Prevalence and Antibiotics Susceptibility Profiles of Streptococcus Pyogenes Among Pediatric Patients With Acute Pharyngitis at Felege Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia

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Abstract

Background: *Streptococcus pyogenes* (*S. pyogenes*) is a Gram positive bacterium which is a leading cause of pharyngitis, skin and soft tissue infection and post streptococcal syndromes. Due to lack of β-lactamase enzyme production, it was considered universally susceptible to penicillin group and later generation of β-lactam antibiotics. As such, empirical treatment was common which might leads to development of antibiotics resistance. Therefore, the aims of this study were to determine the prevalence and antibiotics susceptibility profile; associated factors of *S. pyogenes* among pediatrics patients with acute pharyngitis in Felege Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia

Methods: A total of 154 pediatric patients, whose age ranged from 0-18 years recruited to the study by convenient sampling technique on which hospital based cross-sectional study was carried out from 1st February to 19th June 2020 at FHCSH. *S. pyogenes* were identified by throat swab culture on 5% sheep blood agar with an overnight incubation at 37^{o}C in candle jar with 5% CO_2. Gram stain, catalase test and bacitracin test were used to identify *S. pyogenes*. The data were entered into EpiData version 3.1 and analyzed by SPSS version 20 software. Bivariables and multivariable logistic regressions were carried out for analysis by considering $P < 0.05$ as statistically significant.

Results: From the total throat swabs, 14 (9.1%) with (95% CI; 4.5-14.3) were culture positive for *S. pyogenes.* All isolates were sensitive to penicillin and ampicillin whereas 4 (35.7%), 4 (35.5%), 3 (21.4%), 2 (14.3%), 1 (7.1%), 7 (50.0%) and 1 (7.1%) were resistant for ceftriaxone, vancomycin, erythromycin, tetracycline, chloramphenicol, clindamycin and levofloxacin, respectively. Presence of any smoker in home was significantly associated with *S. pyogenes* acute pharyngitis, while tender lymphadenopathy and recurrence were clinical predictors for *S. pyogenes* acute pharyngitis ($P < 0.05$).

Conclusion: The prevalence of *S. pyogenes* 9.1% which is considered as low prevalence. All *S. pyogenes* remain sensitive to penicillin and resistance was also obtained to clindamycin 7 (50.0%), ceftriaxone 5 (35.7%), erythromycin 3 (21.4%). The current practice of giving erythromycin, clindamycin instead of penicillin and ampicillin is in contrary with microbiology result. There should be routine throat culture and a continuous surveillance of antibiotics resistance pattern for *S. pyogenes* to improve the use of antibiotics in hospitals.

Background

Streptococcus pyogenes (*S. pyogenes*) is a Gram positive, extracellular bacterial pathogen, spherical shape and β-hemolytic bacterium. It is also a catalase negative, bacitracin sensitive; pyrrolidonylarylamidase (PYR) positive, facultativelly anaerobic and it required enrichment for growth on culture media [1] *S. pyogen*es was firstly cultured and identified as the cause of erysipelas by Friedrich Fehleisen in 1883 and its species designation was done by Rosenbach in 1884 [2]. However, in 1933, Rebecca Lancefield made serologic classification of Group A Streptococcus (GAS) based on group A carbohydrate that composed of N-acetyl glucosamine linked to *S. pyogenes* cell wall antigens as rhamnose polymer backbone. Therefore, GAS is also known as *S. pyogenes* [3].

S. pyogenes were responsible for several clinical conditions such as scarlet fever, acute rheumatic fever, glomerulonephritis, sepsis, necrotizing fasciitis, meningitis, streptococcal toxic shock syndrome, impetigo and acute pharyngitis [4]. Acute pharyngitis is one the disease caused by *S. pyogenes.* It is an inflammation of oropharynx mucous membranes or posterior pharynx and tonsils [5] with different clinical manifestations such as sore throat, sudden onset fever, red pharynx, enlarged tonsils, yellow or blood-tinged exudates, petechiae on the soft palate and posterior pharynx [6].

About hundred millions people develop serious *S. pyogenes* infection every year and cause about 660,000 invasive infections and 616 million cases of pharyngitis that result in 163,000 death annually reported from 2009 to 2014 [7]. In African countries, *S. pyogenes* was isolated from children with acute pharyngitis. For example, the prevalence was as high as 66.7%, 28%, 2.3%, and 11.3% in Nigeria [8], Egypt [9], Kenya [10] and Jimma, Ethiopia [11], respectively.

Transmission can be through direct contact, contaminated fomites, or food borne contamination or droplets from those with pharyngeal infection or colonization [12]. Most *S. pyogenes* infections were treated with penicillin still being effectively used for treatment empirically [13]. However, those patients with allergic to penicillin have been treated with erythromycin, amoxicillin, cotrimoxazole, chloramphenicol, tetracycline, azithromycin and clindamycin [14]. Hence, current treatment guidelines discourage the empirical use of antibiotics due to unnecessary antibiotic exposure and drug resistance [15]. Additionally, due to lack of β-lactamase enzyme production by *S. pyogenes*, it was considered universally susceptible to penicillin group and later generation of β-lactam antibiotics. Even though, early untreated *S. pyogenes* acute pharyngitis leads to post infection complications such as acute rheumatic fever (ARF) and rheumatic heart disease (RHD) and glomerulonephritis [16].

There is not much information on the screening of children for carriage of *S. pyogenes* in Ethiopia [17] but empirical treatment is the current practice in the study area and at large in Ethiopia. Additionally, people do not complete their treatment or took irregularly. All these practices might contribute for drug resistance emergency in the study area.

In Amhara region, there was a limited study on prevalence, antibiotic susceptibility profiles and associated factors for *S. pyogenes* among pediatric patients with acute pharyngitis even in Bahir Dar. Therefore, this study aimed to determine the prevalence, antibiotics susceptibility profiles and associated factors of *S. pyogenes* among pediatric patients with acute pharyngitis in FHCSH, Bahir Dar, Northwest Ethiopia.

Materials And Methods

Study area, design and period

The study was conducted at Felege Hiwot Comprehensive Specialized Hospital (FHCSH) in Bahir Dar City. Bahir Dar is capital city of Amhara region which is located 565 kilometers away from Addis Ababa, the capital city of Ethiopia. FHCSH is one of health facilities found in Bahir Dar which was established in 1952 and it serves more than 10 million people of Bahir Dar and the surrounding zones in the region. This Hospital had 13 wards, 430 beds, and about 531 health professionals. The outpatient clients were more than 24000 quarterly and daily outpatient clients are more than 600. So that 1782 total pediatric children were attended in Pediatric OPD quarterly, 594 monthly and 21 daily for different health service in this hospital. There was 121 40, 10 and 2 treated pharyngitis cases from February to may, 2019, quarterly, monthly, weekly and daily [18], respectively. Hospital based cross-sectional study was carried out from 1st February to 19th June 2020 at FHCSH in Bahir Dar.

Population

All children whose ages ≤18 years and were suspected for acute pharyngitis attending at FHCSH were the source population while those suspected for acute pharyngitis attending at FHCSH during the study period were study population and those gave throat swab specimen were study participants.

Inclusion and exclusion criteria

All children with age ≤ 18 years and with symptoms of acute pharyngitis at FHCSH were included to this study. Whereas, those who took antibiotics within two weeks of data collection were excluded in this study.

Sample size determination and sampling technique

The sample size was calculated using a single population proportion formula based on the assumption of 5% expected margins of error, 95% confidence interval (Za/2= 1.96) or alpha (α = 5%) and the previous prevalence of *S. pyogene* reported as 11.3% in Jimma town, Ethiopia [11].

$$N = \frac{(Za/2)^2 \times P(1-P)}{d^2} = \frac{(1.96)^2 \times 0.113(1-0.113)}{(0.05)^2} = 154,$$

where p- prevalence

d- margin of error

N- Number of sample size

Thus, a total 154 throat samples were collected by convenient sampling technique

Data collection and processing

The data were collected by trained pediatric nurses and principal investigator. Sociodemographic, environmental factors, behavioral and housing data were collected by structured pre-tested Amharic version questionnaire using face to face interview with parents/ guardians for participants whose age < 15 and participants whose age >15 years were also interviewed. Clinical data were collected by trained pediatric nurses. At each data collection spot, sufficient explanation about the aim of the research was given to the study participants before interview.

Sample collection and transportation

A single throat swab specimen on the tonsils and the posterior pharynx was collected using sterile cotton swab from each study participants for culture. It was collected at symptomatic area at which cotton swab rolled three times on exudates, inflamed pharynx, and swollen tonsil. Tongue depressor was used to depress tongue during throat swab collection [19]. These throat swabs were transported using Amie's transport media with cod box containing ice pack to Bahir Dar University, Microbiology Research Laboratory Center.

Streptococcus pyogenes identification

Throat swabs were inoculated on 5% sheep blood agar plates and incubated at 37^{O}C in candle jar with 5% CO_2 atmosphere for 24 to 48 hours [20, 21, 22]. Catalase test was done from 24 hour growth of β-hemolytic colonies to differentiate catalase negative *Streptococcus* species. This catalase negative *Streptococcus* species was subjected to bacitracin test. As such, colony suspension with normal saline matched with 0.5 McFarland standards was prepared from fresh 24 hour growth of colonies and placed bacitracin disk on inoculated 5% sheep blood agar. Thus, any inhibition was showed as bacitracin sensitive for *S. pyogenes* [20] after 24 hour incubation at 37^{o}C in candle jar [19].

Antibiotic susceptibility test

Antimicrobial susceptibility test (AST) was done by disk diffusion method on Mueller-Hinton (MHA) agar supplemented with 5% sheep blood [20]. Suspension was prepared from 3-5 pure *S. pyogenes* colonies mixed with 5ml normal saline in sterile glass test tube which matched with 0.5 McFarland standards. Such suspension was evenly spread onto Mueller Hinton agar supplemented with 5% sheep blood using sterile cotton swab. The tested antibiotics included penicillin (P = 10U), ampicillin (AMP = 10µg), erythromycin (E = 15µg), chloramphenicol (C = 30µg), clindamycin (DA = 2µg), tetracycline (TE = 30µg), vancomycin (VA = 30µg), levofloxacin (LEF = 5µg), ceftriaxone (CRO = 30µg), cefotaxime (CTX = 30µg), Collect cefepime (FEP = 30µg). After inoculation, it was incubated at 37^{O}c in a candle jar for over 18 hrs. After then, zone of inhibition was measured with ruler and interpreted as sensitive, intermediate and resistant according to the principles established by CLSI M100 guideline [20].

Quality control

Structured questionnaires were prepared in English, translated into Amharic language and then, translated back to English to check its inconsistencies. About 5% of structured questionnaire was pretested in Shegaw Motta General Hospital and training was provided to pediatric nurse how to collect the data. Throat swab sample was collected aseptically and was transported using Amies transport medium [22] by maintaining cold chain, most often cold box with dry ice [23]. Culture media was prepared aseptically by autoclaving and was checked by overnight incubation of 5% of single batch preparation of media as a control. Additionally, the media was checked for growth of known *Streptococcus pneumoniae* (*S. pneumoniae*) ATCC 49619 [20]. Likewise, Bacitracin test was checked by *Streptococcus pyogene* ATCC as positive and *Streptococcus agalactiae* ATCC as negative control. Moreover, antibiotics susceptibility inhibition zone was interpreted based on CLSI M100 guideline as resistance, intermediate and sensitive [20].

Data analysis

Data was entered by EpiData version 3.1 and data analysis was performed using SPSS version 20. The prevalence of *S. pyogenes* and antibiotics resistance was determined by descriptive statistics and multivariable logistic regression was done by entering the variables with $p < 0.2$ in bivariable logistic regression to identify the associated factor and clinical predictors by considering $P< 0.05$ as statistically significant.

Ethical consideration

The ethical clearance approval was obtained from Bahir Dar University Institutional Review Board and a permission letter was obtained from FHCSH. The purpose and importance of the study was explained to the participants. Informed consent from parent/guardian and assent from children was obtained in accordance with the Declaration of Helsinki. Additionally, absence of link between the study and their service was explained and participation was entirely voluntary based. Furthermore, the confidentiality of study participant was kept and identification of study participant by name was avoided.

Results

Sociodemographic characteristics and prevalence of *S. pyogenes*

A total of 154 pediatric children were recruited to this study. From those, the majority 81 (52.6%) of participants were females and 73 (47.4%) were males. Study participant`s age were ranged from 0- 18 years old with mean age 8.483, median 9.0 and standard deviation (SD = 4.8). Majority of study participants were less than five years age 51 (33.1%)

followed by 5-10 years 46 (29.9%) and 10-15years 43 (27.9%). Moreover, about 102 (66.2%) participants were from urban. Additionally, the majority 65 (42.1%) of participants could not able to read & write (Table 1).

Prevalence of *S. pyogenes*

The overall prevalence of *S. pyogenes* was 14 (9.1%; 95%; CI = 4.5-14.3). Out of the total *S. pyogenes* culture positives with acute pharyngitis, females shared 11 (7.1%). According to age categories, there was no positive for *S. pyogenes* in the age less than five years whereas 8 (5.2%), 5 (3.2%) and 1 (0.7%) were age between 5-10, 10-15 and 15-18, respectively. Furthermore, about 8 (5.2%) *S. pyogenes* were isolated from those participants in primary school. The isolation rates of *S. pyogenes* with different socio-demographic characteristics were summarized (table 1).

Antibiotics susceptibility profiles of *Streptococcus pyogenes*

Different antibiotics classes were used for determining susceptibility profile of *S. pyogenes* isolates. As the result, all isolates of *S. pyogenes* were sensitive for both penicillin and ampicillin. The proportions of antibiotics resistances to clindamycin, ceftriaxone, cefotaxime, cefepime, vancomycin, erythromycin, tetracycline and chloramphenicol were 7(50.0%), 5 (35.7%), 3 (21.4%), 2 (14.3%), 5 (35.7%), 3 (21.4%), 2 (14.3%) and 1 (7.1%), respectively. However, clindamycin 1 (7.1%), erythromycin 2 (14.3%), tetracycline 2 (14.3%) and chloramphenicol 2 (14.3%) were intermediate findings (figure 1).

Out of the total 14 *S. pyogene* isolates, the proportion of multidrug resistant was 3(21.3%). From which, 1(7.1%) was multi drug resistance for erythromycin, clindamycin and vancomycin but 1(7.1%) for erythromycin, tetracycline and vancomycin. The rest 1(7.1%) was multidrug resistance for chloramphenicol, Cephame group and levofloxacin simultaneously.

Factors associated with *Streptococcus pyogenes* acute pharyngitis

All independent variables showing *P*-value of < 0.2 in the bivariable analysis were entered in to multivariable logistic regression analysis. Accordingly, only presence of any smokers in home (AOR = 7.11, CI =1.694-29.82, $P = 0.02$) $P < 0.05$ demonstrated as significant association with *S. pyogenes* acute pharyngitis (Table 2).

All clinical predictors regard to *P*-value in the bivariable was subjected to multivariable analysis. Hence, the two clinical variables such as tender lymphadenopathy (AOR= 14.45, 95% CI =1.6-30.3, $P = 0.03$) and recurrence (AOR = 5.87, 95% CI= 1.63–12.31, $P = 0.02$) were found to be independent predictors for *S. pyogenes* acute pharyngitis in pediatrics (Table 3).

Discussion

Streptococcus pyogenes infection among the pediatric group is a cause of acute pharyngitis in pediatric patients which could leads morbidity and mortality [24]. Pediatric patients with acute pharyngitis require microbiologic investigation and proper treatment to abort complications [25].

The prevalence of *S. pyogenes* in the current study was 14(9.1%). The finding is comparable with the previous conducted in Jimma, Ethiopia 11.3% [11], India 5.5% [16], Japan 5.8% [26], Indonesia 13.5% [27] and Nepal 9.2% [28]. But it was higher than a study from Mexico 0.04-0.42% [29], Brazil 3.9% [30], Romania 4% [31], Iran2.5% [32] and Saudi Arabia 1.5% [33]. This high prevalence rate in our study might be due seasonal nature of *S. pyogenes* incidence which is higher from February to May [11]. Additional reason for the difference might be geography and climatic condition. In the

contrary, the proportion of the recent study 9.1% was much lower than findings from USA [34, 35] and African [36, 37, 38, 39], Iran [40] and Israel [41]. Such variation could be attributed to difference geography, method, socio-economic conditions, and sample size.

In this study, all isolates were sensitive to penicillin which is in agreement with studies reported in USA [29, 30], Asia [16, 42, 43], Europe [41, 44, 45], African countries including Egypt [46], Kenya [39] and Jima, Ethiopia [11]. This is due to lack of β-lactamase production by *S. pyogenes*. Even though, penicillin resistance for *S. pyogenes* may happen by escaping penicillin treatment by entering epithelial cells, which are poorly penetrated by penicillin [47], by forming a biofilm [48] and protection of *S. pyogenes* by other β-lactamase-producing bacterial species [49, 50].

It is known that erythromycin and clindamycin are usually used as an alternative treatment for patients allergic to penicillin. However, in the current study, erythromycin (21.4%) and clindamycin (50%) resistance were recorded which was higher than no resistant to erythromycin and clindamycin in Jimma, Ethiopia [11], erythromycin (10.6%) in Spain [45] but much lower than 64-83% resistance to erythromycin in India [43,51]. Similarly, 35.7%, 21.4% and 14.3% resistance to ceftriaxone, cefotaxime and cefepime were reported in our study which was higher than no resistance for ceftriaxone and cefotaxime in Pakistan [42] and India [16, 43] and Ethiopia [11], respectively. This variation might be due to physician provided treatment of non β-lactam drugs for acute pharyngitis case by considering Gram negative bacteria empirically. This might be the leading cause a high rate cephalosporin and erythromycin resistance. Additionally, erythromycin resistance in *S. pyogenes* occurs via target site modification that erythromycin ribosomal methylase (*erm*) genes encode an enzyme that methylate a single adenine in 23S rRNA and results conformational change in the ribosome, leading to reduced binding of erythromycin and clindamycin [52]. Similarly, in target drug efflux, *mefA* (macrolide efflux pump) genes encode an efflux pump of 14- and 15-carbonring macrolides, conferring resistance to erythromycin only. Tetracycline resistance is conferred by ribosome protection genes such as *tet*(M) or *tet*(O) and efflux pumps for tetracycline encoded by the tet(K) or tet(L) gene also confer tetracycline resistance [53]. The erm and mefA genes are often collocated with tet gene of *S. pyogenes* strains are resistant to both macrolides and tetracycline [54].

In the current study, presence of any smokers in home (*P* value < 0.05) was associated with *S. pyogenes* acute pharyngitis in pediatric patient. This result was in agreement with previous finding in Northern India [44]. This might be due to presence of any smoker in home leads to children inhaled smokes. This cigarettes smoke inhalation kill normal flora which able to compete pathogen from adherence and altered bacterial acquisition and oral mucosal colonization in favor of *S. pyogenes* periodontal pathogens. Furthermore, the presence tender lymphadenopathy and recurrence (*P* value< 0.05) were found to be independent clinical predictors for *S. pyogenes* acute pharyngitis among pediatrics. Similar finding of tender lymphadenopathy and recurrences were reported in India [55], Yemen Saudi Arabia [56] and Jimma, Ethiopia [11]. However, clinical predictors varied with geographical area and immune status of study population [57].

Conclusion And Recommendation

In this study, the prevalence of *S. pyogenes* in pediatric children with acute pharyngitis was 9.1%. All *S. pyogenes* remain sensitive to penicillin and ampicillin. The resistance rate was obtained to clindamycin 7 (50.0%), ceftriaxone 5 (35.7%), vancomycin 5 (35.7%), cefotaxime 3 (21.4%), erythromycin 3 (21.4%), cefepime 2 (14.3%) and tetracycline 2 (14.3%). The overall multidrug resistance was 21.3%. Relatively low resistance was documented to penicillin, ampicillin, levofloxacin and chloramphenicol. Hence, similar to other studies these drugs were considered as an empirical treatment for *S. pyogenes* acute pharyngitis in pediatric patients. The presence of any smoker in home was associated with *S. pyogenes* acute pharyngitis whereas tender lymphadenopathy and recurrence of sore throat were clinical

predictors for *S. pyogenes* acute pharyngitis ($p < 0.05$) in our study. There should be routine throat culture and a continuous surveillance of antibiotics resistance pattern for *S. pyogenes* to improve the use of antibiotics in hospitals.

Abbreviations And Acronyms

ANRSHB: Amhara National Regional State Health Bureau; AOR: Adjusted Odd Ratio; APHI: Amhara Public health Institute; ARF: Acute Rheumatic Fever; AST: Antibiotic Susceptibility Test; ATCC; American Type Culture Collection; BAP: Blood agar plate: BDU: Bahir Dar University; CLSI: Clinical Laboratory of Standard Institute; COR: Crude Odd Ratio FHCSH: Felege Hiwot Comprehensive Specialized Hospital; GAS: Group A Streptococcus; IDSA - Infectious Diseases Society of America; ID: Individual identity; IQC: Internal Quality Control; MHA: Muller-Hinton agar; MIC: Minimum inhibitory concentration; OPD: Outpatient department; PYR: Pyrrolidonyl arylamidase test; RHD: Rheumatic heat disease; RADT: Rapid antigen detection test; SOPs: Standard operating procedures; SPSS: Statistical package for social sciences; URTI: Upper respiratory tract infection; US: United States; WHO: World Health Organization

Declarations

Ethics approval and consent to participate

The ethical clearance was obtained from Bahir Dar University Institutional Review Board and a permission letter was obtained from FHCSH. Informed consents from guardians or parents and assents from each study participants were obtained in accordance with. The confidentiality of study participant was kept and identification of study participant by name was avoided. Positive individuals were linked to health institution for better managements accordingly.

Consent for publication

Not applicable

Availability of data and material

Minimal data could be accessed upon request

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

Destaw Kebede: Participated on the conception, design, data collection, analysis and interpretation. Daniel Mekonnen and Alemale Admas facilitated the data collection and management, drafted, analysis and critically reviewed the manuscript. All authors read and approved of the final manuscript.

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Tables

Table 1: Prevalence of *S. pyogenes* with respect to socio-demographic characteristics among pediatric patient with acute pharyngitis in FHCSH, Northwest Ethiopia, 1st February to 19th June 2020

Variables	Categories	Culture result for *S. pyogenes*		Total
		Positive	Negative	N (%)
		N (%)	N (%)	
Sex	Male	3 (2.0)	70 (45.45)	73 (47.45)
	Female	11 (7.1)	70 (45.45)	81 (52.55)
Age (in year)	<5	0 (0)	51 (33.1)	51 (33.1)
	5-9	8 (5.2)	38 (24.7)	46 (29.9)
	10-14	5 (3.2)	38 (24.7)	43 (27.9)
	15-18	1 (0.7)	13 (8.4)	14 (9.1)
Residence	Urban	9 (5.9)	93 (60.4)	102 (66.3)
	Rural	5 (3.2)	47 (30.5)	52 (33.7)
Education level of children	Cannot read &write	5 (3.2)	60 (39.1)	65 (42.2)
	Can read & write	0 (0)	7 (4.7)	7 (4.7)
	Primary school	8 (5.2)	56 (34.4)	64 (41.6)
	Secondary school	1 (0.6)	16 (10.3)	17 (10.9)
	College and above	0 (0)	1 (0.6)	1 (0.6)
Occupation of parents/guardians	House wife	4 (2.65)	42 (27.3)	46 (29.95)
	Farmer	4 (2.65)	33 (21.4)	37 (24.05)
	Merchant	3 (1.9)	29 (18.8)	32 (20.7)
	Laborer	0 (0)	8 (5.2)	8 (5.2)
	Employed	3 (1.9)	28 (18.2)	31 (20.1)
Total	**14 (9.1)**	**140 (90.9)**	**154 (100)**	

Note: N= Frequency, % = Percent

Table 2: Bivariable and multivariable logistic regression analysis of factors associated with *S. pyogene*s acute pharyngitis in FHCSH, Northwest Ethiopia, 1st February to 19th June 2020

Variables	Categories	*S. pyogenes*		COR(95%CI) *P*- value	AOR(95%CI) *P*- value
		Pos (N)	Neg (N)		
Family number in home	≥5	13	75	11.2(1.4-88.5)0.021*	-
	<5	1	65	1	
Sex	Male	3	70	1	-
	Female	11	70	3.66(2.98-13.71) 0.054*	
Age (in year)	< 5	0	51	3.92(1.24-67.0) 0.35	-
	5-10	8	38	1.42(1.05-3.72) 0.434	
	10-15	5	38	1.59(1.06-5.450) 0.63	
	>15	1	13	1	
Residence	Urban	9	93	1	-
	Rural	5	47	1.09(0.35-3.47) 0.872	
Number of bed shared in home	>2	2	72	6.35 (1.37-29.43) 0.018*	-
	≤2	12	68	1	
Frequently cold Drink	Yes	8	41	3.22 (1.05-9.86) 0.041*	-
	No	6	99	1	
Passive Smoker	Yes	8	30	4.89 (1.57-15.18) 0.006*	7.11(1.69-29.82)0.01**
	No	6	110	1	1
Active smoker	yes	1	23	2.56 (1.32-20.51) 0.38	-
	No	13	117	1	
Separate kitchen	Yes	3	73	1.07 (1.01-3.55) 0.012*	2.05(1.21-5.45) 0.16
	No	11	67	1	1
Malnutrition	Yes	1	4	2.12(1.07-19.10) 0.06*	-
	No	13	136		

Note: N= Frequency, COR = Crude odd Ratio, AOR = Adjusted Odd Ratio, Pos= Positive, Neg= Negative, * = variable enrolled to multivariate regression (P- value <0.2), ** = statistical significant

Table 3: Bivariable and multivariable logistics regression analysis of chief clinical variables for *S. pyogenes* acute pharyngitis in FHCSH, Northwest Ethiopia, 1st February to 19th June 2020

Variables	Category	*S. pyogene*		COR (95%CI) *P* value	AOR (95%CI) *P* value
		Pos (N)	Neg (N)		
Body temperature (ln ^{o}C)	≥ 38	4	31	2.41 (1.41-8.79) 0.57	
	<38	10	109	1	
Painful throat	Yes	13	121	2.04 (1.25-16.51) 0.50	
	No	1	19	1	
Headache	Yes	6	65	1.16 (1.08-3.50) 0.79	-
	No	8	75	1	
Vomiting	Yes	2	33	1.85 (1.94-8.69) 0.44	-
	No	12	107	1	
Abdominal pain	Yes	1	18	1.92(1.24-15.56) 0.54	
	No	13	122	1	
Enlarged tonsil	Yes	8	75	1.86 (1.38-3.50) 0.80	-
	No	6	65	1	
Recurrence	Yes	11	54	5.84 (1.56-21.87) 0.01*	5.87(1.89-26.78) 0.02**
	No	3	86	1	1
Inflame pharynx	Yes	9	87	1.10 (1.349-3.45) 0.88	-
	No	5	53	1	
Pharyngeal Exudate	Yes	12	84	4.0 (1.86-18.56) 0.08*	-
	No	2	56	1	
Lymphadenopathy	Yes	13	71	1.83 (1.6-5.56) 0.029*	14.45(1.6-30.3) 0.02**
	No	1	69	1	1
Scarlatiniform Rash	Yes No	10	41	12.6 (1.61-99.2) 0.02*	-
		4	99	1	
Dysphagia	Yes No	10	79	1.93 (1.58-6.45) 0.29	-
		4	61	1	
Running nose	Yes No	2	25	1.3 (1.28-6.20)	-

	12	115	0.74 1

Note: N= frequency, COR = Crude odd Ratio, AOR = Adjusted Odd Ratio, Pos= Positive, Neg= Negative, * = variable entered to multivariate regression (*P*- value <0.2), ** = statistical significant

Figures

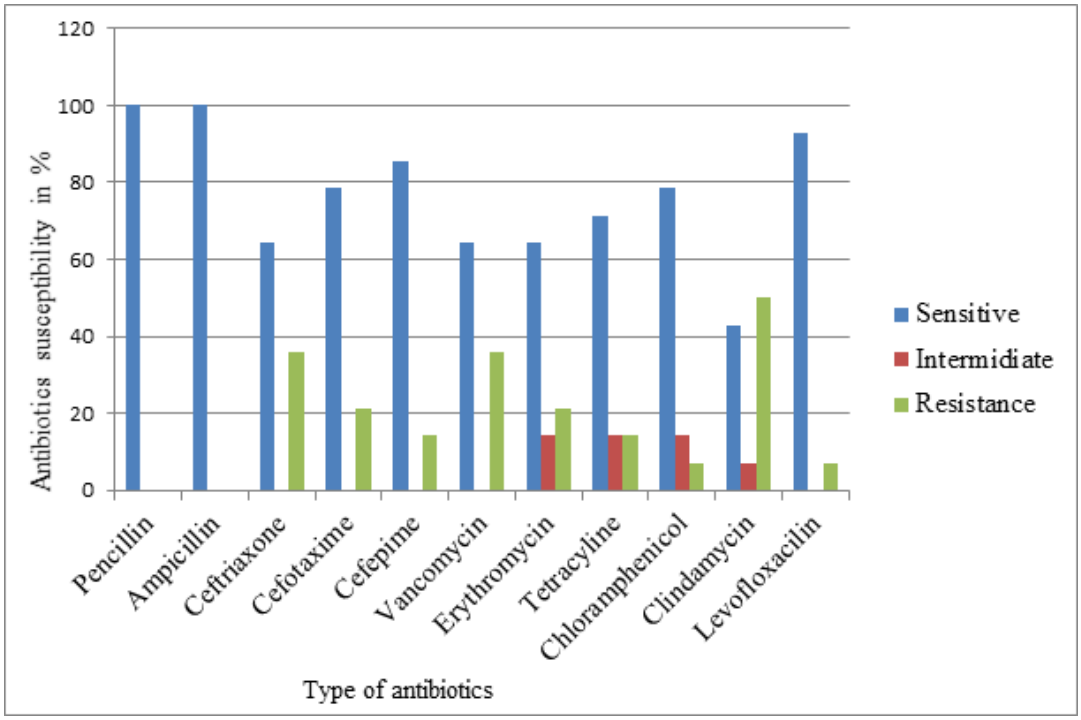

Figure 1

Antibiotic susceptibility profile of S. pyogenes isolates among pediatric patient with acute pharyngitis in FHCSH from 1st February to 19th June 2020