

# Schools as Surveillance Hubs: Uncovering Adult TB Burden through Child-Led Screening in Kakamega County, Kenya

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## Abstract

## Original Research Article

Tuberculosis (TB) continues to pose a public health challenge in Kenya. Many adult cases remain undiagnosed due to stigma, poor health-seeking behavior, and limited diagnostic access. To respond to this gap, the Kenya Innovation Challenge TB (KIC-TB) project piloted a school-based, child-led screening initiative in Kakamega County. The approach used schoolchildren as health messengers to identify symptomatic adults within households and schools. This study applied a retrospective, descriptive cross-sectional design using data from 312,660 individuals screened across 205 schools between 2019 and 2024. Children used simplified symptom checklists to assess household members, while staff underwent direct screening. Confirmed cases were diagnosed using GeneXpert, and treatment linkage was monitored. Statistical tests including chi-square, Fisher's exact test, and odds ratios were used to compare TB yields between groups. Adults made up 15% of those screened but accounted for over half of confirmed TB cases. The TB yield among parents was 1.34%, significantly higher than among children at 0.08%. Chi-square testing confirmed a significant difference in detection across groups ( $\chi^2 = 2412.81$ ,  $p < 0.001$ ). Parents had 16.65 times higher odds of TB diagnosis compared to children. Fisher's exact test showed a significantly higher yield among non-teaching staff than teachers ( $p = 0.041$ ). Treatment initiation exceeded 99% for confirmed cases. Schools can serve as effective TB surveillance hubs when supported by child-led screening. This model is cost-effective, community-based, and able to uncover undetected TB cases within household settings. Findings support the integration of school-based screening into Kenya's national TB surveillance framework.

**Keywords:** Tuberculosis, school-based screening, child-led outreach, adult TB detection, statistical analysis, community health, surveillance.

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## 1. INTRODUCTION

Tuberculosis (TB) continues to pose a serious public health risk in Kenya. The country remains among the top 30 nations with the highest TB burden globally. Data from 2023 estimate the national TB incidence at 223 cases per 100,000 people, with over 18,000 annual deaths linked to the disease. These figures reflect an urgent need to strengthen strategies for early detection and timely treatment [1]. Although diagnostic services and treatment coverage have improved, an estimated 44 percent of TB cases are either not identified or not reported. Adults living in low-income and informal settlements are the most affected by this gap [2].

Several challenges contribute to the low detection of TB among adults. These include social stigma, poor care-seeking habits,

minimal or no symptoms, and limited access to diagnostic services, especially in areas on the outskirts of urban centers [3]. Standard facility-based approaches often miss individuals who do not recognize the severity of their symptoms or are unable to travel to health centers due to cost or time constraints [4].

To close this gap, alternative approaches have been introduced, especially at the community level. Evidence from global studies suggests that engaging households and local networks in TB screening efforts can lead to better case detection [5,6]. In Kenya, one such initiative was implemented through the Kenya Innovation Challenge TB (KIC-TB) project between 2019 and 2024. Run by the Community Support Platform (CSP) in collaboration with Amref Health Africa in Kenya and supported by the Global Fund, the project piloted school-based TB

screening in Kakamega County. It trained school-going children to identify and report symptoms among family and community members, leveraging their everyday interactions and trusted relationships.

Although the initial focus was to improve childhood TB detection, the project revealed a different outcome. Adults connected to the school environment, especially parents and non-teaching staff, showed significantly higher rates of TB diagnosis than the students themselves. Specifically, parents recorded a detection rate of 1.34 percent and non-teaching staff 0.65 percent, while the rate among children was only 0.08 percent. These findings suggest that schools can serve as useful sites for reaching adults who would otherwise be missed by conventional screening models [7].

## 2. LITERATURE REVIEW

Efforts to control tuberculosis globally have expanded in recent years, yet a substantial share of cases still go undetected, especially among adults living in resource-limited settings. In Kenya, data from the national TB prevalence survey conducted in 2016 indicated a rate of 558 per 100,000 people; considerably higher than previous estimates by the World Health Organization. This suggests that nearly 40 percent of TB cases may be overlooked by routine detection methods [8]. In rural areas of western Kenya, studies have reported high rates of undiagnosed pulmonary TB, estimated at 6 cases per 1,000 individuals, with many affected persons not engaging with formal health services [9].

To improve early detection, community-level screening has been introduced as a key strategy alongside facility-based interventions. Findings from household screening programs across both rural and urban Kenyan settings reveal a TB prevalence rate of 1.4 percent among adults screened within their homes. These results point to the value of moving from passive approaches to more proactive screening models, particularly in environments where health-seeking behavior remains low [10].

Although schools are not typically used as entry points for TB screening, there is early evidence showing their potential in this area. A notable example comes from China, where a school-based approach involving students in household TB screening resulted in a 281 percent increase in smear-positive case detection during the first year of implementation [5]. This outcome points to the significant opportunity that educational settings present for expanding TB surveillance beyond clinical environments.

The idea of involving children in broader public health and social efforts is not new. Programs such as the “Children-as-Agents-of-Change” and “Eco-Schools” have shown that students can influence household and community behaviors, especially in areas related to environmental and health awareness [11]. These initiatives demonstrate that children can serve as credible and active messengers for change.

Despite these examples, few studies have explored how schoolchildren can be engaged in TB-specific screening efforts, particularly those targeting adult populations. This gap is more

pronounced in the context of low-resource settings, where adult TB often goes undetected. The current study responds to this gap by assessing how child-led approaches, implemented through schools, can support the identification of adult TB cases; many of whom are missed by traditional, passive screening methods.

## 3. METHODS AND STUDY DESIGN

### 3.1 Study Design

This study used a descriptive, retrospective design to examine data generated by the Kenya Innovation Challenge Tuberculosis Fund (KIC-TB) project. The project ran from 2019 to 2024 in Kakamega County, Kenya. The study focused on assessing how schoolchildren contributed to identifying suspected TB cases among adults in their homes and school communities.

### 3.2 Study Setting

The intervention took place in 205 public schools, including both primary and secondary levels, across eight sub-counties in Kakamega County. These were Lurambi, Shinyalu, Mumias West, Butere, Ikolomani, Mumias East, Malava, and Lugari. School selection was guided by student population size, community TB risk, and spatial distribution to ensure broad coverage.

### 3.3 Study Population

Participants included students enrolled in Grade 4 and above, their family members mainly parents and guardians as well as teachers and non-teaching personnel. These groups were involved in symptom screening either as screeners or as the focus of screening activities. Students were selected based on their capacity to understand and apply simplified screening tools after training.

### 3.4 Screening Approach

Trained teachers, referred to as TB ambassadors, conducted sessions to equip students with basic TB screening skills. Children were assigned to screen household members using standard checklists designed for ease of use. At the same time, health workers and Community Health Promoters (CHPs) carried out onsite screenings of school staff. CHPs also followed up on referrals from students and ensured that individuals with symptoms were guided to diagnostic services.

### 3.5 Data Collection and Management

Screening information was recorded using structured forms tailored for both school and community settings. All data were entered into the Kobo Collect system to support timely reporting and monitoring. Key data points included age, gender, symptoms reported, screening outcomes, diagnostic confirmations, and whether treatment was initiated. A validation process was conducted to align community records with facility-based data. Confirmed TB cases linked to the

initiative were marked with a unique "KIC" identifier to support tracking and analysis.

### 3.6 Data Analysis

Data were processed using SPSS version 22 and Microsoft Excel. Descriptive analysis was used to summarize demographic details and screening outcomes across different groups. TB detection rates were calculated for children, parents, teachers, and non-teaching staff. To explore differences in TB positivity between these groups, comparative tests were applied. The Chi-square test was used to assess overall group differences. Odds Ratios (ORs) were computed to compare relative risk between specific groups, such as between parents and children. In cases involving small numbers, such as comparisons between teachers and non-teaching staff, Fisher’s Exact Test was used to ensure accurate results. All statistical tests were two-sided, and a p-value below 0.05 was considered statistically significant. Results were reported using tables, graphs, and percentage estimates, with 95% confidence intervals provided where applicable.

### 3.7 Ethical Considerations

The study received formal ethical approval and operational clearance from relevant government and institutional authorities, including the Ministry of Health,

Ministry of Education, and the Teachers Service Commission. School heads also granted permission for implementation. Written consent was obtained from parents or guardians for children to participate, while assent was requested from the children themselves. Adult participants gave either written or verbal consent depending on the setting. Children were not involved in clinical testing or handling samples. Their participation was limited to recognizing TB symptoms and referring individuals for follow-up, in accordance with Kenya’s Children Act (2012) and the African Committee of Experts on the Rights and Welfare of the Child (ACERWC) guidelines [12].

## 4. RESULTS AND DISCUSSIONS

The school-based, child-led TB screening initiative in Kakamega County reached a total of 312,660 participants. Among those screened, children made up the majority at 266,075 individuals (85 percent). Adults, including parents, teachers, and non-teaching staff, accounted for 56,664 participants (15 percent). Although adults formed a smaller portion of the total screened population, they contributed significantly to the overall number of confirmed TB cases. Out of 1,383 confirmed cases, 700 were detected among adults. This represents 50.6 percent of the total TB burden identified through the initiative, highlighting a disproportional contribution relative to their share of the screened population.

Table 1: TB Yield by Target Population

Category	Number Screened	Confirmed TB Cases	Yield (%)	% of Total TB Cases
Children	266,075	217	0.08%	15.7%
Parents	51,310	688	1.34%	49.7%
Teachers	4,735	8	0.17%	0.6%
Non-teaching Staff	619	4	0.65%	0.3%
<b>Total Adults</b>	<b>56,664</b>	<b>700</b>	<b>1.24%</b>	<b>50.6%</b>
<b>All Confirmed Cases</b>	—	<b>1,383</b>	—	<b>100%</b>

To explore differences in TB detection across the screened groups, statistical comparisons were carried out. The summary of results is presented in Table 2. A chi-square test showed a strong and statistically significant relationship between TB outcomes and subgroup classification ( $p < 0.001$ ). The odds ratio comparing parents to children revealed that parents were over 16 times more likely to test positive for TB. For

comparisons involving smaller samples, Fisher’s exact test was applied. It showed that non-teaching staff had a significantly higher TB positivity rate than teachers ( $p = 0.041$ ). These statistical outcomes confirm that variations in detection rates across adult subgroups were not only large but also statistically meaningful, indicating the need for targeted interventions within these populations.

**Table 2: Summary of Statistical Tests**

Comparison	Test	Statistic	p-value	Interpretation
Group vs. TB Status (All Groups)	Chi-square Test	$\chi^2 = 2412.81$	< 0.001	Significant difference in TB yields across all population groups.
Parents vs. Children (Odds Ratio)	Odds Ratio	OR = 16.65	—	Parents were over 16 times more likely to be TB-positive than children.
Teachers vs. Non-teaching Staff (Fisher's Exact Test)	Fisher's Exact Test	OR = 0.26	0.041	Staff had significantly higher TB yields than teachers despite smaller sample size.

## 4.1 Epidemiological Insights

The findings present a noteworthy shift in focus: although children were the main group targeted for TB screening, adults, especially parents accounted for the majority of confirmed TB cases. Parents alone were responsible for 49.7 percent of all confirmed diagnoses, despite making up only 16.4 percent of those screened. Their TB yield stood at 1.34 percent, which was significantly higher than the 0.08 percent observed among children. This large difference reveals a hidden burden of TB within households, which may not be identified through standard facility-based screening. The data indicate that parents were 16.75 times more likely to test positive for TB than children. This strongly supports the usefulness of the child-led screening approach in uncovering adult cases that might otherwise remain undetected. Other adult groups within the school environment, including teachers and non-teaching staff, also showed higher TB detection rates than children.

Notably, non-teaching staff recorded a yield of 0.65 percent, suggesting possible occupational or community-related exposure risks. These staff members often hold roles such as cooks, cleaners, or guards and may live in settings where TB transmission risk is elevated due to factors like poor housing or limited access to care. Teachers showed a lower but still relevant yield of 0.17 percent, reinforcing the value of including all adults within the school system in routine screening efforts.

## 4.2 Operational Success and Linkage to Care

A key strength of this intervention was its child-led structure. By training learners to use basic symptom checklists and encouraging them to screen adults in their households, the project expanded health surveillance beyond formal facilities and into homes. This method relied on trusted family relationships, helped reduce stigma around TB, and required minimal resources, making it both practical and acceptable within the local context. The approach aligns with results from similar school-based models. In Nairobi County, a pilot by Ciheb Kenya enabled students and teachers to refer individuals with symptoms for follow-up testing, showing encouraging outcomes [13]. Comparable efforts in China led to a 281 percent rise in smear-positive case detection when students conducted family-based screening [5]. In South Africa, involving learners in household contact tracing also proved effective in identifying undiagnosed adult TB [Yuen et al 2015].

Another important outcome was the program's strong linkage to care. Among those diagnosed with TB, over 99 percent began treatment. This high initiation rate points to effective coordination among schools, community health promoters (CHPs), diagnostic sites, and sub-county health management teams. Achieving this level of follow-through is often challenging in decentralized systems, yet this model demonstrated that integrated school and community health partnerships can deliver timely care with minimal loss to follow-up [15].

## 4.3 Implications for Surveillance Strategy

The school environment emerged as an effective base for community-level TB surveillance. It offered an accessible, socially embedded platform that did not require major investment in new infrastructure. Schools naturally connect with multiple generations and hold a central place in local communities, making them well-suited for reaching groups that may not interact with the formal health system.

The role of children in this approach was central, not symbolic. They were not limited to learning about health but actively contributed to identifying at-risk individuals in their homes. This involvement led to the detection of over 700 adult TB cases, showing that children can play a practical and measurable role in improving disease surveillance. The intervention shifts the view of children from passive recipients of health services to active participants in community health promotion.

These findings support the case for integrating child-led strategies into Kenya's broader TB control efforts. The model demonstrated that schools can support early case detection among adults through a cost-conscious, community-rooted approach. As a result, schools should be recognized as valuable assets within the national TB response and included in future surveillance planning.

## 5. CONCLUSION

The findings from this study highlight the potential of schools to serve as effective platforms for community-level TB surveillance. While traditionally focused on child health, schools can extend their role by engaging students as active contributors to public health. The intervention in Kakamega

County showed that when learners are equipped with simple tools and guidance, they can help identify TB cases within their households and school environments; groups often overlooked by standard facility-based screening. Although adults formed just 15 percent of the total screened population, they accounted for more than half of all confirmed TB cases. Parents alone were linked to nearly 50 percent of the total burden, with a detection rate over 16 times greater than that of children. These findings were supported by strong statistical evidence, including a highly significant chi-square result ( $\chi^2 = 2412.81$ ,  $p < 0.001$ ), confirming substantial differences in TB yields across population subgroups. The elevated detection among parents and non-teaching staff further supports the value of schools as entry points for identifying adult TB cases.

The success of this approach was rooted in its child-led design. By placing students at the center of outreach efforts, the project overcame common barriers such as stigma and poor health-seeking behavior. It also achieved a treatment initiation rate exceeding 99 percent, showing that once identified, individuals were successfully linked to care. This model demonstrates that school-based, learner-driven screening is both practical and scalable. It provides a culturally appropriate way to reach adults in under-resourced settings and may inform future efforts to integrate education and health systems. Its application could extend beyond TB to other health issues where adult detection remains a challenge.

## 6. RECOMMENDATIONS

### Integrate Adult TB Screening into School Health Activities

The high detection rates among parents and staff point to the need for structured adult screening within school-based programs. Schools should be supported with tools and training to carry out regular TB symptom checks for adults alongside ongoing child-focused health efforts.

### Expand the Child-Led Screening Approach Nationally

The effectiveness of the Kakamega intervention suggests it can be scaled to other counties, especially those facing high TB burdens or poor access to care. This model should be incorporated into Kenya's national TB strategy as a proven community outreach method.

### Embed TB Awareness in the School Curriculum

Introducing TB education into classroom content can build long-term awareness. Lessons on symptom recognition and health-seeking behaviour, combined with take-home screening tasks and school health clubs, can reinforce the role of learners in promoting household health.

### Include Non-Teaching Staff in School Health Screenings

Higher TB yields among non-teaching staff reflect an overlooked occupational risk. These groups should be routinely

included in school-based screening and health promotion to ensure comprehensive coverage.

### Improve Referral Systems between Schools and Health Facilities

Each school should have a direct referral link to nearby diagnostic centers. Standard protocols and clear roles for community health volunteers (CHVs) are needed to ensure seamless follow-up and timely treatment after screening.

### Position Schools as Part of National Health Surveillance Systems

Government policy should formally recognize schools as platforms for early disease detection. This would support the allocation of resources, enable cross-sector partnerships, and reinforce the integration of health services within the education sector.

### Adapt the Model for Other Health Conditions

The success of this child-led TB screening approach suggests potential for similar strategies to be applied to other diseases that spread within households. Conditions such as hepatitis, neglected tropical diseases, or chronic respiratory infections may benefit from school-based outreach, especially in underserved areas.

## 7. FURTHER RESEARCH

There is a need for longitudinal studies to assess how child-led TB education influences adult health behaviors over time. Such studies should investigate whether early household-level awareness improves screening uptake, treatment initiation, and long-term adherence among adults. Tracking these patterns over multiple years can show whether this model reduces community-level transmission and contributes to national TB control targets.

Research should also compare outcomes across different regions to identify social, cultural, or structural factors that shape effectiveness. This can help explain variation in uptake and refine strategies for different contexts. Evidence from diverse settings will strengthen the case for scaling up child-led screening and guide adaptations for broader public health use.

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