

RESEARCH ARTICLE

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Pertussis outbreak investigation in south Gondar zone, Northwest, Ethiopia

Fikirte Estifanose Wagaye, Anemaw Asrat, Bizuayhu Shimekaw, Mohammed Hassen, Wudu Terefe, Abebe Gelaw, Getasew Mulat Bantie

ABSTRACT

Aims: Pertussis, also known as whooping cough, is a highly contagious respiratory infection caused by the bacterium *Bordetella pertussis*. Though vaccines are the most successful and cost-effective way of preventing pertussis, the outbreak of pertussis is still high in the Amhara region. The study aimed to investigate the pertussis infection in Simada district, North West Ethiopia, 2021.

Methods: A community-based active surveillance was conducted in the Simada district from December 3/2020 to January 05/2021. A total of 43 cases was identified using the modified Centers for Disease Control and Prevention (CDC) pertussis diagnosis criteria and line lists. The collected data were entered into the Epi-data (Epidemiological Data) version 3.1 and analyzed using R version 4.0.3 software and descriptive statistics computed.

Results: A total of 43 cases were identified with an overall attack rate of 7.1 per 1000 population. All complicated cases occurred in children under four years of age. The most affected groups were females. There was an interrupted routine immunization service in the cluster at the health post-level to associate vaccination coverage with the occurrence of a pertussis outbreak. The

outbreak was reported after three days of the occurrence of more transmission from person to person.

Conclusion: The outbreak of pertussis was high and the children were suffering. It is advisable to build capacity, consolidate routine vaccination services, and enhancing the vaccine cold chain management system, surveillance and early treatment of infected patients to control the expansion of pertussis.

Keywords: Ethiopia, Immediately reportable disease, Pertussis toxin, Vaccine preventable disease

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INTRODUCTION

Pertussis (whooping cough) is a contagious infectious respiratory disease, caused by a gram-negative, toxin-producing bacillus [1, 2]. The disease is transmitted by contact with respiratory secretions and presented with the insidious onset of coryza (runny nose), sneezing, low-grade fever, and a mild, occasional cough [3]. However, in young infants, pertussis can initially present as apneic or cyanotic episodes before the development of cough [4–7].

The African region contributed the largest burden with 7.8 million (33%) cases and 92,500 (58%) deaths [1, 8]. Infants and young children are most susceptible to

pertussis and pneumonia is the most common pertussis-related complication in all age groups [9, 10].

In Ethiopia, a pentavalent formulation containing Diphtheria, Pertussis, Tetanus, Hepatitis B, and Haemophilus influenza type B (DTP-HepB1-Hib1) vaccines are in practice since 2007 as part of a routine immunization program [11]. Completion of a three-dose pertussis-containing vaccine scheduled at 6, 10, and 14 weeks of birth prevents 80% of cases and 95% of deaths [9, 12, 13]. According to the WHO vaccine-preventable diseases 2019 global summary report, there were no reported pertussis cases from 2000 to 2017 in Ethiopia. In 2018, however, there were 2423 cases of pertussis reported in Ethiopia [8].

Despite the repeated occurrence of pertussis outbreaks in Ethiopia, data on its risk factors are lacking mainly due to lack of surveillance data, weak surveillance system, and absence of diagnostic facilities for confirmation of *Bordetella pertussis* [14]. This study was investigated once a report brought from health facilities with increasing number coughing patients. The Simada District health office was informed notified cases on December 7, 2020. The objective of this study was to confirm the existence of an outbreak, identify the potential risk factors, and characterize the extent of the outbreak in Simada District, Northwest Ethiopia.

MATERIALS AND METHODS

This descriptive active surveillance was conducted in Simada District from December 3/2020 up to January 05/2021. The district is located 205 km away from Bahir Dar City, capital of Amhara region and 770 km from Addis Ababa. The district is administratively divided into 39 kebeles (the smallest administration unit). For this report, nasopharyngeal samples were taken from ten suspected cases by experienced laboratory professionals from Jamba kebele and sent to the Ethiopian Public Health Institute, national reference laboratory and tested using Polymerase Chain Reaction (PCR). Of which, five of them were found positive. Pertussis cases reported to the district health office were classified by the outbreak investigation team as laboratory-confirmed, probable, or suspected pertussis using modified CDC criteria [15]. A confirmed pertussis case is defined as an acute cough illness of any duration with a positive PCR for *B. pertussis*, or a case that meets the clinical case definition and is epidemiologically linked directly to a lab-confirmed case. A probable pertussis case is a case of cough lasting ≥ 2 weeks AND paroxysms of coughing, inspiratory “whoop” or post-tussive vomiting, AND no laboratory confirmation. A suspected case is defined as a non-improving cough of 14 days or more or cough of any duration with paroxysms, or cough of any duration with a whoop.

An epidemic of pertussis according to the CDC pertussis epidemic is defined as a situation when two

or more cases clustered in time. ≥ 2 PCR confirmed cases clustered in time and space where transmission is suspected to have occurred in that setting OR 1 PCR confirmed case AND 1 epi-linked case with cough illness lasting ≥ 2 weeks with one of the following: paroxysms of coughing, inspiratory whoop, or post-tussive vomiting [16, 17]. The parents of the suspected children were interviewed using an interviewer administered structured questionnaire comprising of sociodemographic pertussis clinical diseases and vaccination-related characteristics. Data entry, cleaning, and coding were performed using Epi-data version 3.1 software, and analysis were done using R version 4.03 software. Descriptive statistics were computed and presented.

Ethical approval

Ethical approval was obtained from the ethical review board of Bahir Dar University. A support letter was obtained from Amhara National, Regional State Public Health Institute. Permission letter was also obtained from the south Gondar zone health department and Simada District health office accordingly. In addition, written consent was secured from study participants after providing clear information about the overall objectives of the study.

RESULTS

The median [($\pm$) Interquartile range)] age of the infected children were 4 ($\pm$ 3) years. There was a sex predilection of cases with 55.8% females. One-fifth, 21.1% of the children were students. During the time of the outbreak of Simada District, the outbreak investigation team mapped the Jamba kebele as a high-risk area for pertussis. The pertussis outbreak occurred from December 3, 2020, in January 5, 2021 with complications of edema and conjunctivitis.

Pertussis outbreak situation

A total of 43 cases were identified with an overall attack rate of 7.1 per 1000 population. All collected blood samples (5/10) were positive for pertussis virus-specific immunoglobulin, which is enough to confirm a pertussis outbreak according to the CDC-guideline. The pertussis outbreak was reported as an outbreak on December 3, 2020. The index case, a six year female, had a cough started in November, 20/2020.

“Some Kabul members went to Yemuja Kabul (a neighboring Kebele) for wedding ceremonies ahead of the cough and then, had visited to Yemuja health post. However, the cough started in communities after coming back from wedding ceremonies” a 40-year-old family member reported.

The vaccination statuses of cases were not unknown, nor the immunization coverage of the affected kebele. However, reported Expanded Program of Immunization (EPI) coverage of the district was 96% in 2019–2020 (Figure 1).

The outbreak occurred in a remote area (about 6 hours on foot from the main road) in which scheduled immunization delivery was challenging. And the Jamba health post is about 3 hours far from the cluster (Yequasa) health center. Health Extension Workers deliver immunization by using vaccine carrier for 1–2 days. The Jamba health post had not in the previous years, there were financial and trained staff scarcity for cold chain maintenance in the district.

The outbreak investigation team observed that the Jamba health post had not the EPI registration documents, functional refrigerators, and functional power supply. And the children were taking vaccination as an outreach program irregularly from the cluster health center, which is about 6 hours apart to arrive in the Jamba health post, by bringing via vaccine carrier. Though children got vaccination in an outreach program in interrupted manner, they were not provided immunization card. In addition, there were no immunization and growth monitoring charts in the Jamba health post. The outbreak investigation team also described, the communities believed that pertussis should be treated at home and no need of medical intervention.

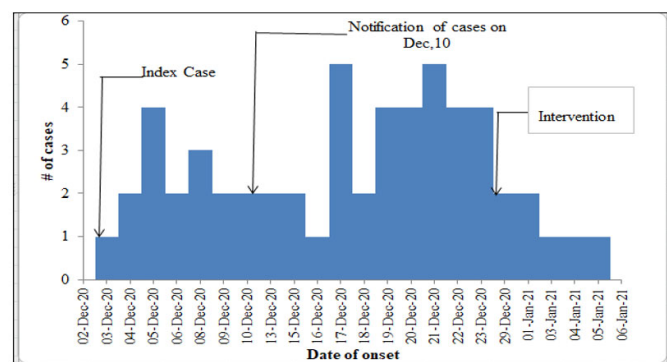


Figure 1: Epi curve of pertussis cases by date of onset of cough in Jamba kebele, Simada district South Gondar zone Northwest Ethiopia, 2021.

DISCUSSION

The presence of pertussis outbreak was checked after arriving in the Jamba kebele of the Yequsa cluster Simada District. The signs and symptoms of the cases were led to pertussis based on standard case definitions of the regional guideline. The source of the case was unknown; however, the first reported case was a 6-year-old female who had a traveling history in Muja kebele for a wedding ceremony to her relatives. Throughout the outbreak, the overall attack rate of the outbreak was 7.1

per 1000 population. This finding was higher than the study finding of Mekedela district, Ethiopia (1.3 per 1000 population) [18]. However, the current finding was lower than study finding of northwestern Nigeria (2.10 per 100) [19]. This might be recovering of cases before the cases are detected and under-reporting of cases or weak surveillance activities.

The current study finding reported that the most affected segmented population was children whose ages are under the age of four years. Majority of the cases had whooping cough, post-tussive vomiting and apnea, facial edema and sub-conjunctiva hemorrhage. This finding was consistent with the study findings of Mekdela District, Ethiopia [18]. The possible justification for this could be due to distant and inaccessible health facilities, cultural barriers to go to health facilities, or interruption of routine immunization program. Moreover, there were no related vaccination data in the households there were also reports on the interruption of routine immunization services at the health post level to associate vaccination coverage with the occurrence of a pertussis outbreak.

Strengths and limitations of the study

Absence of vaccination card was difficult to determine the vaccination status, dose received, the exact date of vaccination and other relevant information which could cause information bias. Recall bias on the date of onset by the cases and their mothers since the investigation was conducted lately after 13 cases occurred. The absence of vaccination data and interruption of immunization in affected kebele was the other problem.

CONCLUSION

In this outbreak, the overall attack rate was 7.1 per 1000 population. Most of the affected children were females and all complicated cases occurred in children under four years of age. Therefore, capacity building, consolidation of routine vaccination services, and enhancing the vaccine cold chain management system are critical issues to prevent the outbreak of vaccine-preventable diseases.

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Author Contributions

Fikirte Estifanose Wagaye – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Anemaw Asrat – Conception of the work, Design of the work, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Guarantor of Submission

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Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

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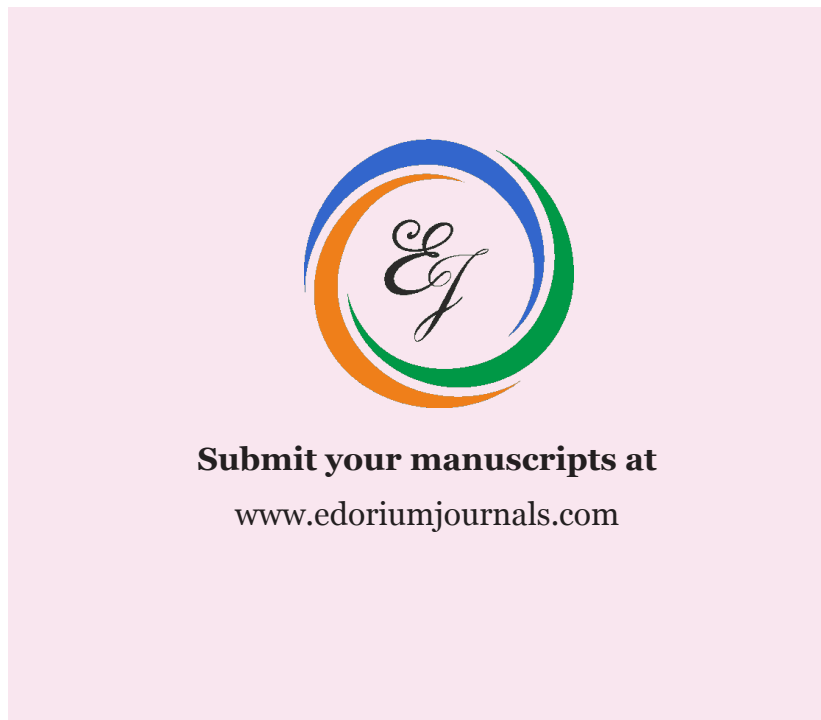
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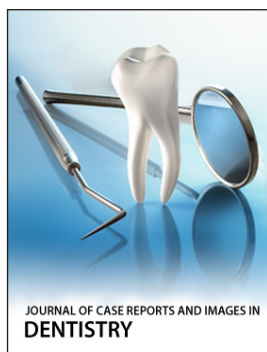
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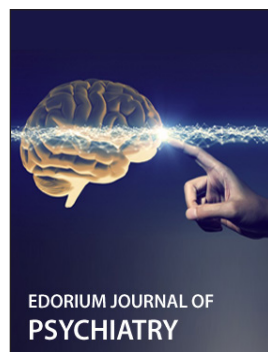
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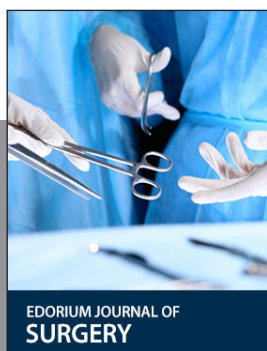
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