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Evaluation of Tuberculin Skin Test Positivity and Annual Risk of Infection among Children Visiting the Basic Health Unit, Kachi Shahani, Bhakkar

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Abstract:

Background: TB is still a major public health problem in Pakistan and children are at high risk of latent TB infection (LTBI). A lack of understanding of the burden and risk factors of LTBI in paediatric populations will hinder the effectiveness of TB control strategies. The objective of the study was to find out the prevalence of LTBI among children attending BHBU Kachi Shahani of District Bhakkar, Punjab, Pakistan and to look for risk factors associated with this infection.

Methods: The study was conducted by cross sectional approach that is hospital based study in the Basic Health Unit Kachi Shahani, Bhakkar in which 425 children age (1-15 years) were selected. Demographic details such as age, sex, residence and BCG scar were obtained by using a structured questionnaire. Tuberculin Skin Test (TST) was injected intradermally with 0.1 mL of purified protein derivative and induration was measured 48-72 hours after the injection. If any induration was $\geq$10 mm, this was treated as positive for LTBI. The data were analysed using SPSS version 25. The prevalence was reported with 95% confidence intervals, and the Annual Risk of Infection (ARI) was estimated using the formula $ARI = 1 - (1 - P)^{(1/a)}$. Chi-square tests and multivariable logistic regression were used to test for associations with demographic factors in TST-positive children.

Results: Of the 425 participants, the majority were aged 6-10 years (41.4%), male (52.5%), and from rural areas (65.4%). In 82.4% of children, BCG scar was observed. The overall TST positivity rate was 16.9% (72/425) and it was continuing to rise with age; the rate was 8.5% in children aged 1-5 years, 15.3% in children aged 6-10 years and 26.7% in children aged 11-15 years. The risk of infection was estimated at 2.2% per year. Multivariable logistic regression showed that children aged 11-15 years had significantly higher odds of being TST positive than did the children aged 1-5 years (aOR 3.12, 95% CI: 1.45-6.70, P=0.003). Children who did not have a BCG scar were also significantly more likely to test positive for TST (aOR 2.41, 95% CI: 1.31-4.44; P=0.005). Sex (aOR 1.18, 95% CI: 0.72-1.92, P=0.507) and place of residence (aOR 1.56, 95% CI: 0.90-2.69, P=0.108) were not significantly associated with TST positivity.

Conclusions: The study shows that the overall prevalence of latent tuberculosis infection is high among the children of Bhakkar (16.9%) while the Annual Risk of Infection is estimated to be 2.2%. Being older (11–15 years) was a significant independent risk factor for LTBI, as was the absence of a BCG scar. These indicate the need to urgently strengthen TB control efforts, particularly regarding contact tracing, improving TB preventive therapy for older children and adolescents, and maintaining high BCG vaccination coverage, in this high TB burden context.

Ongoing monitoring and targeted interventions are key to curb transmission of TB and LTBI in children in Pakistan.

Keywords: Latent tuberculosis infection, Tuberculin Skin Test, children, Pakistan, Annual Risk of Infection, BCG vaccination.

Introduction

Tuberculosis (TB) remains one of the biggest public health issues in the world especially in low- and middle-income nations. Mycobacterium tuberculosis is the causative agent that may develop latent infection much earlier than clinical disease onset and children are the sentinel indicators of further transmission within the community (Yates et al., 2024). The importance of identifying latent infection of TB among children is that it indicates recent infection and enables the determination of the force of infection in a population. The most commonly used field screening device in screening the latent TB infection is the tuberculin skin test (TST), also referred to as the Mantoux test, and the derived annual risk of tuberculous infection (ARTI) is an important epidemiological measure used to quantify the dynamics of the transmission of TB in a region (Menzies and Vissandjee, 1992).

TST positivity in children gives an understanding of the cumulative probability of TB infection by the age of that child. ARTI can be estimated using suitable statistical techniques, which is the annual risk of infection of a vulnerable individual. As an example, a survey of primary school children in Northern KwaZulu-Natal, South Africa, with a threshold of [?]10 mm induration, estimated ARTI at 1.7% to 2.4% (Yates et al., 2024). In Pakistan, household contacts of cases of active TB have been reported to have high latent infection burdens; in Umerkot, Sindh province TST positivity among contacts of smear-positive pulmonary TB cases was reported to be 49.4% (Rathi, Akhtar, Rahbar, and Azam, 2002). Such high prevalence rates emphasize the persistence of the community transmission and the necessity to track the rate of the infection in children as the indicator of recent infection. The case under investigation is especially applicable to District Bhakkar in Pakistan. Although TB control programs are mainly concerned with the detection and treatment of cases, the scale of latent infection in children and the anual risk of being infected is undocumented.

The estimation of ARTI in school-age children gives useful public health data. Active and continuing transmission is indicated by high ARTI and may be of interest in increased interventions including active case finding, preventive therapy in latent infection, and infection-control interventions in communal settings. On the other hand, low ARTI can mean that there is less transmission or effective TB control programs (Yates et al., 2024). In KwaZulu-Natal, as an example, an ARTI estimate of about 2% provoked the demand to implement measures to interrupt transmission, which demonstrates that even average ARTI values may be epidemiologically important (Yates et al., 2024). TST-based surveys have limitations even though they are useful. BCG immunization can cause false-positive responses, especially when administered post-infant or as a booster. Majority of the studies however show that BCG vaccination at birth has minimal effect on TST indurations in older children (Menzies and Vissandjee, 1992).

False negatives can be caused by malnutrition and immunosuppression, and the assumptions used in ARTI computations, including constant force of infection and small reversion, are not always true. However, TST surveys, when undertaken with proper methodology, are still a main pillar of epidemiological surveillance of the spread of TB in children. Since the national and regional TB burden in Pakistan is high, and there is little information on infection among school children in particular districts, this study in District Bhakkar will fill a knowledge gap. The evaluation of TST positivity and the estimation of ARTI will allow the study to present empirical data on the extent of the TB infection and transmission among children, define risk subpopulations, and inform prevention strategies in schools and preventive therapy and control of TB. The study aims to determine TST positivity and estimate the annual risk of tuberculosis infection (ARI) among children visiting the Basic Health Unit, Kachi Shahani, Bhakkar, and to assess demographic and epidemiological factors associated with TST positivity.

Materials And Methods

Study Design and Area

A cross-sectional hospital-based survey were conducted among children visiting at Basic Health Unit, Kachi Shahani, District Bhakkar, Punjab Pakistan. Children visited at BJU included to ensure representativeness of socio-economic and geographic variation.

Sample Size

The required sample size were be calculated using the formula for a single proportion:

$n = Z^2 \ p(1\text{-}p)/d^2$

where:

- (Z = 1.96) for 95% confidence level
- (p =) expected TST positivity (assumed 0.50 if unknown)
- (d =) margin of error (0.05)

This yields approximately 385 children; assuming 10–15% non-response, the final target was ~425 children.

Sampling Strategy and Collection

Children who visited at Basic Health Unit, Kachi Shahani, Bhakkar were selected for sampling. An informed consent were filled before collecting samples. Children who do not have active TB and whose parents or guardians provide consent were eligible to participate. The Tuberculin Skin Test was administered using an intradermal injection of 0.1 mL of purified protein derivative on the volar surface of the forearm. Trained staff were measured the induration after 48 to 72 hours in millimeters and will also record BCG scar status, age, sex, and other demographic details.

Sample Processing

Induration of 10 mm or more were taken as a positive result for latent TB infection, with adjustments made when needed for participants who received the BCG vaccine. All data were reviewed for completeness and consistency before being entered into the database.

Data Analysis

The prevalence of TST positivity were reported as a percentage along with 95 percent confidence intervals. The annual risk of infection were calculated using the formula
ARI = 1 − (1 − P)(1/a), where P represents the prevalence of TST positivity and a is the mean age of the children. Associations between TST positivity and factors such as age, sex, BCG status, school type, and location were examined through Chi-square tests and logistic regression. All analyses were carried out using SPSS Version 25. P-value <0.05 were consider significant between to variables.

Results

Demographic Characteristics of the Study Population

The study included 425 children visiting at the Basic Health Unit (BHU), Kachi Shahani, Bhakkar. The mean age of children taking part was 8.4 ± 2.6 years (range: 1–15 years). Males represented 52.5% (n = 223) of the participants, while females accounted for 47.5% (n = 202). The majority of children (82.4%) had a visible BCG vaccination scar.

Table 1 Demographic characteristics of study participants (n = 425)

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	1–5	118	27.8
	6–10	176	41.4
	11–15	131	30.8
Gender	Boys	223	52.5
	Girsl	202	47.5
Residence	Rural	278	65.4
	Urban	147	34.6
BCG scar	Present	350	82.4
	Absent	75	17.6
Total		**425**	**100**

Demographic Characteristics of the Study Participants

Demographic profile of children (N = 425) involved in this study is shown in Table 1. The subjects were divided into three age groups 1-5 years, 6-10 years and 11-15 years. Children aged between 6 and 10 years numbered 176 (41.4%) followed by 131 (30.8%) children aged between 11 and 15 years and 118 (27.8%) children aged between 1 and 5 years. The majority of the participants were of primary school age (this distribution).

Sex distribution according to gender showed that out of 425 participants, 223 (52.5%) were male and 202 (47.5%) were female, with almost equal distribution of both sexes and a slight predominance of males. Children were predominantly (65.4%) from rural areas, while 147 (34.6%) were from urban areas. This finding is proof of the rural areas which are covered by Basic Health Unit Kachi Shahani, Bhakkar. Evaluation of the BCG vaccination status revealed that 350 (82.4%) children had a visible BCG scar and 75 (17.6%) children did not have any BCG scar. High rate of children with BCG scar indicates good vaccination coverage among study population. Overall, the study population was fairly evenly distributed by gender, the majority were aged 6-10 years, and had lived in rural areas and were previously immunized against BCG vaccination.

Prevalence of Tuberculin Skin Test (TST) Positivity

Among the 425 children, **72 were TST positive**, giving an overall prevalence of **16.9% (95% CI: 13.5–20.8%)**.

Table 2. Prevalence of Tuberculin Skin Test positivity

TST Result	Frequency (n)	Percentage (%)
Positive (≥10 mm)	72	16.9

Negative (<10 mm)	353	83.1
Total	**425**	**100**

Of the 425 children examined, 72 (16.9%) were positive and 353 (83.1%) were negative Tuberculin Skin Test (induration ≥10 mm). This means almost one in six of all the participants in the study had some evidence of TB infection or previous experience of being exposed to the bacterium Mycobacterium tuberculosis. The absence of children that were TST negative indicates that most of the children were not highly reactive to tuberculin. A high burden of tuberculosis infection in children who attend the Basic Health Unit (BHU) Kachi Shahani, Bhakkar, is reflected by 16.9% of overall positivity rate by TST in the area.

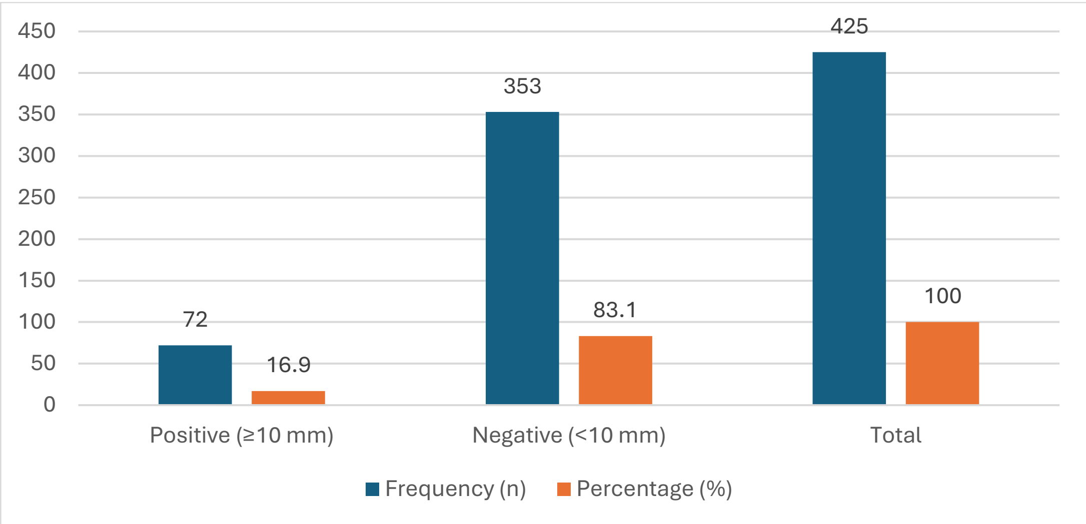

Figure 1 Showing Prevalence of Tuberculin Skin Test positivity

Annual Risk of Tuberculosis Infection (ARI)

The prevalence of TST positivity was **16.9%**, and the mean age of study participants was **8.4 years**.

The ARI was estimated using:

ARI = 1 − (1 − P)^(1/a)

Where:

- P = 0.169
- a = 8.4 years

The estimated **Annual Risk of Tuberculosis Infection (ARI)** was **2.2% per year**.

Table 3. Estimation of Annual Risk of Tuberculosis Infection

Parameter	Value
Number of children	425
Mean age (years)	8.4
TST prevalence (%)	16.9
Estimated ARI (%)	2.2

The estimated Annual Risk of Tuberculosis Infection (ARI) among children visiting the Basic Health Unit, Kachi Shahani, Bhakkar is presented in Table 3. There were 425 children who participated in the study, with a mean age of 8.4 years. Overall positivity for the Tuberculin Skin Test (TST) was 16.9%, meaning that in about one in six children, there was evidence of past exposure to Mycobacterium tuberculosis. Based on the observed prevalence of the TST and the average age of the study population, the estimated ARI was 2.2%. That means that on average approximately 2.2 out of 100 children who were not infected were infected with TB in the study area in each year of the study. The estimated ARI represents the intensity of current community transmission of Mycobacterium tuberculosis and suggests that there remains a risk of exposure to children. The discovery of such an infection emphasises the importance of improved TB control to reduce transmission, including people ensuring that they are diagnosed early, infectious people are treated promptly and that contact tracing is in place, and improving community awareness. The relatively high ARI also highlights the need for ongoing surveillance in the study area and targeted TB interventions to reduce the LTBI burden among children.

Association Between Demographic Factors and TST Positivity

Older children demonstrated a significantly higher prevalence of TST positivity compared with younger children (**P = 0.001**). TST positivity was also significantly associated with the absence of a BCG scar (**P = 0.004**). No significant association was observed with sex.

Table 4Association between demographic variables and TST positivity

Variable	**Category**	**TST Positive n (%)**	**TST Negative n (%)**	**χ^2**	**P-value**
Age group	1–5 years	10 (8.5)	108 (91.5)		
	6–10 years	27 (15.3)	149 (84.7)		
	11–15 years	35 (26.7)	96 (73.3)	14.82	0.001
Sex	Male	40 (17.9)	183 (82.1)		
	Female	32 (15.8)	170 (84.2)	0.36	0.548
Residence	Rural	54 (19.4)	224 (80.6)		
	Urban	18 (12.2)	129 (87.8)	3.62	0.057
BCG scar	Present	49 (14.0)	301 (86.0)		
	Absent	23 (30.7)	52 (69.3)	8.41	0.004

Significant at $P < 0.05$.

The association of selected demographic characteristics with the positivity of Tuberculin Skin Test (TST) among the study participants is presented in the 4.4 table. There was a significant relationship between TST positivity and age group (χ^2 = 14.82, P = 0.001). There was a progressive increase in the prevalence of TST positivity with age and 8.5% of children aged 1–5 years, 15.3% aged 6–10 years and 26.7% aged 11–15 years were positive. The results of these findings suggest that older children were more likely to have latent tuberculosis infection which may be related to cumulative exposure and latency of Mycobacterium tuberculosis for a longer period of time.

There was no significant difference between the sex and TST positivity ($\chi^2 = 0.36$, P = 0.548). A higher number of males (17.9%) tested positive than females (15.8%) but this difference was not statistically significant and indicated that children in this study population were equally likely to be infected with the virus whether male or female.

As far as home location is concerned, children residing in rural areas had more TST positive cases (19.4%) than children living in urban areas (12.2%). This difference was not statistically significant in the present study ($\chi^2 = 3.62$, P = 0.057) and residence alone was not associated with the positivity of the TST, although the positivity rate seemed to be higher in the rural children.

Logistic Regression Analysis of Factors Associated with TST Positivity

Multivariable logistic regression showed that children aged 11–15 years had significantly higher odds of TST positivity compared with children aged 1–5 years (Adjusted OR = 3.12, 95% CI: 1.45–6.70). Children without a BCG scar also had significantly increased odds of TST positivity.

Table 5. Multivariable logistic regression analysis of factors associated with TST positivity

Variable	**Category**	**Adjusted OR**	**95% CI**	**P-value**
Age	6–10 vs 1–5 years	1.74	0.81–3.74	0.154
	11–15 vs 1–5 years	3.12	1.45–6.70	0.003
Sex	Male vs Female	1.18	0.72–1.92	0.507
Residence	Rural vs Urban	1.56	0.90–2.69	0.108
BCG scar	Absent vs Present	2.41	1.31–4.44	0.005

Statistically significant (P < 0.05).

Logistic regression analysis was performed to identify factors associated with the positivity of TST.Logistic regression analysis was performed to assess factors associated with positivity of TST. Children ages 11-15 years were found to be significantly more likely to be TST+ than children ages 1-5 years (aOR 3.12, 95% CI: 1.45-6.70). The likelihood of TST positivity was also found to be significantly higher in children who did not have a BCG scar.

The findings of the multivariable logistic regression analysis conducted to find the independent factors associated with Tuberculin Skin Test (TST) positivity in children of the Basic Health Unit, Kachi Shahani, Bhakkar is presented in Table 4.5. Age and BCG scar status were still significant predictors of TST positivity after controlling for the effect of other variables in the model, while sex and residence were not significantly associated with TST positivity.

The odds of being TST positive were 1.74 times higher for children aged 6-10 years compared to children aged 1-5 years (Adjusted OR = 1.74; 95% CI: 0.81–3.74) but this association was not statistically significant (P = 0.154). Children aged 11–15 years had significantly more odds of having a positive TST than children aged 1–5 years (Adjusted OR = 3.12; 95% CI: 1.45 –

6.70; P < 0.003). The result indicates that TB infection risk increases with age most likely due to a longer duration of exposure to Mycobacterium tuberculosis.

There was no significant relationship between TST positivity and sex. Male children did not have significantly different odds of being TB-positive compared to female children (Adjusted OR = 1.18; 95% CI: 0.72–1.92; P = 0.507), suggesting a similar risk of TB infection between boys and girls.

Also, children who lived in a rural area were 1.56 times more likely to be TST-positive than those in urban areas (Adjusted OR = 1.56; 95% CI: 0.90–2.69), but this did not statistically prove to be significant (P = 0.108). Place of residence was not thus the separate significant predictor of TST positivity in the present study

Table 6. Distribution of TST positivity according to age group

Age group (years)	Number Examined	Positive (n)	Prevalence (%)
1–5	118	10	8.5
6–10	176	27	15.3
11–15	131	35	26.7
Total	**425**	**72**	**16.9**

The 425 children in the study were distributed by age group according to the results of the Tuberculin Skin Test (TST) (Table 4.6). Overall, 72 children were found to be TST positive, giving an overall prevalence of 16.9%. There was a progressive increase in the percentage of TST positivity with age. The smallest proportion of children (10/118, or 8.5%) was TST positive for children aged 1-5 years. 27 of the 176 children (15.3%) aged 6–10 years were TST positive and there was a significant increase in infection prevalence rates compared to the younger children. Children (11–15 years) had the highest prevalence with 35 of 131 (26.7%) having positive results. The rise in TST positivity with age indicates that older children are more likely to have been exposed to Mycobacterium tuberculosis at some time in their lives, probably because of exposure over the years.

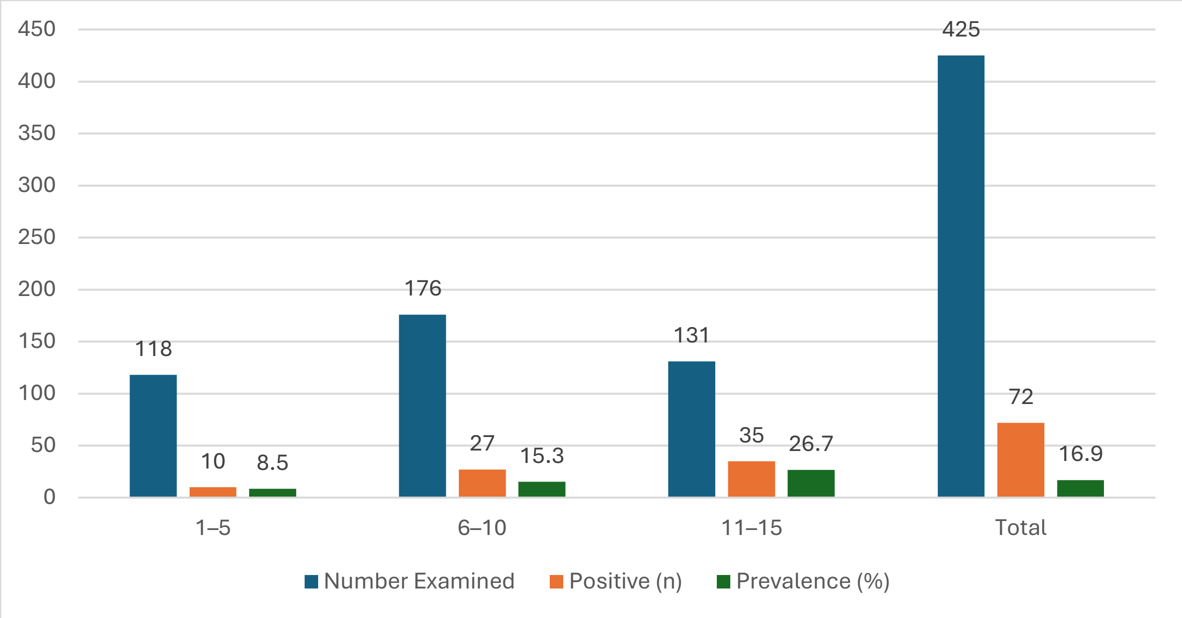

Figure 2

Discussion

The present study gives important information about the burden of latent tuberculosis infection (LTBI) and their risk factors among children who are receiving treatment in the Basic Health Unit Kachi Shahani, Bhakkar, Pakistan. Our results suggest that Tuberculin Skin Test (TST) positivity rate was 16.9% with the estimated Annual Risk of Infection (ARI) of 2.2% indicating the ongoing problem of tuberculosis transmission in this community, and the need for better TB control measures specifically for the paediatric population.

The TST positivity rate (16.9%) seen in our study suggests that around one in six children in this group has been exposed to Mycobacterium tuberculosis. This is a high prevalence and is similar to what has been reported in other high TB burden countries. According to Nasiri et al. (2017), the results of the meta-analysis indicated that the overall positivity rate of TST among the general population in Iran was 26.2% and there was significant difference among the different subpopulations. The prevalence in our study was less than the pooled estimate but is the usual scenario in an endemic area of TB transmission in Pakistan.

The estimated ARI or Annual Risk of Infection of 2.2% is significant. The ARI is an important epidemiological measure reflecting the level of tuberculosis transmission in the community (Sutherland & Fayers, 1975). A rate of 22 per 1,000 uninfected children per year is the ARI of 2.2%. This is much higher than that of India (0.48%) assumed for 2024 and the Philippines (0.98%) (World Health Organization, 2024). Recent modelling studies have estimated that the global trend of ARIs is declining at an annual rate of 3.8-4.1% (Schwalb et al., 2023) in several high burden countries. The ARI recorded in our study, however, indicates that transmission in this region is still extremely high, which can indicate that TB control measures are not effective or sufficient, that diagnosis of infectious cases may be delayed, and community transmission may be ongoing.

However, it is important to note that this is an assumption made in ARI estimation from cross sectional TST surveys, that immunoreactivity will remain throughout one's life. Recent data, however, suggest that in children and young adults, TST reversion is about 22.2% of the cases per year (Schwalb et al., 2023). Underestimation of the true ARI by 2-5 fold occurs when reversion is not considered, especially in older age groups (Schwalb et al., 2023). So, this estimated ARI of 2.2% might be a conservative number and the actual annual risk of infection may be significantly higher. We have shown that reversion is ignored, leading to a dramatic underestimation of the true ARI in populations and our understanding of how the transmission intensity of the infection is defined by M. tuberculosis (Schwalb et al., 2023). The implications of this finding for TB control programming are important because it implies that there may be more new cases of TB than are generally believed.

Increased age was highly correlated with TST positivity as one of the most important findings of our study. The prevalence of LTBI was progressive, with 8.5% of children aged 1-5 years, 15.3% aged 6-10 years and 26.7% of adolescents aged 11-15 years. Multivariable logistic regression analysis revealed that children aged 11-15 years were significantly more likely to be positive for TST than those in the youngest age group (aOR 3.12, 95% CI 1.45-6.70, P=0.003). This age-dependency in prevalence of infection is a pattern that has been observed in many epidemiological studies and is related to the accumulation of exposure to TB over time (Martinez et al., 2020; Zafar et al., 2014). A study in Karachi, Pakistan, found that the odds of being TST-positive were higher in household contacts of TB cases with increasing age (Zafar et al., 2014).

Several mechanisms could be responsible for the age-related rise in TST positivity. First, older children have had a longer period of potential exposure to infectious TB cases in their homes, schools and communities. Secondly, older children have larger social networks leading to more opportunities for exposure to infectious people. Thirdly, in a context where TB is being spread there is an inevitable increase in the cumulative probability of infection with each year of life. This trend has also been observed in refugee populations, where adults 50 years or older had the highest rates of LTBI (37.5%) compared to adolescents aged 13-17 (9.7%) (Bennett et al., 2008).

It is especially worrisome that LTBI was prevalent among adolescents in our study. Although adolescents with LTBI are not considered to be at higher risk of progression to TB disease, that risk is higher during periods of rapid growth and immunological changes (Martinez et al., 2020). In addition, adolescents have been shown to be more likely to generate infectious aerosols and pass on M. tuberculosis to other individuals when they develop pulmonary disease than younger children (Martinez et al., 2020). The results highlight the need for specific screening and preventive treatment programmes for older children and adolescents in high-burden areas.

In our study, there were no differences in the positivity of TST between the sexes. There was no significant difference in the prevalence of TST positivity between males and females in either the bivariate analysis (χ^2=0.36, P=0.548) or multivariable logistic regression (aOR 1.18, 95% CI: 0.72-1.92, P=0.507). This is in line with earlier studies showing that there is little difference in the prevalence of LTBI between the sexes in children under 18 (Neyrolles & Quintana-Murci, 2009).

Adult populations tend to have a higher prevalence of LTBI in men, but this male predominance usually happens during adulthood, as a result of behavioural, occupational and biological factors (Neyrolles & Quintana-Murci, 2009). Household and community exposure to M. tuberculosis is the main determinant of exposure in children, not sex-specific behaviours. Studies exploring sex differences in LTBI rates have reported that there are minimal differences or none for younger age groups, and that there are more significant differences for older age groups (Schwalb et al., 2023). The lack of any sex- difference in our paediatric population is also consistent with literature, and indicates that sex should not be a factor in TB control interventions.

The prevalence of TST positivity was higher among children from rural areas (19.4%) than in those from urban areas (12.2%), but this was not statistically significant (χ^2=3.62, P=0.057; aOR 1.56, 95% CI: 0.90-2.69, P=0.108). The borderline significance indicates that "residence" should be further explored with a larger sample size. Several factors also exist in the rural setting of Pakistan that may account for the higher prevalence of TB in the rural areas: substandard housing conditions, poor ventilation, inadequate access to healthcare facilities and delays in the

diagnosis and treatment of infectious TB cases (Hussain et al., 2015). Barriers to accessing healthcare services often exist in rural areas, which means that infectiousness is prolonged and intra-household and community transmission is higher (Hussain et al., 2015).
The study population was mostly rural (65.4%) as the catchment area of Basic Health Unit – Kachi Shahani is based on a rural population. This rural dominance is in line with the demographics of Bhakkar District and similar to other studies carried out in the area (Khan et al., 2019). In the multivariable model, however, residence was not statistically significant so other factors, especially age and BCG vaccination status, may be more influential explanations for the presence of LTBI in this population.
One of the most apparent observations from our study is the high correlation between lack of BCG scar and the presence of a TST. Children who were TST positive but did not have a BCG scar had significantly higher odds of being TST positive than those with a scar (30.7% versus 14.0% aOR 2.41, 95% CI: 1.31-4.44, P=0.005). This relationship was seen to still exist following adjustment for potentially confounding factors, suggesting that not having a BGC scar is an independent predictor of LTBI.
BCG vaccination is extensively used in Pakistan, in general, at birth. The high level of coverage (82.4%) found in our study is similar to the national immunization programme reports (Pakistan Bureau of Statistics, 2020). Some studies have demonstrated the TB infection protection afforded by BCG vaccination, which is evidenced by the lower TST positivity rate in vaccinated children (Ameer et al., 2023; Roy et al., 2014). The prevalence of LTBI was found to be 12% in children with a BCG scar and 29.5% in children without a scar with an estimated vaccine effectiveness of 59% against LTBI in a Swedish study of immigrant children (Benn et al., 2020). Although BCG works best to prevent severe childhood TB (TB meningitis and miliary TB) (Mangtani et al., 2014), these results indicate that BCG could also provide some protection against LTBI acquisition.

Conclusions

Finally, this study shows that there is a significant burden of LTBI in children attending the Basic Health Unit Kachi Shahani, Bhakkar, Pakistan (16.9% TST positive, ARI of 2.2%). The factors most strongly associated with positivity of TST were age, and absence of BCG scars. The high prevalence of LTBI and continued transmission emphasizes the need for enhanced TB control interventions such as increasing early case detection, contact tracing, TPT for children who meet the eligibility criteria and maintaining high BCG coverage. There should be a focus on targeted screening and preventive treatments for older children and adolescents who are over-represented. Ongoing surveillance and research are crucial to track transmission patterns and the impact of control measures in this high burden context. This report is part of expanding evidence base on paediatric TB epidemiology and in support of the global goal to end TB in children and adolescents.

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