Conjunctivitis outbreak among children in Central zone of Tigray, Northern Ethiopia 2023

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ABSTRACT

Introduction: Bacteria are the second most common cause of infectious conjunctivitis after viral cause. Conjunctivitis is not a reportable disease, in Tigray and in September 2022 conjunctivitis cases showed an increment among children, but the disease outbreak and drug sensitivity test were not assessed. An investigation started in December 22, 2022 using a multidisciplinary team aimed to investigate the epidemics of conjunctivitis in Tigray from December 22, 2022 to January 20, 2023. **Methods:** Community-based cross-sectional study was used to recruit participants in January 2023 using a convenient sampling technique. Data were collected using questionnaire prepared by the investigators, entered into Epi-data, and analyzed using SPSS-22. The laboratory samples from the affected conjunctiva of the children were collected for laboratory diagnosis. The data were presented using tables, figures, and statements. **Results:** A total of 56 children were enrolled and 50% of them were male. The median age was 18 (7.25-36) months and the majority (94.6%) of individuals reported complaints in both eyes, including inflammation and discharge. From the 24 children collected laboratory sample, five gram-positive and two gram-negative bacteria were identified using the gram stain, and Staphylococcus aureus was isolated from 3/7 (42%) participants using culture. The isolated Staphylococcus aureus was susceptible to tetracycline, gentamycin, and ciprofloxacin, but resistant to chloramphenicol in two participants. **Conclusion:** The outbreak of conjunctivitis was confirmed and was caused by staphylococcus-aureus a gram-positive bacterium with a few children infected with gram-negative bacteria. In addition, the bacteria are not resistant to the most commonly prescribed antibiotics for conjunctivitis. Therefore, better to apply selective treatment with pathogen-susceptible antibiotics.

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Introduction

Conjunctivitis is the inflammation of the conjunctiva, the thin, transparent layer of tissue that lines the inner surface of the eyelid and covers the white part of the eye [1]. Conjunctivitis can be caused by viruses, bacteria, fungi, allergens, contact lens use, chemicals, and certain diseases [2]. Viral and bacterial conjunctivitis (pink eye) is very contagious. They can spread easily from person to person [3]. Conjunctivitis can be transmitted through hand-to-eye contact, via eye contact with contaminated objects, through sexual encounters with eye-to-genital contact, or vertically from mother to foetus [2].

Bacterial conjunctivitis is the second most common cause of infectious conjunctivitis after viral conjunctivitis [4, 5]. Among non-infectious types, allergic and toxin-induced aetiologies conjunctivitis was common [5]. Worldwide, recurrent conjunctivitis epidemics are prevalent [6]. In West Africa, frequent seasonal outbreaks of infectious conjunctivitis were experienced [7]. Ocular infection and its complications, cataracts, and ocular trauma are prevalent illnesses in Sub-Saharan Africa that significantly impact day-to-day life [8].

Serious problems from conjunctivitis are uncommon and frequently result in a moderate condition [9]. However, the risk of complications is higher in patients with herpes zoster virus conjunctivitis. Patients with *Neisseria gonorrhoeae* should receive the proper care since they are at high risk for corneal involvement and secondary corneal perforation [5].

In the last 20 years´ eye disease due to infectious disease has reduced and around 80% of eye diseases are preventable and treatable. Strategic activities on government leadership and community participation and empowerment have contributed toward this reduction [10]. In addition, Ethiopia provides mass antibiotics administration every year to all age groups, which is one of the strategies for trachoma prevention and treatment [11].

Eye disease prevention and control measures like community health education, water and hygiene sanitation measures, mass antibiotics chemoprophylaxis, and filing of antibiotics stock which treat conjunctivitis in all the health facilities were applied. Following the eruption of the war in Tigray, northern Ethiopia in November 2020, all prevention and control measures were interrupted due to collateral damage and intentional destruction and looting of health facilities. The epidemic of infectious diseases including conjunctivitis is expected in war-torn areas with humanitarian crises [12]. Conjunctivitis epidemic and seasonal infections adversely impact education, the workforce, and the economic force, and the economy adversely [6].

Conjunctivitis is not considered under routine surveillance system of the country causes delay in its detection and interventions. Unlike the previous months, conjunctivitis was reported in high numbers in the monthly report for September to November 2022 of the Regional Health Bureau (RHB) of Tigray and a rumour of unusual cluster of conjunctivitis cases were also reported from the Central zone of Tigray. Therefore, this study aimed to investigate the epidemics of conjunctivitis and the drug sensitivity tests for commonly prescribed antibiotics for conjunctivitis in central zone of Tigray, Northern Ethiopia in 2022.

Though a number of conjunctivitis cases were reported from all districts of the region, a high cluster of cases was reported from four districts (Yechilla Abergele, Kola-temben, Keyih-Tekli, and Abyi-Adi). The region was under siege and reported a critical shortage of medical supplies. The number of cases increased since September 2022 and some interventions were applied by international Non-Governmental Organizations (NGO) but still a high number of cases was reported. Consequently, the investigators in collaboration with the RHB of Tigray and Action Against Hunger (AAH) an NGO working in the area deployed to investigate the epidemics on December 22, 2022.

Methods

Study settings and period

The investigation was done in Tigray region, Northern Ethiopia located 780 KM from Addis Ababa the capital city of Ethiopia. Tigray region is bordered by Eritrea to the north, Sudan to the west, Afar region to the East, and Amhara region to the south. The specific study areas were Abyi-Adi, Yechilla-Abergelle, Kola-Temben, and Keyih-Tekli districts located in the central zone of Tigray 90-130 km away from Mekelle in the south-eastern direction. Abyi-Adi district is a town administration, whereas the rest are rural districts (**Figure 1**). The total population of the four districts is 285,085. All four districts have lowland weather conditions and the districts were affected by the prolonged war from November 2020 until November 2022. As part of the region, the districts were under siege for the last two years from the data collection time. The epidemic investigation was conducted from December 22, 2022, to January 20, 2023.

Study design

Community-based cross-sectional study design was applied to investigate an outbreak of conjunctivitis and assess the drug sensitivity of the causative agents in central zone of Tigray, Northern Ethiopia.

Study population and eligibility criteria

Children living in the neighbourhoods of the conveniently selected primary health care units and clinically screened positive for conjunctivitis were selected during the study period.

Study variables

In this study variables like age, sex, address, clinical manifestations, and laboratory results were used to assess and confirm the causative agent of the outbreak and its drug susceptibility.

Sample size and sampling technique

A total of 200 children (50 each from four districts) were screened for conjunctivitis by ophthalmologist clinically and sample collected for laboratory diagnosis based on the adequacy of the sample consecutively from the accessible kebelles (sub-districts administration) of the districts in the selected four districts through convenient sampling method. Conveniently, a total of 200 children screened and 56 of them were diagnosed for conjunctivitis clinically. Clinical characterization of the disease was done among the 56 clinically diagnosed cases and laboratory characterization was done among the 24 children who met the sample adequacy criteria one sample from each selected child.

Data collection tool and procedure

Data were collected through a questionnaire prepared by the investigators for the observational data. The investigators agreed on the investigation procedure and then deployed to the study areas. The investigators met with the health facilities and district health offices about the purpose of the investigation, then data were collected from participants selected from the screened children in the nearby health facilities of the affected areas.

In the affected area quickly screened the children to identify participants with active conjunctivitis. Then quantitative data were collected from the caregivers of the participants.

Laboratory investigation and drug sensitivity test

Eye discharge specimens were collected from 34 children suspected of bacterial conjunctivitis with enough conjunctiva discharges/adequate sample and transported to Tigray Health Research Institute (THRI) for culture. Based on the eye discharge sample adequacy and quality, only 24 samples were eligible and the ophthalmologist distributed the samples into Gram-stain (14), Giemsa-stain (03), and culture (07). A direct smear was collected for Gram and Giemsa stains from sample participants and inoculated in different media for bacterial identification. Direct smear was tested for organisms like bacteria and yeast cells, polymorphonuclear cells (PMN), mononuclear cells (MN), squamous epithelial cells, and other cytoplasmic inclusions. For the culture-positive results, a drug sensitivity test was done on the commonly prescribed antibiotics (tetracycline, gentamycin, ciprofloxacin, and chloramphenicol) for conjunctivitis.

Data Analysis

The collected data were entered into Epi-data 3.1 and analyzed via SPSS 22. The median and interquartile range were calculated for continuous variables. Age was categorized into three levels (<6 months, 6-24 months, and >24 months) and all categorical variables were analyzed and presented with a frequency table and narrative statements.

Availability of data and materials

Data are available from the corresponding author based on reasonable requests.

Consent to participate

Written informed consent was obtained from all the children´s parents/legal guardians for publication of the information and image of children without specific identification (Related file_2).

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of Mekelle University College of Health Science with reference MU-IRB2037/2022. Permission letter was received from Tigray Regional Health Bureau to the selected catchment health facilities. All methods were done under relevant guidelines and ethical regulations. Written informed consent was obtained from all children´s parents/legal guardians who participated in the study to collect the necessary information after a detailed explanation of the objective of the study and the right to withdraw at any time. All the information collected was kept anonymous and only used for this study.

Results

In this investigation, 200 children were screened and 56 (28%) of them had conjunctivitis. The median age was 18 (Inter Quartile Range=7.25-36) months and 8(14.28%) children were less than six months, 31(55.36) were six to 24 months old, and 17(30.36%) were >24 months age. Twenty-eight (50%) of the participants were male. Concerning their residence, of the total 56 participants, eight (14.28%) from Abyi-Adi, 18 (32.14%) from

Abergelle Yechilla, 15 (26.79%) from Kola-Temben, and 15 (26.79%) were from Keyih Tekli districts (Table 1).

Clinical features

The majority of the patients (94.64%, 53/56) had complaints in both eyes and all patients had redness of the eye and discharge (Figure 2 and Figure 3). Four patients had complicated cellulitis and symblepharon (left lower). The median duration (Interquartile Range) of the disease were 14 (7-21) days and more than half 38 (67.86%) of the participants had less than 14 days for their current illness.

Laboratory results

Of the 34 samples collected, 24 were eligible for bacteriological examinations and the rest 10 samples were excluded due to the poor quality of the specimen. Fourteen were gram stained, three Giemsa stained, and seven of the samples for culture and drug sensitivity examination. Fifty percent (7/14) of the participants were positive for gram reaction including 5(71%) gram-positive bacteria likely *staphylococcus* and *streptococcus* species and 2(29%) gram negative bacteria were identified. Regarding cellular morphology, the majority of the participant´s gram reaction indicated poly morpho nuclear cells (PMN) followed by mononuclear cells. One participant was diagnosed with *candida spp*. Three of the seven participants were culture-positive. *Staphylococcus aureus* was isolated from individuals with culture positive for presumptive conjunctivitis. The isolated *Staphylococcus aureus* was susceptible to Tetracycline (100%), Gentamycin (100%), and Ciprofloxacin (100%) antimicrobial drugs in all children who had isolated the pathogen. However, the *Staphylococcus aureus* isolated from two children (66.67%) were resistant to Chloramphenicol (Table 2).

Factors of conjunctivitis

Regarding associated factors, of the total 56 children diagnosed for conjunctivitis,18 (32.14%) of them had taken antibiotics previously to treat the same disease and none of them had taken eye discharge samples for laboratory before initiating treatment. Twenty (35.71%) and 15 (26.78%) of them had recurrent symptoms and contacts in their household with the same clinical symptoms respectively. Very few children 7 (12.50%) had taken vitamin A and none of them took azithromycin chemoprophylaxis for trachoma previously. Three (1.5%) of the children were suspected of measles (fever, rash, and cough and/or coryza in addition to conjunctivitis) and 14 participants completed their routine immunization and 17 and 25 participants had incomplete and unvaccinated for the routine immunization respectively. Concerning their sanitation, 23 (41.07%) participants used pit latrines, and 32 (57.14%) used pipelines for drinking water purposes (Table 3).

Public Health Action Taken

- Antibiotics were prescribed to be bought from private drug shops as there was a stock-out in all government health facilities
- The study findings were discussed in the regional health cluster and NGOs took their shared activities
- Information about the disease outbreak was disseminated via local television
- Based on the drug sensitivity test results, the appropriate available drugs within the region were mobilized and distributed to the affected districts based on their case load

Discussion

We confirmed a conjunctivitis outbreak in Central zone of Tigray. In this study, 56 people with conjunctivitis were enrolled from 200 screened children. Fifty percent of the participants were males, and the Median age was 18 months. The majority (94.6%) of individuals reported both eye complaints, including redness and discharge. Laboratory tests confirmed presence of both Gram-positive and gram-negative bacteria, and Staphylococcus aureus was isolated using culture.

In our study, conjunctivitis outbreak predominantly affected children under two years of age (69.64%). This findings differs from studies done in Burkina Faso (mean age was 9 (range 0-47) years) and a systematic review study (common 1-4 years) [5, 13]. This variation may result from the varied research population, and sample sizes. Likewise, it could be explained by the higher susceptibility of those in less than two-year age group to eye infections. This could be due to new-borns and young children being particularly vulnerable to infections due to their still developing immune systems. Additionally, this might be exacerbated by the humanitarian catastrophe happened in Tigray. Most water, hygiene, sanitation activities, and resources were diminished as a result of the crisis, which facilitated the disease spread especially in those susceptible age group populations due to poor sanitation.

This study showed that both boys and girls were equally affected by the conjunctivitis outbreak. This was in line with study conducted in Ghana [14]. This finding differs from the study conducted in Israel showed males had

higher prevalence [15]. Studies conducted in Sudan, Yemen and China showed increase prevalence of conjunctivitis in females [16-18]. Those differences could be attributed to behavioural or environmental factors such as care practices or exposure rates.

In this study, bacterial conjunctivitis had affected half of the participants that had a laboratory diagnosis. The magnitude of the bacterial conjunctivitis was higher compared with the study conducted in Pakistan (14.5%) and Burkina Faso (26%) [13, 19], but it was similar with study conducted among college students and all ages group in USA and Brazil [20, 21]. In our study, bacterial conjunctivitis was high, this may have been caused by the defacto siege and blockage of the health services of the state that has a deficiency of medical supplies. This finding is also supported by the study done in Pakistan where bacterial infection was the second most frequent cause of conjunctivitis after viral infection [5].

Regarding the median duration of the disease, bacterial conjunctivitis generally resolves within 5-7 days but it may extend to 14 days to clearly go away [2]. Our study showed the median duration (Interquartile Range) of the disease was 14 (7-21) days and more than half (67.86%) of the participants had less than 14 days. This could indicate either delayed treatment, more resistant bacterial strains, or environmental factors.

Staphylococcus aureus was isolated from the cultured samples and the gram stain result likely contained *staphylococcus and streptococcus species*. The outcome is connected to the Lagos research. 27.7% of cases of conjunctivitis are caused by *Staphylococcus aureus* [22]. This may be due to the lacking of medical supplies, where no antibiotics were taken by most of the victims which facilitated the transmission within the community.

In this study, the majority of patients (94.64%) reported having complaints in both eyes in addition to redness and discharge in all of the patients. The outcome of this study is higher than the study conducted in Burkina Faso (79%) of cases involved both eyes and (89%) of patients experienced purulent discharge) [13]. This could be due to the lack of hygiene and sanitation which easily facilitated the transmission and contamination of both eyes.

In this study, 26.78% of the patients had family members who experienced the same symptoms. The finding is larger than the study done in Burkina Faso where 10% of the study participants had the same illness in their family [14]. In addition, this finding is supported by evidence that all ages and genders are susceptible to the contagious illness of bacteria conjunctivitis [3-5]. This could be due to a lack of treatment-seeking behaviour in the family due to a humanitarian crisis and a lack of awareness which facilitates the disease transmission.

In this study, the use of pit latrine, and access to pipe water drinking was low compared to national standards (56% and 69% respectively) [23]. This implies a significant public health challenge. Poor access to sanitation and water as was the case in our study area worsen the hygiene situation, further facilitating the transmission of the disease. Also the low quality of the water in the surrounding also creates a suitable environment for spreading the disease resulting in higher morbidity and mortality due to infectious diseases including conjunctivitis.

Our study findings revealed that very few children (12.50%) had taken vitamin A, none of them took azithromycin chemoprophylaxis for trachoma previously and majority were unvaccinated. Vitamin A and azithromycin could potentially reduce the incidence and severity of conjunctivitis, while vaccinations and proper hygiene are critical in preventing outbreaks. One of the aggravating factors for this outbreak was lack of vaccination due to the existing war between the regional and federal government. There was absolute blockage of basic services, medicine and goods for two years. Subsequently, the vaccination and materials used for keeping proper hygiene were blocked from entering the region for two years. This had exacerbated the outbreak.

Our findings showed resistance to chloramphenicol. This reflects similar trends seen in other studies [24, 25]. Resistance to chloramphenicol has been reported in various regions, often linked to its overuse in treating eye infections. A Sudanese study showed, bacterial conjunctivitis isolates showing significant resistance to tetracycline (94.2%) and moderate resistance to chloramphenicol [16]. This resistance reduces treatment effectiveness, increasing the need for alternative antibiotics like gentamicin or ciprofloxacin. This has public health implication highlighting the need for surveillance of antibiotic resistance patterns to guide proper treatment prescription and community health education to prevent misuse of antibiotics.

Limitations of the study

The study intended to verify the diagnosis and investigate the epidemics, but it lacks analytical analysis to assess the associated risk factors due to the inadequacy of the sample sizes as a result of various factors including samples for laboratory investigations. Similarly, the samples that were cultured was also few in number due to the lack of laboratory supplies during the study period.

Conclusion

Confirmed an outbreak of conjunctivitis among children which affected a high number of children compared with the other studies done in different setups. This was majorly a bacterial conjunctivitis; the isolated staphylococcus aureus was sensitive to the commonly prescribed antibiotics for conjunctivitis except Chloramphenicol which reported some resistance. Therefore, it is better to apply selective treatment for the clinically suspected conjunctivitis with the susceptible antibiotics in the region in collaboration with the World Health Organizations and other NGOs to mitigate and control the transmission cycle.

What is known about this topic

- Bovine brucellosis is a neglected zoonotic disease that is endemic to Gauteng Province in South Africa where an official control program is in place
- The disease can be eliminated by rigorous control programs that broadly include vaccination, controlled cattle movement and test-and-slaughter practice
- Publicly available data are lacking on the prevalence and current situation of the disease in sub-Saharan African countries

What this study adds

- Confirmed the existence of a bacterial conjunctivitis epidemic in the local area among children
- Drug sensitivity test was done for the commonly prescribed antibiotics to guide proper treatment

Competing interests

The authors declare no competing interests.

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Authors´ contributions

We would like to thank Tigray Regional Health Bureau for facilitating the necessary authorization and providing partial funding for printing materials. Similarly, we would like to sincerely thank Action Against Hunger for contributing to data collection and transportation. Similarly, we would like to express our strong appreciation to all staff of health facilities in the study districts, data collectors, and study participants for their unreserved support and participation.

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Table 1: Characteristics of participants with and without conjunctivitis in selected districts of central Tigray 2023 (N=200)			
Variables	**Category**	**Clinically with conjunctivitis**	**Clinically without conjunctivitis**
		Frequency (%)	**Frequency (%)**
Age	<6-months	8 (14.28)	20 (13.89)
	6-24 months	31 (55.36)	84 (58.33)
	>24 months	17 (30.36)	40 (27.78)
Address	Abyi-Adi	8 (14.28)	42 (29.16)
	Yechilla Abergelle	18 (32.14)	32 (22.22)
	Kolla Temben	15 (26.79)	35 (24.31)
	Keyih Tekli	15 (26.79)	35 (24.31)

Table 2: Drug sensitivity result for selected antibiotics among participants with conjunctivitis in the selected district of central Tigray, 2023		
	Drug sensitivity (N=03)	
Antibiotics type	**Resistant**	**Sensitive**
Chloramphenicol	2 (66.67%)	1 (33.33%)
Tetracycline	0	3 (100%)
Gentamycin	0	3 (100%)
Ciprofloxacin	0	3 (100%)

Table_3: Factors associated with conjunctivitis among children of central Tigray, 2023 (N=56)	
Variables	**Frequency (%)**
Recurrent symptom (two and above episodes within two weeks)	20 (35.71%)
Previous antibiotics treatment to the same illness (within one month)	18 (32.14%)
Took vitamin A regularly	7 (12.5%)
Having family with similar symptom in the same household	15 (26.78%)
Took Azithromycin previously	0
Concomitant chronic disease	1 (1.78%)
Utilization of latrine	23 (41.07%)
Safe source of water for drinking	32 (57.14%)
Travel history to places where eye disease is common	6 (10.71)
Suspected cases of measles	3 (5.36)
Vaccination	
Complete	14 (25%)
Incomplete	17 (30.36)
Unvaccinated	25 (44.64)

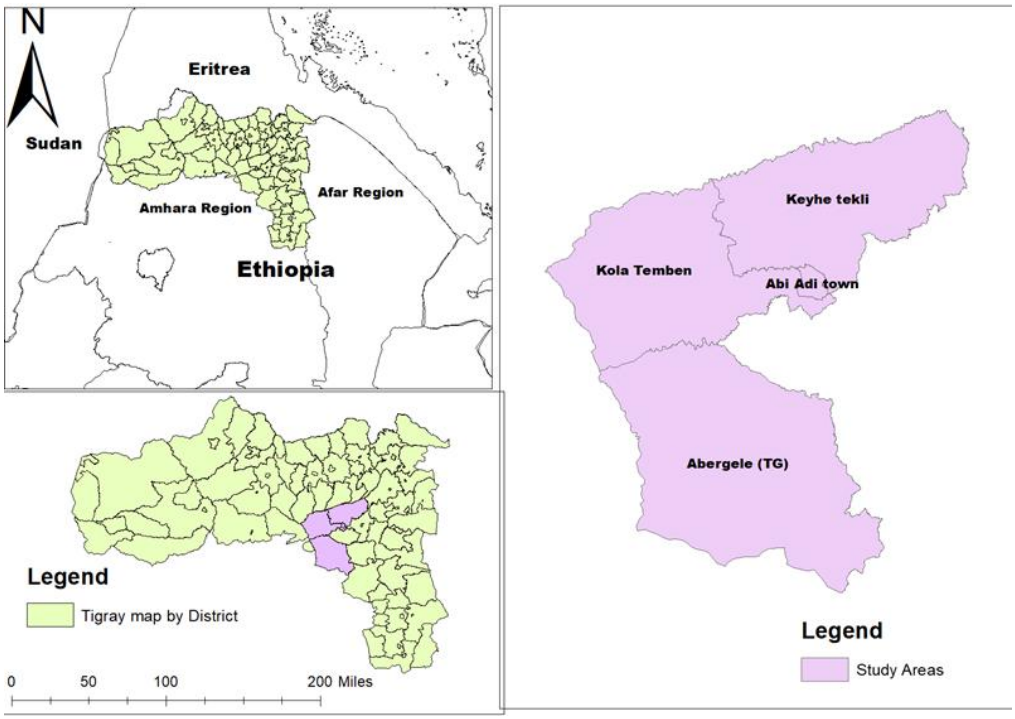

Figure 1: Map of the epidemic investigation conducted districts, Tigray 2023

Figure 2: Picture of individuals with conjunctivitis in selected districts of Central Tigray, 2023

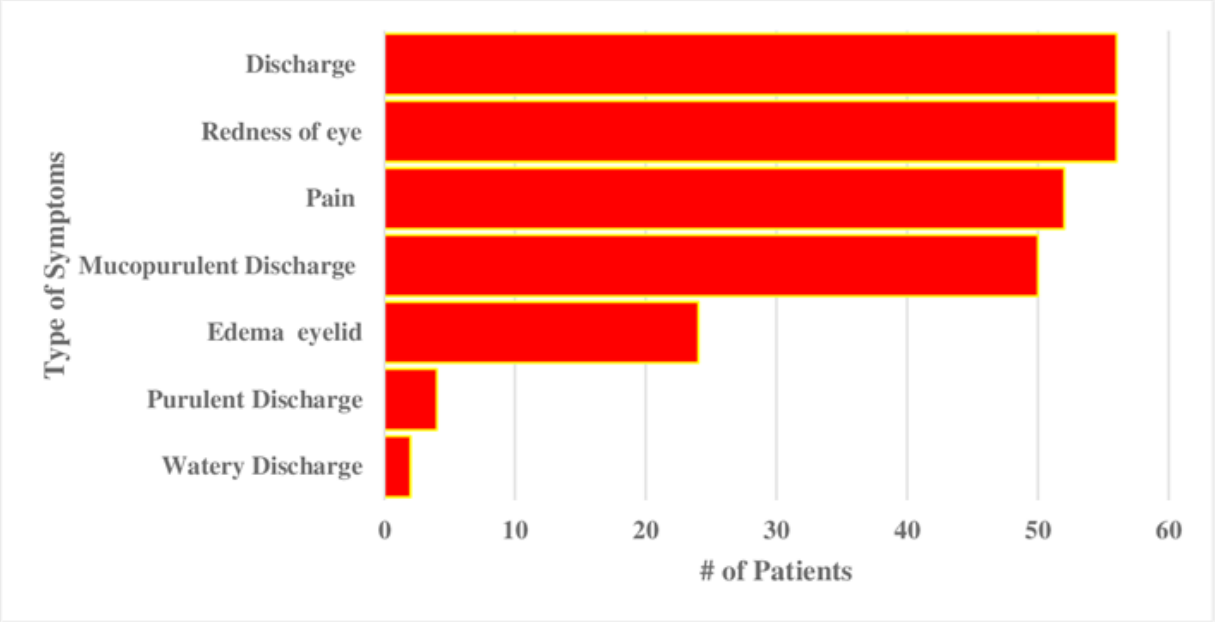

Figure 3: Signs and symptoms of individuals with conjunctivitis in selected districts of central Tigray 2023