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## Short Communication

## Evaluation of Ziehl–Neelsen smear for diagnosis of pulmonary tuberculosis in childhood in a rural hospital in Ethiopia

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## ABSTRACT

The goal of this study is to describe the experience with smear microscopy examination for acid-fast bacilli (AFB) of spontaneous sputum from children in a district hospital located in a rural zone of Ethiopia. All sputum reports of children were retrospectively reviewed from July 2007 until June 2012. During the period of study, 875 children less than 15 years old were screened and 48 (5.5%, 95% confidence interval [CI]: 4.1–7.3%) were diagnosed with pulmonary tuberculosis sputum smear positive. The mean age of the children with sputum positive for AFB was significantly higher than children with sputum negative for AFB (11.4 versus 10.4) ( $p = 0.001$ ). Only 1 out of 47 (1.3%) children of 6 years or less had sputum positive for AFB. In 13- and 14-year-old children, 8.7% had sputum positive for AFB (20 of 229) ( $p = 0.03$ ). Spontaneous sputum has a low diagnostic yield in childhood in low-income countries. Alternative methods should be implemented in rural areas to improve diagnosis of pulmonary TB, particularly in children less than 12 years old.

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### Introduction

Tuberculosis (TB) is one of the leading causes of morbidity and death in adults and children in sub-Saharan African countries [1]. The diagnosis of pulmonary TB in resource-limited settings is established by sputum examination using microscopy for acid-fast bacilli (AFB) [2,3]. It is the most efficient way of identifying sources of TB infection, and the

main tool for diagnosing pulmonary TB in this setting [3]. The sensitivity of the test is poor and case detection rates are low. In low-income countries, mycobacterium culture in Lowenstein medium or similar is generally not available [2,3].

Pulmonary TB in children is difficult to diagnose by bacteriology means because children rarely produce sputum, and the sputum often is not of good quality for smear microscopy

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examination [2,4]. In the present study, the aim was to describe the experience with microscopy examination for AFB of spontaneous sputum in children from a district hospital located in a rural zone of Ethiopia.

## Material and methods

The Gambo General Hospital is a 150-bed rural general hospital located in the West Arsi zone (Oromya Region), 250 km south of Addis Ababa. The influence area of the Gambo General Hospital is restricted to approximately 90,000 inhabitants. Most of the population live in a rural setting and work in agriculture and farming.

All spontaneous sputum reports from children presenting at the Gambo General Hospital were retrospectively reviewed from July 2007 until June 2012. The patients were required to produce three sputum specimens over 2 days, with at least one sputum specimen being collected at early-morning [2]. Sputum smears were considered positive if three or more AFB were observed in 100 oil immersion fields [2]. Pulmonary TB positive is confirmed when at least 2 of 3 smear results were positive for AFB by the National Tuberculosis and Leprosy Control Programme [2]. Institutional ethical clearance was obtained from the Institutional Ethics Review Committee of Gambo General Hospital.

The data from the records were transferred into a computer database (Excel 2000; Microsoft). Estimates were obtained of the prevalence with 95% confidence intervals (CI) using the Wilson procedure. A descriptive statistical analysis was performed. Fisher exact test was used for qualitative variables comparison, and U Mann Whitney test for quantitative variables;  $p$ -value less than 0.05 was considered as significant.

## Results

During the period of study, 10,140 patients were screened for AFB stain of sputum, of whom 875 (8.6%) were children less than 15 years. The mean age of these children was 10.4 years (standard deviation [SD] = 7.9) and 54.4% were female. From 875 children, 45 children had three AFB positive, 3 had two positive AFB, and 4 had only one AFB positive; 48 children (prevalence: 5.5%, 95% CI: 4.1–7.3%) were diagnosed with pulmonary TB sputum smear positive by National Guidelines [2]. The mean age of the children with sputum positive for AFB was 11.4 (SD = 2.3), significantly higher than children with sputum negative for AFB (10.4; SD = 2.7) ( $p = 0.001$ ). The young-

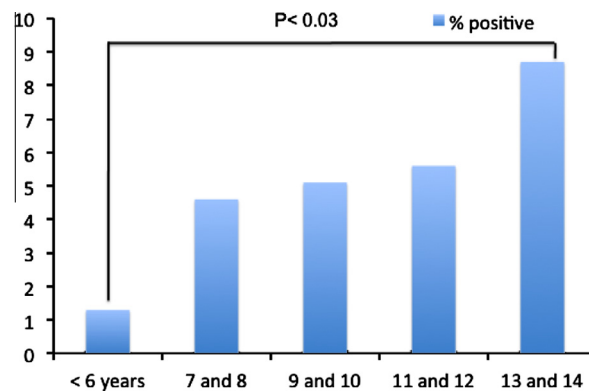


Fig. 1 – Results of smear sputum by age group.

gest child of whom the sputum smear was positive in two sputum samples was 6 years old. The Table 1 and Fig. 1 show the sputum test results by age group. An increasing yield rate was observed in older children. Children of 6 years or less had only 1.3% sputum positive for AFB. In children aged 7 and 8 years old, 4.6% had sputum positive for AFB. 5.1% of the children aged 9 and 10 years old had positive sputum for AFB. In children aged 11 and 12 years old, 5.6% had sputum positive for AFB. However, 8.7% of the children aged 13 and 14 years old had sputum positive for AFB compared with children aged 6 years or less ( $p = 0.03$ ). The results of sputum for AFB had no relationship with the gender of the children.

## Discussion

In this study, in a resource-limited setting, spontaneous sputum microscopy smear positive for AFB was rare in children. Moreover, in a previous study performed in the center with 1029 cases of TB diagnosed in paediatric patients, only 12.8 were smear positive pulmonary TB [5]. Other strategies need to be considered to improve the diagnosis of pulmonary TB in children, such as gastric aspiration or sputum induction with nasopharyngeal aspiration.

Gastric aspiration or gastric lavage may be performed to get adequate material for smear examination. Gastric lavage is unpleasant, relatively invasive, requires trained staff and hospitalization for an overnight fast, although it may be performed in an outpatient clinic [6]. However, this procedure is not easily feasible in resource-limited rural areas with a great diagnostic burden.

Sputum induction is proposed as a way to improve sample collection and enhance sensitivity of sputum examination using microscopy to diagnose pulmonary TB [3,7]. This procedure is easier to perform, has a better sensibility than gastric aspiration [8,9] and it is well tolerated by children [8]. Therefore, it might be simple to implement in a resource-limited setting [3]. It is necessary to have a well-ventilated room, 5 ml of hypertonic saline and a nebulizer mask attached to oxygen at a flow rate of 4–8 l/min for 10–15 min [7,9]. Sometimes it is necessary to perform a nasopharyngeal aspiration to collect the specimen, especially in children less than 4 years old.

Nasopharyngeal aspiration itself is an attractive diagnostic procedure, requiring minimal facilities and training. Passing a nasal cannula elicits a cough reflex in many children, so naso-

Table 1 – Summary of children evaluated for smear sputum by age group.

Age group	No. of cases	No. of positive	Percentage of positive (95% CI)	OR (95% CI)
<6 years	78	1	1.3 (0.07; 7.9)	1
7–8 years	130	6	4.6 (1.9; 10.2)	3.7 (0.44; 31)
9–10 years	217	11	5.1 (2.7; 9.1)	4.1 (0.51; 32.8)
11–12 years	173	10	5.6 (3.2; 1.3)	4.7 (0.63; 37)
13–14 years	229	20	8.7 (5.6; 13.3)	7.9 (0.98; 56)

CI: confidence interval; OR: Odds ratio.

pharyngeal aspiration may be regarded as a form of sputum induction [4].

In conclusion, in low-income countries, a microscopy smear positive of spontaneous sputum for AFB has a low diagnostic yield in childhood, having a direct correlation to the increasing age of children. In children older than 13 years, the sputum efficiency is better. Alternative procedures, such as sputum induction followed by nasopharyngeal aspiration, might be useful in rural areas to improve the diagnosis of pulmonary TB in children less than twelve years old.

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### Conflict of interest

None declared.

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