TUBERCULOSIS PREVALENCE AND RISK FACTORS DURING HAJJ SEASON 1440

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Abstract

Tuberculosis (TB) is a persistent global public health challenge, affecting millions annually. The Hajj pilgrimage brings together over two million Muslims from diverse regions, creating conditions conducive to the spread of infectious diseases. This retrospective study investigates TB prevalence during the 1440 Hajj season using data from healthcare facilities in Makkah. The findings reveal a prevalence rate of 2.8% and highlight significant risk factors, including overcrowding, delayed medical attention, and comorbidities such as diabetes. These findings contribute to improved preventive strategies for TB during mass gatherings, providing a global health benefit by informing policy recommendations to reduce risks in similar high-density settings worldwide. Recommendations include improved pre-travel screening, targeted public health interventions, and enhanced international collaboration to reduce TB risks during mass gatherings.

Introduction

Tuberculosis (TB) remains a major global cause of mortality, driven by Mycobacterium tuberculosis. Despite advancements in diagnostics and treatments, the burden of TB continues, compounded by multidrug-resistant strains (WHO, 2016). The annual Hajj pilgrimage to Makkah, attracting attendees from TB-endemic regions, poses unique challenges. Overcrowding, extreme heat, and comorbidities among elderly pilgrims amplify TB risks (Al-Orainey, 2013; Yezli et al., 2017). In addition to traditional methods, emerging technologies such as Artificial Intelligence (AI) offer enhanced capabilities for early detection and screening, improving prevention strategies for TB in large-scale gatherings like Hajj. This study addresses a critical gap in understanding TB dynamics during the 1440 Hajj season to inform effective preventive strategies.

Methodology

A retrospective analysis was conducted using data from healthcare facilities in Makkah:

- Population: Pilgrims presenting with respiratory symptoms during Hajj 1440.
- Diagnostics: Clinical evaluation, chest X-rays, sputum smear microscopy, and GeneXpert MTB/RIF assay.
- Drug Susceptibility Testing: Detection of multidrug resistance via genetic markers (rpoB and katG mutations).

- Statistical Analysis: Prevalence rates and risk factors were evaluated using SPSS, with chi-square tests and logistic regression determining significance ([$p < 0.05$]). Despite the use of advanced diagnostic methods, access to state-of-the-art equipment such as GeneXpert may be limited in remote healthcare settings, requiring adaptation of diagnostic strategies

Ethical approval was obtained from the institutional review board.

Results

1. Prevalence: 2.8% of symptomatic pilgrims tested positive for TB.
2. Demographics:
    - 50% of cases occurred in individuals aged >50 years.
    - Higher prevalence among Southeast Asian (29%) and Sub-Saharan African pilgrims.
3. Drug Resistance:
    - Rifampicin resistance: 15%.
    - Isoniazid resistance: 10%.
4. Risk Factors:
    - Overcrowding, diabetes (35%), and delayed medical attention.

Discussion

This study's findings align with previous research emphasizing TB's heightened transmission risks during mass gatherings. The prevalence rate of 2.8% observed in this study is consistent with similar mass gatherings, such as those documented by Memish et al. (2013).

Differences in regional vulnerability were noted, with higher TB prevalence among Southeast Asian pilgrims compared to Sub-Saharan African attendees. This contrasts with findings by Gautret et al. (2016) and may reflect regional disparities in health policies and pre-travel screening.

The varying levels of TB prevalence can be linked to different national health policies, with regions like Southeast Asia facing higher TB burden due to less comprehensive screening programs.

The detection of rifampicin and isoniazid resistance in 15% and 10% of cases, respectively, aligns with global MDR-TB trends (WHO, 2016). However, these findings underscore the necessity of genetic testing for tailored interventions, as supported by Zumla et al. (2018).

Enhanced screening measures and vaccination campaigns, as recommended by Al-Tawfiq et al. (2019), could mitigate respiratory infections during Hajj. The need for comprehensive public health campaigns targeting TB awareness is critical to reduce the disease burden in future gatherings.

Conclusion

This study underscores the urgent need for integrated TB management strategies during the Hajj. Recommendations include:

- Pre- and post-travel screening using advanced diagnostics.
- Deployment of genetic testing for MDR-TB.
- Public health education campaigns tailored to pilgrims and healthcare providers.

Long-term global partnerships are essential to mitigate TB risks during mass gatherings. Investing in predictive analytics, health infrastructure, and standardized guidelines will significantly improve disease control.

Future Directions

Collaborative research and sustainable investments are imperative. Strategies such as adopting AI for early TB detection and implementing standardized health policies could reduce risks. Long-term studies are necessary to evaluate intervention effectiveness and shape global health practices for mass gatherings.

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Figure 1: Age Distribution of TB Cases

The chart below illustrates the age distribution of TB cases during the Hajj season, highlighting the higher prevalence among individuals aged above 50 years. as shown in Age Distribution of TB Cases (Figure 1).

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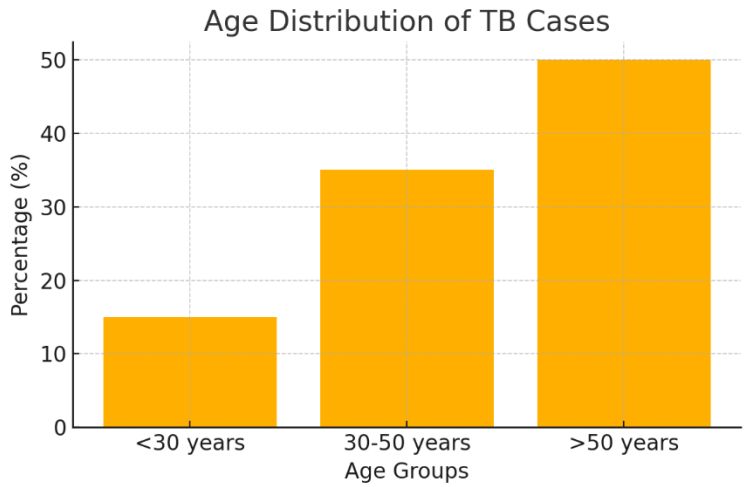


Figure 2: Distribution of TB Cases by Nationality
The pie chart below represents the distribution of TB cases by nationality, with a higher prevalence among Southeast Asian and Sub-Saharan African pilgrims.

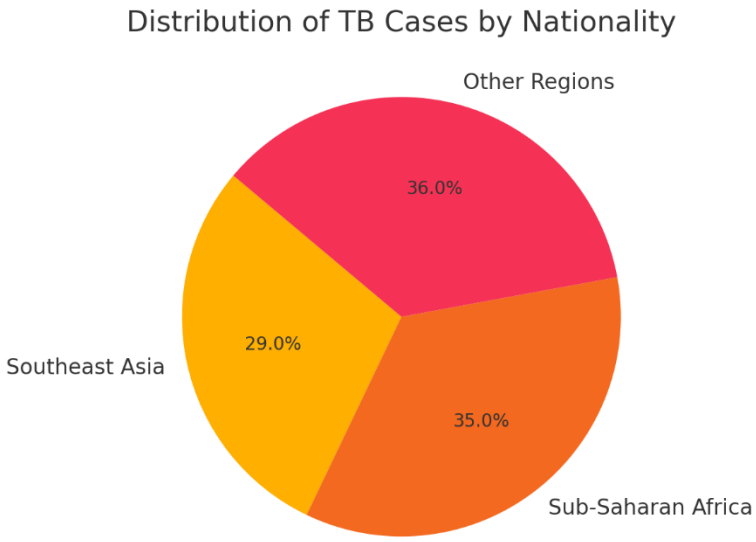
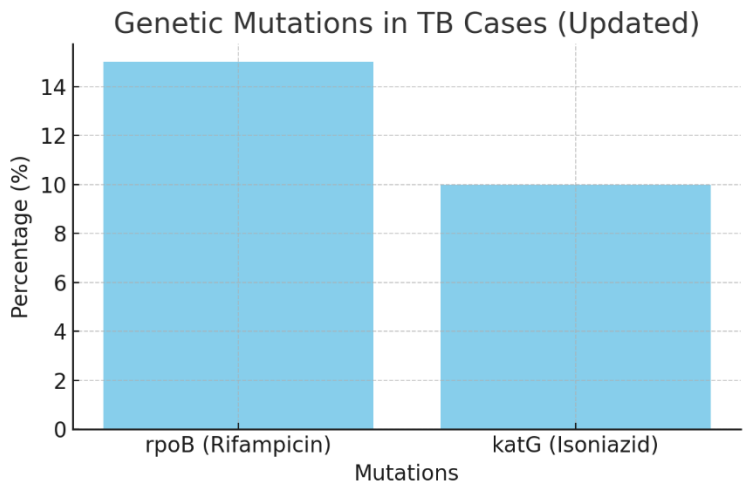


Figure 3: Genetic Mutations in TB Cases
The updated bar chart below shows the percentage of genetic mutations detected in TB cases, highlighting resistance to Rifampicin and Isoniazid. as detailed in Genetic Mutations in TB Cases (Figure 3).


Genetic Mutations in TB Cases (Updated)
Percentage (%)
0
2
4
6
8
10
12
14
rpoB (Rifampicin)
katG (Isoniazid)
Mutations