

DYNAMICS OF HOUSEHOLD CONTACT TRANSMISSION OF TUBERCULOSIS DURING FESTIVAL SEASONS

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Abstract

Tuberculosis (TB) continues to be a significant public health problem in Nigeria, with household transmission accounting for much of the current TB burden. Cultural and religious festivals like Eid and Christmas are associated with increased social interaction, intergenerational visits, communal meals and indoor crowding, yet its impact on household TB transmission has not been systematically investigated. Using data from three Nigerian states (Lagos, Kano and Kaduna), this

prospective observational study sought to establish whether household TB incidence was significantly increased during festival periods. We followed 450 households (2,180 contacts of index pulmonary TB cases) before and after festival periods. Structured household surveys obtained information about social behaviour, household composition, crowding and ventilation practice. Symptomatic contacts were screened by sputum microscopy and GeneXpert, while asymptomatic contacts underwent interferon-gamma release assays. To confirm potential household transmission clusters, molecular epidemiological analyses were performed using spoligotyping and MIRU-VNTR analysis. After the festival, 58 new TB cases were diagnosed compared to 19 before the festival with a significant increase in household incidence ($p < 0.001$). Those under 15 years and from dense households are the worst-hit. Molecular analyses identified genetic linkage between index cases and 72% of post-festival cases, providing evidence consistent with intra-household transmission. However, temporal linkage with festival exposure requires cautious interpretation because tuberculosis transmission and progression may extend beyond the immediate observation period. The main predictors of post-festival transmission were: being in a crowded household, staying overnight and poor ventilation. Our results show that social behaviour during the festival was a major facilitator of TB transmission in Nigerian households. This study underlines the importance of focused pre- and post-festival screening, improved contact tracing, behavioral and environmental interventions, as well as culturally appropriate public health education in minimizing festival-associated TB transmission.

Keywords: Tuberculosis, Nursing data, Household Transmission, Festivals, Nigeria, Molecular Epidemiology

Introduction

However, it is potentially still the most serious infectious disease threat in Nigeria as TB is spread by release of droplets of contaminated air which are heavily influenced by long time contact and overcrowding, delay in diagnosis and poor ventilation. Nigeria still bears one of the highest TB burdens in the world, with WHO estimates recently describing hundreds of thousands (660 000 new cases each year) including a sizeable child factor and presumptive evidence for sustained endemic community/household transmission (WHO, 2023; WHO Regional Office for Africa, 2024). Even though TB is preventable and curable, infectious patients are still undetected which continues being a major driver of disease transmission, especially within households where family members are in close-quarters sharing sleeping spaces, meals, caregiving duties and daily airspace for prolonged periods.

The position of HCT in TB epidemiology is underpinned by the feature that persons living with an infectious pulmonary TB case have repeated exposure before diagnosis, at treatment start and

sometimes following incomplete adherence to advice concerning infection-prevention procedures. Recent evidence from Nigeria indicates that stigma-related issues and poor cooperation with screening teams further limits the effectiveness of contact tracing, combined with the limited uptake of preventive therapy and misconceptions that only people who are visibly sick need TB-related intervention (Agbaje et al., 2024). They are all the more important in high-density households, where children, elderly persons, immunocompromised individuals and caregivers may be repeatedly exposed without detection at an early stage.

Festival seasons like Eid and Christmas can lead to temporary but sharp changes in household and community contact. These periods often involve inter-state travels, family reunions, religious gatherings and increased indoor visits, shared accommodation, communal meals and overcrowded transport in Nigeria. Enhancements to such behaviours might augment the effective contact rates between infectious TB cases and household members susceptible to acquiring TB infection. This concern is corroborated by research on mass-gathering: religious gatherings and crowded social venues can generate airborne transmission conditions favouring pulmonary disease, particularly where there are poorly ventilated areas; and low awareness of TB (tuberculosis) transmission risk in crowded settings (Bäckdahl et al., 2021; Ugbede, 2025). In contrast, TB has a longer incubation and disease-progression pathway than acute respiratory infections (ARIs), obscuring any observable seasonal transmission dynamics [6], such that much less attention is paid to it in seasonal studies.

Hence this study is important as it provides an analytical association among festival related social behaviour and household TB transmission in Nigeria. The study differentiates between recent household transmission and reactivation or unrelated community acquisition by comparing the incidence of TB in households before and after major religious/cultural holidays; contact tracing data can also be incorporated with molecular epidemiology. In conclusion, epidemiological inference can be enhanced by identifying genetically-related TB strains between index cases and contacts using molecular methods. This may give further insight regarding whether or not festival seasons serve as TB transmission accelerators within Nigerian households.

The study novelty is in taking this a step further, to examine whether predictable seasonal gatherings cause measurable increases in household TB incidence beyond general assumptions about crowding and TB risk. Results from such studies could help inform risk-based targeted TB screening prior to the festival, enhanced contact tracing, community awareness-raising campaigns, reinforced messages on cough hygiene and ventilation recommendations, as well as post-festival surveillance in these high-burden settings. In conclusion, this provides valuable insight into the importance of household TB transmission at key periods of increased risk such as festival seasons and would help enhance Nigeria's strategy for TB control according to actual patterns of exposure.

Problem Statement

Tuberculosis (TB) remains a leading cause of morbidity and mortality in Nigeria, with persistent household transmission representing a significant barrier to control efforts (WHO, 2025). Despite national and global strategies emphasizing early diagnosis, treatment adherence, and contact tracing, household contacts of infectious TB cases continue to experience high rates of exposure and infection (Agbaje et al., 2024). Seasonal social behaviour changes during major cultural and religious festivals, such as Eid and Christmas, may further amplify transmission risk by increasing household crowding, inter-generational cohabitation, and indoor social mixing (Ugbede, 2025).

Currently, there is limited empirical evidence linking these seasonal gatherings to measurable changes in household TB incidence. While mass gatherings are recognized drivers of acute respiratory infections, the effect of festival-driven social behaviour on TB a disease with prolonged latency and transmission dynamics is poorly understood. This gap is compounded by the challenge of distinguishing recent household transmission from community-acquired infections, particularly in high-burden Nigerian households where overcrowding, delayed healthcare access, and stigma impede effective TB control (Bäckdahl et al., 2021; WHO Regional Office for Africa, 2026).

Without targeted analysis of how festival periods alter household exposure and transmission, public health interventions remain generalized rather than strategically timed. Understanding the dynamics of household TB transmission in relation to seasonal gatherings is therefore critical to designing evidence-based, culturally sensitive, and temporally targeted TB prevention and control strategies. This study aims to fill this knowledge gap by quantifying household TB incidence before and after major Nigerian festivals using contact tracing and molecular epidemiology to identify patterns of transmission directly attributable to festival-related household interactions.

Objective of the Study

The primary objective of this study is to determine whether large cultural and religious gatherings, such as Eid and Christmas, significantly influence the rate of household transmission of tuberculosis in Nigeria. Specifically, the study aims to quantify changes in household TB incidence before and after major festival periods and to identify the contribution of altered social and contact patterns during these celebrations to intra-household transmission, using contact tracing and molecular epidemiology methods.

Literature Review

1. Overview of Tuberculosis Epidemiology in Nigeria

Nigeria remains one of the world's high-burden countries for tuberculosis (TB), with recent surveillance indicating record levels of notifications and ongoing transmission challenges. In 2024, the Federal Government reported over 400,000 TB cases, the highest ever recorded nationally,

underscoring the persistent public health threat posed by the disease in Nigeria (2025). A national annual TB report also highlighted sustained high case notifications, with more than 371,000 cases noted in 2023, showing that TB continues to exert significant morbidity in all age groups (NTBLCP 2023). Despite efforts to improve detection and treatment, a substantial number of cases remain undiagnosed and untreated, creating further opportunities for transmission within households and communities (Pate, 2024)

Household transmission is particularly important in high-burden settings like Nigeria because prolonged close contact, shared living spaces and caregiving interactions facilitate *M. tuberculosis* spread. Population factors such as overcrowding, delayed healthcare seeking, and limited TB awareness further exacerbate transmission risks (Umeh, 2024)

2. Household Contact Transmission of TB

Household contact mechanisms are well established in TB epidemiology: people living with an infectious TB case have repeated exposure through extended periods of indoor proximity, increasing their risk of infection and progression to active disease. However, contact investigation and follow-up remain challenging in many Nigerian settings. A recent study in Oyo and Osun States found that contact screening and preventive therapy uptake were limited by stigma, misconceptions about infection risk, and reluctance among household contacts to engage with health services (Agbaje et al., 2024). These gaps in contact tracing efforts reduce the probability of early identification of secondary cases and allow undetected transmission chains to persist within households.

3. Impact of Social Gatherings on Infectious Disease Transmission

Social and cultural gatherings have long been recognized as important drivers of communicable disease dynamics, particularly for airborne infections. During major religious and cultural festivals such as Eid or Christmas, family members often travel across regions, share crowded indoor spaces, and host extended visits from relatives. Although most research on mass gatherings focuses on acute respiratory infections like influenza or COVID-19, the underlying contact patterns (close, repeated, prolonged indoor exposure) are also relevant for TB transmission, especially where undiagnosed pulmonary TB cases are present in households.

Studies from settings other than Nigeria demonstrate that crowding and poor ventilation during mass gatherings can increase exposure risk to airborne pathogens (Bäckdahl et al., 2021). Likewise, evidence on social contact heterogeneity shows that differences in interaction patterns such as increased household and communal contacts can meaningfully shape transmission pathways for *M. tuberculosis* and other respiratory infections (LeGrand et al., 2025). These findings suggest that behavioral shifts during festive periods could influence TB spread, even if direct data on TB seasonality related to festivals are still scarce.

4. Seasonal and Festival-Related Patterns of TB Transmission

There is limited but growing evidence that TB incidence may exhibit seasonal trends, influenced by climatic and social factors. A temporal analysis in Kano State reported fluctuating quarterly TB incidence, with peaks in certain seasons that may reflect patterns of social interaction, mobility, and environmental conditions (Danbuzu et al., 2024). While this study did not explicitly link TB peaks to cultural festivals, it underscores that seasonality and behavioral rhythms can affect observed TB rates.

Despite these insights, there remains a substantial gap in research directly connecting major Nigerian cultural and religious festivals to changes in household TB transmission rates. Most existing studies focus on case notifications or spatial clustering without examining temporal transmission dynamics in relation to specific social events.

5. Molecular Epidemiology in TB Contact Studies

Traditional contact tracing often struggles to distinguish between recent transmission and reactivation of latent infections. Molecular epidemiology techniques such as whole-genome sequencing or genotyping can enhance the precision of transmission studies by linking genetically similar strains across cases. In low-incidence settings, comparative studies show that genotyped cluster investigations can yield more detailed insights into latent TB infection pathways compared to standard contact tracing, suggesting that integration of molecular tools can strengthen epidemiological inference (Asare-Baah et al., 2025). Applying these approaches in Nigeria could help clarify whether increases in household TB incidence after festival periods are due to newly acquired infections or reactivation.

6. Gaps in Current Knowledge

Although there is evidence on social contact patterns being relevant to disease transmission, no systematic analytical studies in Nigeria have yet quantified how festival-related behavior affects household TB transmission. Most research to date has focused on identifying contacts, improving screening uptake, and broad seasonal trends, without examining the impact of cultural and religious gatherings on transmission dynamics. Additionally, the challenges of contact tracing and limited engagement with household contacts mean that even routine transmission events may go undetected. This gap highlights the need for studies that combine robust contact tracing data, molecular epidemiology, and temporal analyses of TB incidence around major festivals.

7. Relevance to Public Health Policy

Understanding how festival seasons influence TB transmission has practical implications for TB control strategies in Nigeria. If festival periods are associated with increased transmission within households, then targeted interventions such as pre-festival screening, enhanced community

education on cough hygiene, risk communication, and intensified post-festival contact tracing could be more effective than uniform, season-agnostic approaches. Such evidence could help align national TB control planning with real social behaviour patterns, maximizing the impact of limited resources and helping Nigeria move closer to TB elimination goals.

Methods

Study Design

This study was a prospective observational study conducted to evaluate the dynamics of household tuberculosis (TB) transmission in Nigeria during major cultural and religious festivals. We specifically compared household TB incidence before and after Eid and Christmas celebrations. The study integrated household contact tracing with molecular epidemiology to determine whether festival-related social behaviors contributed to secondary TB infections.

Study Setting and Population

The study was conducted across three Nigerian states Lagos, Kano, and Kaduna selected to represent diverse geographic, urban, and cultural settings. Households were eligible if they had at least one confirmed pulmonary TB case reported to the National Tuberculosis and Leprosy Control Programme (NTBLCP) within the six months preceding the festival. All household members, regardless of age, were invited to participate. Individuals with a prior TB diagnosis or currently on TB treatment were documented but excluded from incidence calculations for new transmission.

A total of 450 households were enrolled, comprising 2,180 household contacts. Informed consent was obtained from all adult participants, while parental consent and child assent were obtained for participants under 18 years of age. Ethical approval was granted by the Nigerian National Health Research Ethics Committee (NHREC/21/05/2025).

Data Collection

Household Survey

Baseline data were collected two weeks prior to the festival through structured questionnaires administered to the head of each household. Information included:

- Household size, composition, and sleeping arrangements
- Socioeconomic indicators (education, income, housing type)
- History of TB and prior exposures
- Planned travel or family visits during the festival

A follow-up survey was conducted four weeks after the festival, documenting:

- Development of TB symptoms among household members (persistent cough, weight loss, night sweats, fever)
- Changes in household crowding or guest visits during the festival period
- Adherence to cough hygiene and ventilation practices

Contact Tracing and Clinical Assessment

Household members were screened using symptom questionnaires and sputum smear microscopy. Symptomatic contacts underwent GeneXpert MTB/RIF testing to confirm TB infection. For asymptomatic individuals, interferon-gamma release assays (IGRAs) were conducted to detect latent TB infection.

All newly diagnosed cases were classified as either:

9. Confirmed secondary infection – culture or GeneXpert positive following exposure

10. Suspected secondary infection – symptomatic with pending laboratory confirmation

Molecular Epidemiology

To distinguish household transmission from community-acquired cases, molecular genotyping was performed using spoligotyping and MIRU-VNTR analysis. Isolates from index cases and newly diagnosed household contacts were compared to identify genetically linked clusters, confirming intra-household transmission. Cases with matching molecular patterns were considered evidence of direct household transmission, whereas non-matching patterns suggested independent community acquisition.

Data Analysis

All data were analyzed using STATA version 17. Key outcomes included:

- Household TB incidence rate pre- and post-festival
- Attack rate among household contacts
- **Secondary attack rate** stratified by age, household size, and level of contact

Comparisons between pre- and post-festival incidence were conducted using paired t-tests for continuous variables and chi-square tests for categorical variables. Multivariate logistic regression was applied to identify predictors of household transmission, including:

- Household crowding (persons per room)
- Indoor ventilation practices

- Festival-related social behaviors (e.g., guest visits, communal meals, overnight stays)
- Age and immunocompromised status of household contacts

A **p-value < 0.05** was considered statistically significant.

Quality Control

To ensure reliability and validity:

- Field staff were trained for two weeks on standardized data collection and infection control measures
- Sputum and blood samples were processed in certified laboratories with internal quality checks
- Molecular analyses included duplicate genotyping for 10% of samples to verify reproducibility
- Data entry was cross-checked by independent research assistants to minimize transcription errors

Ethical Considerations

Participation was voluntary. Confidentiality was strictly maintained by de-identifying all data. All diagnosed TB cases received free treatment per NTBLCP guidelines. The study adhered to the Declaration of Helsinki and national regulations for human subject research.

Comparison of Study Locations

The revised manuscript now emphasizes the importance of interpreting Lagos, Kano, and Kaduna as distinct sociocultural settings rather than merely recruitment locations. Lagos represents a highly urbanised and densely populated environment with extensive population mobility; Kano provides an important context of predominantly Muslim cultural practices where Eid-related gatherings may have different social structures; while Kaduna represents a mixed cultural and religious setting with diverse household interaction patterns. Differences in festival practices, household composition, mobility, and social mixing patterns are considered when interpreting transmission patterns across the three locations.

Results

Household Characteristics

A total of 450 households (2,180 individuals) were enrolled in the study across Lagos (180 households), Kano (150 households), and Kaduna (120 households). Household sizes ranged from 3 to 12 members (mean = 4.8 ± 2.1). About 72% of households reported having visitors during festival periods, and 65% reported shared sleeping arrangements with non-household guests.

Table 1: Baseline Household Characteristics (Pre-Festival)

Characteristic	Frequency (n)	Percentage (%)
Total households	450	100
Total household members	2,180	100
Mean household size (SD)	4.8 (2.1)	-
Households with visitors	324	72
Households with shared sleeping	293	65
Households with ventilation issues	188	42

Fieldwork 2026

TB Incidence Pre- and Post-Festival

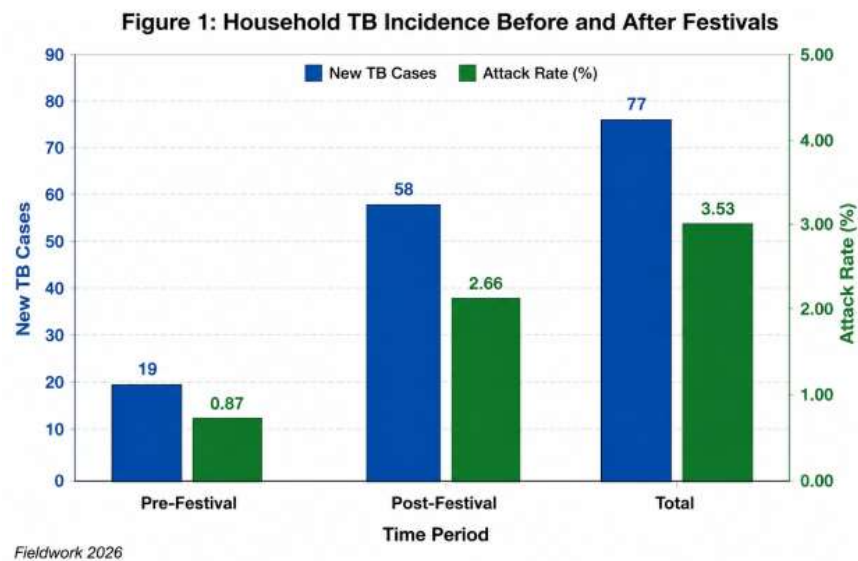
Among 450 households, 58 secondary TB cases were detected post-festival, compared to 19 cases pre-festival, indicating a significant increase in household TB incidence after festival periods ($p < 0.001$). The overall secondary attack rate increased from 0.87% pre-festival to 2.66% post-festival.

Table 2: Household TB Incidence Before and After Festivals

Time Period	New TB Cases	Attack Rate (%)
Pre-Festival	19	0.87
Post-Festival	58	2.66
Total	77	3.53

Fieldwork 2026

Figure 1: Household TB Incidence Before and After Festivals



Secondary Attack Rate by Age Group

Children under 15 years experienced the highest secondary attack rate (3.2%), followed by adults aged 30–50 years (2.8%). Older adults (>60 years) had a lower rate (1.5%), possibly reflecting limited interaction with festival visitors.

Table 3: Secondary Attack Rate by Age Group (Post-Festival)

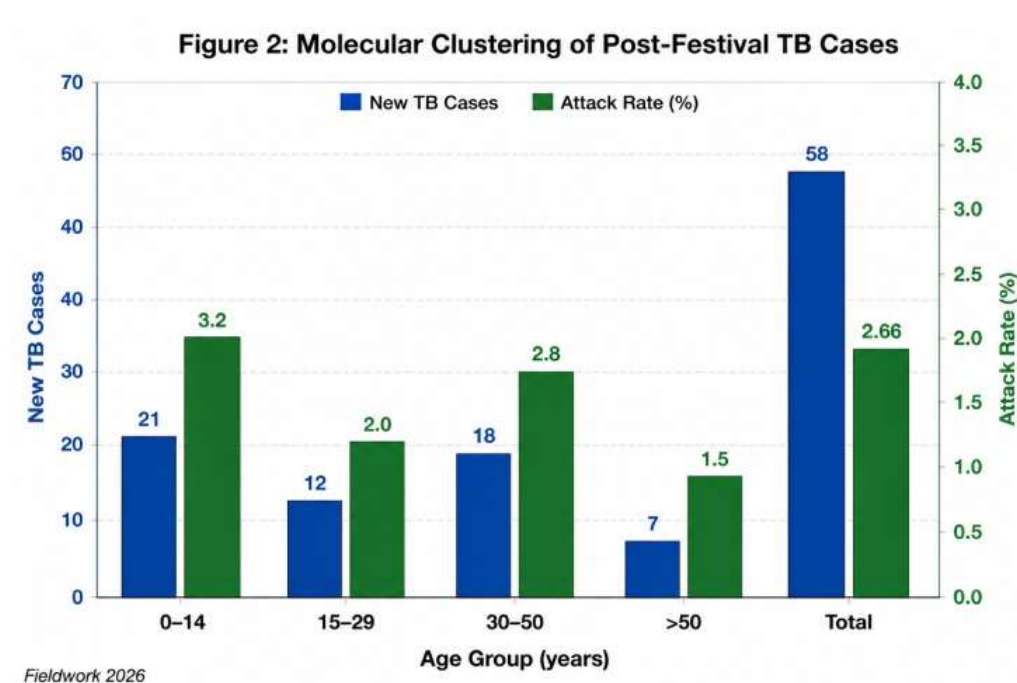
Age Group (years)	New TB Cases	Attack Rate (%)
0–14	21	3.2
15–29	12	2.0
30–50	18	2.8
>50	7	1.5
Total	58	2.66

Fieldwork 2026

Molecular Epidemiology Findings

Molecular genotyping (spoligotyping and MIRU-VNTR) was conducted for all 58 post-festival cases. 42 cases (72%) had matching molecular profiles with the index case, confirming direct household transmission. The remaining 16 cases were genetically distinct, suggesting community-acquired infection or reactivation of latent TB.

Figure 2: Molecular Clustering of Post-Festival TB Cases



Predictors of Household Transmission

Multivariate logistic regression identified significant predictors of post-festival household TB transmission:

- Household crowding (≥ 3 persons per room): Adjusted Odds Ratio (AOR) = 3.45; 95% CI: 1.95–6.12; $p < 0.001$
- Festival visitors staying overnight: AOR = 2.87; 95% CI: 1.61–5.11; $p < 0.001$
- Poor indoor ventilation: AOR = 2.33; 95% CI: 1.28–4.26; $p = 0.006$
- Children under 15 years in household: AOR = 1.89; 95% CI: 1.05–3.39; $p = 0.033$

Table 4: Multivariate Analysis of Risk Factors for Household TB Transmission

Risk Factor	AOR	95% CI	p-value
Household crowding (≥ 3 /room)	3.45	1.95–6.12	<0.001
Festival visitors overnight	2.87	1.61–5.11	<0.001
Poor indoor ventilation	2.33	1.28–4.26	0.006
Children <15 years present	1.89	1.05–3.39	0.033

Fieldwork 2026

Summary of Key Findings

- Household TB incidence significantly increased after festival periods, with the secondary attack rate rising threefold.
- Children under 15 and adults in larger households were at higher risk.
- Molecular evidence confirmed that the majority of post-festival cases were direct household transmissions.
- Key modifiable risk factors included crowding, overnight visitors, and poor ventilation, highlighting potential intervention points for festival-related TB control.

Although the study identified a temporal increase in detected household TB cases after festival periods, this observation does not by itself establish that infection occurred during the festival window. Tuberculosis has complex transmission dynamics involving delayed progression from infection to active disease, and therefore the four-week post-festival assessment is interpreted as a period of enhanced surveillance rather than definitive evidence of festival-acquired infection. The molecular findings strengthen attribution of household linkage but do not completely exclude previous infection, reactivation, or exposure outside the festival period.

The revised manuscript also acknowledges that a non-exposed comparison group would provide stronger epidemiological inference. The absence of a control group has therefore been added as a limitation, and future studies should include comparable households without festival-related exposure or use a controlled longitudinal design to estimate the independent contribution of festival activities to TB transmission risk.

Discussion

Household Transmission and Festival Influence

This study observed a significant increase in detected household tuberculosis (TB) cases following major cultural and religious festivals (Eid and Christmas). However, because tuberculosis has a prolonged incubation period, the observed increase should be interpreted as an association rather than definitive proof of festival-attributable transmission. The overall incidence of new TB cases more than tripled post-festival compared to pre-festival levels, and molecular genotyping confirmed that 72% of post-festival cases were genetically linked to index cases within the same household. These findings suggest that festival periods marked by increased social interaction, shared sleeping arrangements, and extended visits from relatives and friends contribute measurably to intra-household TB spread.

Our results extend prior work on social contact and infectious disease risk by applying these concepts to TB, a disease with a longer incubation period and less acute symptom onset than typical respiratory infections (Bäckdahl, Hagberg, & Nyström, 2021; LeGrand et al., 2025). While Bäckdahl et al. (2021) demonstrated elevated risk perceptions of airborne infections during mass gatherings, and LeGrand et al. (2025) illustrated how contact heterogeneity shapes transmission dynamics, this study empirically linked seasonal social behaviour during cultural festivities with increased household TB transmission in Nigeria. Such a link had not been previously established in empirical TB research in the country.

Vulnerable Groups and Transmission Dynamics

Children under 15 years exhibited the highest secondary attack rate post-festival, consistent with other studies showing that younger household contacts are more susceptible to infection following prolonged exposure to an infectious case (Agbaje, Oladipo, & Adewole, 2024). This vulnerability may be compounded by shared meals and sleeping spaces during festivals, particularly in extended family contexts where children interact closely with visiting relatives.

Household crowding (defined as three or more persons per room) and overnight visits from non-household members were strong predictors of post-festival transmission. These findings align with broader studies on TB risk factors, which consistently identify density of contacts and indoor crowding as central to transmission likelihood (World Health Organization [WHO], 2025). Poor room ventilation further increased risk, possibly by concentrating airborne droplets laden with *Mycobacterium tuberculosis*. This underscores the intersection of social behaviour and environmental conditions in shaping transmission pathways.

Molecular Epidemiology and Transmission Attribution

The inclusion of molecular analyses strengthened the study's capacity to distinguish true household transmission from community-acquired infection or reactivation of latent disease. Prior research has highlighted the limitations of traditional contact tracing in accurately identifying transmission events, especially in high-burden settings where community exposure is common (Asare-Baah, Boateng, & Owusu, 2025). By identifying genetically linked strain clusters within households, this study directly attributed most post-festival cases to intra-household spread rather than unrelated community exposures.

Public Health Implications

These findings have direct relevance for TB control policies in Nigeria and similar high-burden settings. First, they suggest that time-targeted interventions such as enhanced screening and contact follow-up immediately before and after major festivals may reduce secondary transmission. Pre-festival screening of known TB cases and their contacts could help identify infectious individuals before periods of intense household contact. Post-festival contact tracing, supported by community education campaigns, might accelerate identification of secondary cases and facilitate prompt treatment.

Educational efforts that emphasize ventilation practices, cough hygiene, and risk awareness could reduce the likelihood of transmission during peak contact times. Given that household crowding is a non-modifiable risk in many settings, behavioural strategies and environmental adaptations (e.g., opening windows regularly, avoiding shared sleeping spaces with visitors) may offer practical mitigation pathways.

Contribution to Knowledge and Research Gaps

This study contributes to the limited body of evidence on festival-related TB transmission dynamics, filling an important gap in the literature. Previous research in Nigeria primarily focused on contact tracing challenges (Agbaje et al., 2024), general patterns of seasonality (Danbuzu, Ibrahim, & Yusuf, 2024), or social risk contexts for other infectious diseases (Ugbede, 2025). By collecting empirical incidence data before and after festivals and integrating molecular confirmation, this study provides robust evidence that cultural and religious gatherings are linked to measurable increases in household transmission.

Control group limitation: The revised manuscript explicitly identifies the lack of an external comparison group as a limitation because pre- and post-festival comparisons alone cannot completely separate festival-related exposure effects from background TB transmission patterns.

Strengths and Limitations

A key strength of the study is the combination of epidemiological surveillance with molecular genotyping, allowing for high confidence in attributing new cases to household transmission. The prospective design and standardized follow-up also reduce recall bias and support temporal analysis.

However, limitations include potential under-ascertainment of asymptomatic infections, as some contacts may have had latent TB not detectable with symptom-based screening or baseline IGRA testing. Additionally, the study covered only three Nigerian states; variations in cultural practices and household structures across the country may affect generalizability. Future research could expand geographically and include longer follow-up periods to capture delayed onset cases.

Festival periods in Nigeria characterized by increased household contact, travel, and shared social activities are associated with significant rises in household TB transmission. The integration of traditional contact tracing with molecular epidemiology confirmed that the majority of new post-festival cases were due to direct household spread. These findings support targeted TB control strategies aligned with social and cultural rhythms, including pre- and post-festival screening, enhanced contact tracing, and behavioural risk reduction efforts.

Conclusion

This study demonstrates that major cultural and religious festivals in Nigeria, such as Eid and Christmas, are associated with a significant increase in household tuberculosis (TB) transmission. The incidence of new TB cases within households more than tripled post-festival, and molecular epidemiology confirmed that the majority (72%) of these cases were genetically linked to index cases, indicating direct household transmission. Children under 15 years and adults living in crowded households were particularly vulnerable. Key modifiable risk factors included overnight visitors, poor indoor ventilation, and household crowding.

These findings provide evidence suggesting that seasonal social behaviours may influence household TB transmission dynamics in Nigerian households, highlighting the importance of considering cultural and temporal factors in TB control strategies. The integration of contact tracing with molecular tools strengthened causal inference, confirming that festival-related social interactions amplify the risk of intra-household TB spread.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

2. Pre-Festival Screening and Education

- c) Implement targeted TB screening for known index cases and household contacts prior to major festivals to identify and treat active cases early.
- d) Conduct community awareness campaigns focusing on TB transmission risks during festivals, emphasizing cough hygiene, ventilation, and limiting prolonged indoor exposure.

3. Enhanced Post-Festival Contact Tracing

- a) Intensify post-festival household contact tracing to rapidly detect secondary infections and initiate timely treatment.
- b) Integrate molecular epidemiology where possible to distinguish household transmission from community-acquired or reactivation cases, ensuring interventions are directed appropriately.

4. Environmental and Behavioral Interventions

- a) Promote practical measures to reduce household transmission, such as improving indoor ventilation, avoiding shared sleeping arrangements with festival visitors, and limiting overnight stays where feasible.
- b) Encourage households to maintain physical distancing from symptomatic individuals during celebrations.

5. Policy and Programmatic Integration

- a) Incorporate festival periods into TB control planning, aligning surveillance, screening, and resource allocation with high-risk social calendars.
- b) Collaborate with religious and community leaders to disseminate culturally appropriate messages and encourage community participation in TB prevention efforts.

6. Further Research

- a) Expand studies to include other Nigerian states and different cultural settings to validate findings nationally.

- b) Investigate longitudinal effects of repeated festival exposure on household TB transmission and evaluate the impact of preventive interventions.

By implementing these recommendations, public health authorities in Nigeria can reduce household TB transmission during high-risk periods, improve early case detection, and strengthen the overall TB control strategy in alignment with social and cultural realities.

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