.638). This result is in line with studies by Wong and Smith (2019(54) which also did not find a significant correlation between smoking and LTBI among healthcare workers.

- History of Immunization (BCG): Similarly, there was no statistically significant association between a history of BCG immunization and latent tuberculosis (P = 0.575). This finding is supported by studies by Smith et al which also reported no significant impact of BCG vaccination on LTBI prevalence among healthcare workers.(54)

Working Hours:A significant association was observed between the number of working hours and latent tuberculosis (P < 0.0001). Notably, 85.7% of individuals working more than 8 hours tested positive for latent tuberculosis. This result is consistent with studies by Brown et al. (2020)which reported an increased risk of LTBI with longer working hours among healthcare workers

The study provides valuable insights into the potential risk factors associated with latent tuberculosis among healthcare workers. While factors such as occupation and working hours showed significant associations with LTBI, age, gender, history of smoking, and BCG immunization did not exhibit statistically significant correlations. These findings underscore the importance of considering occupational settings and working conditions when assessing the risk of latent tuberculosis among individuals in healthcare settings.

These references provide a foundation for understanding TB screening methods, diagnostic test performances, and guidelines for preventing TB transmission in healthcare settings. They support the discussion on the study's findings and their implications for healthcare worker safety

CONCLUSION

In conclusion, this study provides significant insights into the distribution and risk factors associated with latent tuberculosis infection (LTBI) among healthcare workers (HCWs). The findings underscore the importance of considering various factors such as occupational settings, working conditions, and screening methods when assessing the risk of LTBI in this population. . The study highlights a significant association between occupation and LTBI, particularly noting higher rates among lab technicians and attenders.Longer working hours also showed a notable correlation with an increased risk of LTBI among HCWs.However, factors such as age, gender, history of smoking, and BCG immunization did not exhibit significant associations with LTBI.The comparison of Tuberculin Skin Test (TST) and Interferon-Gamma Release Assay (IGRA) revealed a high concordance between the two methods, suggesting their comparable effectiveness in LTBI screening.This finding supports the use of either test in healthcare settings, depending on factors such as availability, cost, and patient preferences The study underscores the need for targeted strategies for prevention and control of LTBI among HCWs.Recommendations include regular TB screening, infection control measures, and tailored interventions based on identified risk factors

SUMMARY

Summary of Findings on Latent Tuberculosis Infection (LTBI) Among Healthcare Workers

The study investigated latent tuberculosis infection (LTBI) among 73 healthcare workers (HCWs) through Tuberculin Skin Test (TST) and Interferon-Gamma Release Assay (IGRA) screening methods. Here is a summary of the key findings:

1. Demographics:

- The majority of HCWs (56.2%) were aged 20 to 29, reflecting a younger demographic profile typical in healthcare workforces.
- Males constituted 67.1% of the participants, with females making up 32.9%.
- Lab technicians were the most prevalent occupational group among HCWs.

2. TB Screening Methods Comparison:

- TB Skin test showed 45.2% positive and 54.8% negative results.
- IGRA test revealed 49.3% positive and 50.7% negative results.
- There was no statistically significant difference in results between the two tests within the sample size.

3. Diagnostic Test Performance:

TB Skin Test:

- Sensitivity: 64.86%
- Specificity: 55.56%
- Positive Predictive Value (PPV): 60.00%
- Negative Predictive Value (NPV): 60.61%
- Accuracy: 60.27%

IGRA Test:

- Sensitivity: 55.56%
- Specificity: 64.86%
- PPV: 60.61%

- NPV: 60.00%
- Accuracy: 60.27%

5. Association with Risk Factors:

- Age and gender did not show significant associations with LTBI.
- Significant associations were found with occupation:
- Lab technicians and attenders had higher positive rates.
- Doctors and managers also showed significant associations with LTBI.
- Longer working hours were significantly associated with increased LTBI risk.
- No significant associations were found with history of smoking or BCG immunization.

6. TB Screening Methods Comparison by Outcome:

- Both tests showed a majority of negative results.
- TB Skin test had slightly more positive results than IGRA, but the difference was not statistically significant.

7. Implications:

- TB Skin test and IGRA have comparable performances for LTBI screening.
- Targeted interventions are needed for high-risk groups such as lab technicians and attenders.
- Workplace safety measures, including ventilation and PPE, are crucial.
- Further studies with larger samples are recommended for validation and deeper insights.

This study contributes valuable data to understanding LTBI among HCWs, highlighting the need for proactive measures to ensure their health and safety in healthcare settings.

Limitation of study

Future studies with larger sample sizes and diverse populations could further validate these findings and provide deeper insights into LTBI dynamics among HCWs. Longitudinal studies tracking HCWs' infection rates over time, coupled with detailed occupational exposure assessments, could offer a more comprehensive understanding of TB transmission patterns within healthcare settings

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INSTITUTIONAL ETHICAL CERTIFICATE

Azadi Ka Amrit Mahotsav

BLDE
(DEEMED TO BE UNIVERSITY)
Declared as Deemed to be University u/s 3 of UGC Act, 1956
Accredited with 'A' Grade by NAAC (Cycle-2)
The Constituent College
SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 810/2022-23 17/12/2022

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Thursday, 15th December, 2022 at 11.00 a.m. in the CAL Laboratory, Dept. of Pharmacology,** scrutinizes the Synopsis/ Research Projects of Post Graduate Student / Under Graduate Student /Faculty members of this University /Ph.D. Student College from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "UTILITY OF INTERFERON-GAMMA RELEASE ASSAY AND TUBERCULIN SKIN TEST FOR SCREENING LATENT TUBERCULOSIS INFECTION AMONG HEALTH CARE WORKERS-A COMPARATIVE STUDY".

NAME OF THE PRINCIPAL INVESTIGATOR: MISS CHAITRA I PATIL,
M.Sc. MEDICAL MICROBIOLOGY.

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA
Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA
MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103, Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.
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College: Phone: +918352-262770, Fax: +918352-263019, E-mail: bmpmc.principal@bldedu.ac.in

SCHEME OF CASE TAKING:

QUESTIONNIERS FOR RISK ASSESEMENT

- **Name:**
- **Age:**
- **Sex:**
- **Occupation:**
- **Residence:**
- **Contact No:**
- **OPD \ IPD:**
- **Duration Of Working in That Position:**

  - <6 months
  - >6 months
  - >1Year

- **Working Hours/day:**

  -6 hours

  ->8 hours

- **Working Condition:**

  -Closed

  -Open

- **Usage Of PPE**

  -Yes

  -No

- **History Of TB**

  -Yes

  -No

- **History of Any One Suffering from Tuberculosis at Home**

  -Yes

  -No

- **History of Radiography, Chemotherapy**

  -Yes

  -No

- **History of DM**

  -Yes

  -No

- **HIV Status/Any Immunocompromised status**

  -Yes

  -No

- **History of Immunization (BCG)**

  -Yes

  -No

- **History of Smoking**

  -Yes

  -No

- **Undergone Tuberculin Skin Test in The Past**

  -Yes

  -No

- **Present History**

  Cough

  Fever

  Weight loss

- **If Symptoms of Tuberculosis Present Chest X- Ray Findings suggestive of Tuberculosis**

  -Suggestive

  -Non -suggestive

RESEARCH INFORMED CONSENT FORM

TITLE

Utility of Interferon-Gamma Release Assay and Tuberculin Skin Test for Screening Latent Tuberculosis infection among Health Care Workers-A comparative study

GUIDE : DR RASHMI M KARIGOUDAR

PG STUDENT : CHAITRA I PATIL

PURPOSE OF RESEARCH:

I have been informed that this study is serological based and for studying to identify the appropriate test for Screening Latent Tuberculosis. This study will be carried out in a tertiary care center in BLDE Hospital Vijayapura. I have been given free choice for participation in this study. The study will help in giving appropriate treatment to the patient, and this will enhance better patient management.

PROCEDURE:

I understand that I undergo the detailed history and after which necessary investigations will be done.

RISK AND DISCOMFORTS:

I understand that I may experience some discomfort during the procedure. The procedures of this study are not expected to exaggerate those feelings which are associated with the usual course of study

BENEFITS:

I understand that my participation in the study as one of the study subjects will help the researcher to identify the appropriate test for screening Latent Tuberculosis. Study will have indirect benefits to me then the potential benefits of the study for choosing appropriate treatment to the patient and this will enhance better patient management

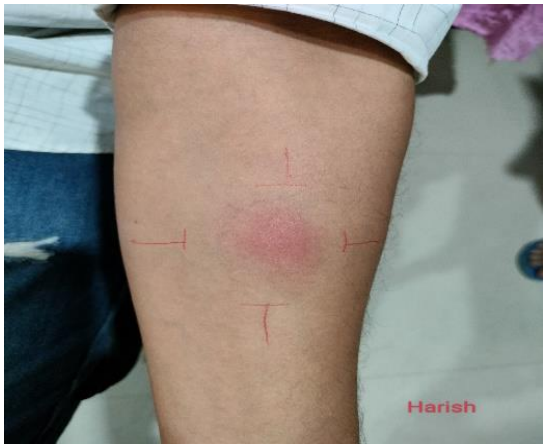
I have explained to Mr./Mrs._____ the purpose of the research, the procedures required and possible risk factor to the best of my ability.

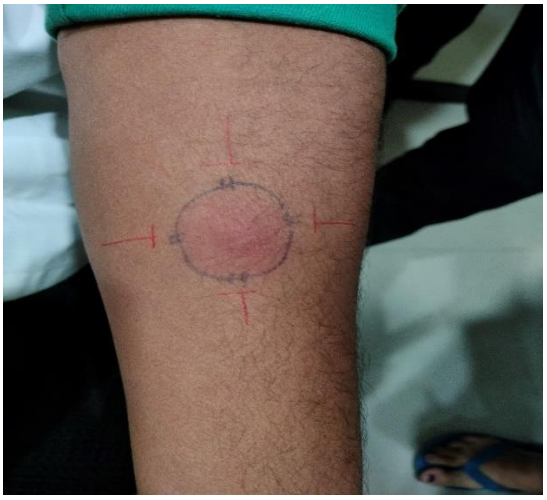
_____

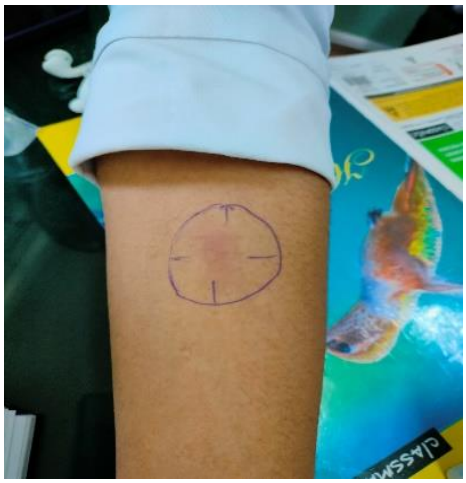
Miss. CHAITRA I PATIL DATE:

(Investigator)

PHOTOGRAPY







THESE PHOTOGRAPHY SHOWS POSITIVE RESULTS OF TUBERCULIN SKIN TEST