# Conjunctivitis among Rural and Urban School Children in Erbil Governorate/ Iraq

**Nabaz Fisal Shakir Agha** (MSc)[1]

## Abstract

**Background:** In children conjunctivitis is the most widespread ocular surface disease. It is referred to any inflammatory condition of the conjunctiva. Conjunctivitis was the most common associated comorbidities that had an influence on the health of children.

**Objective:** To compare the prevalence of allergic and infective conjunctivitis among school children in the rural & urban Regions of Erbil Governorate / Iraq.

**Patients and Methods:** A cross-sectional study was performed from the 1st Sep 2018 – end of May 2019 in primary schools in the rural area of Makhmur district and urban districts in Erbil Governorate .From every suspected case of clinically conjunctivitis, a sample for bacterial culture was gained by winding a thin cotton micro swab moistened in brain heart infusion broth over the lower fornix of the conjunctival sac.After culturing on blood, chocolate, and MacConkey agars, the colonies were specified and identified by using Gram staining technique, morphological, biochemical & Analytical Profile Index (API) tests.Allergic conjunctivitis was diagnosed clinically. The Kurdish & Arabic versions of International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire were used. MS excel package and SPSS 20 software was used for analysis.

**Results:** The total numbers of urban and rural School children who had shared in this study were 1129 and 1093 respectively. The prevalence of infective conjunctivitis in both urban & rural children was as such: 127(11.2%) & 211(19.3%).The rates of positive culture in both were: urban 69, 54.3%; rural 143, 67.8 %( $p \leq 0.01$). Staphylococcus aureus was the most common pathogen isolated, urban: 37(53.6%) rural: 79(55.2%).Infective conjunctivitis was distributed significantly in young ages and in male students ($p \leq 0.05$).Regarding allergic conjunctivitis: the prevalence of allergic conjunctivitis were: urban 247(21.9%), rural 81(7.4%).Allergic conjunctivitis was more distributed in older ages and male children, but this was not-significant .itching was complained by all student.

**Conclusion:** Infectious conjunctivitis among rural school children is still a major public health problem. While higher percentage of allergic conjunctivitis among urban school children was noted.

**Keywords:**Schoolchildren,Conjunctivitis,Rural,Urban,allergicconjunctivitis,Erbil.

**Corresponding Author:** Nabaz.shakir@epu.edu.iq

**Received:** 4th August 2019

**Accepted:** 17th September 2019

**DOI:https://doi.org/10.26505/DJM.18014850804**

[1] Medical Technical Institute - Erbil Polytechnic University- Erbil - Iraq.

## Introduction

Conjunctivitis refers to any inflammatory status of the conjunctiva [1]. It is commonly caused by bacteria or viruses; in addition to , chemical irritants, conventional eye medicament or allergy may play a role in causing conjunctivitis [2][3] .It has been estimated that 6 million patients diagnosed with acute conjunctivitis in the United States each year, with the cost of treating such cases alone about $380–860 million per year [4]. Conjunctivitis is the most prevalent ocular surface disease, predominately in children [2].It may readily disseminate in daycare centers and school 'classes leading to deprivation from attendance and consequently from the educational process [5].

Numerous US state health departments order students to be cured with local antibiotic eye drops preceding the resumption back to school regardless of the potential & implicit reason of conjunctivitis [4][6]. Allergic conjunctivitis (AC) is defined as inflammation of the conjunctiva induced by allergy [7]. AC comprises a series of events which starts when the conjunctiva displays an antigen-specific response with Th-2 upon contact with an allergen, liberating cytokines and yielding IgE. IgE then binds to mast cells which break down; generating histamines, prostaglandins, platelet-activating factor, more cytokines and other intermediaries. The signs and symptoms of AC result from the activation of inflammatory cells by these intermediaries [7][8]. For example, when histamine links to H1 receptors on nerve endings, it gives rise to itching; while in case of attachment to $H^2$ receptors located on blood vessels in the conjunctiva, the consequence will be vasodilation and lacrimation [9]. The process could be boosted and turn into persistent in nature with cumulative mobilization of neutrophils and eosinophil's by mast-cell generated cytokines and Th-2 cytokines respectively [8] [9].The present study aimed to compare the prevalence and some aspects of conjunctivitis (infective & allergic) in both urban and rural school' children.

## Patients and Methods

### Study protocol

This study was a cross sectional study in which school 'children were screened for conjunctivitis. It was performed from the period between September 2018 to May 2019 in primary schools of rural Makhmur district in Erbil Governorate and urban districts in Erbil city. Makhmur district is situated 67 kms south- west of Erbil city in Erbil province. Nine schools had been selected to achieve such a study including four schools in the rural Makhmur district and five schools in the urban Erbil city.

### Ethical considerations

This study was approved by the Ethics Committee of Erbil Medical Technical Institute, Erbil Polytechnic University, Iraq. Health Directorate of Erbil, Education Directorate of Erbil. The parental endorsements in both written and oral forms were acquired for their children to be enrolled in the study. The students were informed about study's objectives and they

could withdraw thereof if they wished so to do.

**Study population**

Inclusion criteria in this study were all children in the selected schools of aged 7-12 years while exclusion criteria were eye trauma, recent eye surgery, patients who are on systemic, local antibiotic and chemotherapy.

**Study design**

All children were examined by an ophthalmologist referred from Rizgary Hospital. For each child suspicious of having bacterial conjunctivitis, a sample for bacterial culture was gained by winding a thin cotton micro swab moistened in brain heart infusion broth over the lower fornix of the conjunctival sac. All swabs were inoculated on blood, chocolate and MacConkey agars, the colonies were then specified by employing Gram staining technique, and identified by using routine morphological, biochemical tests and API tests [10] [11]. The diagnosis of bacterial conjunctivitis was based on: (i) mucous or mucopurulent discharge in the involved eye; (ii) positive bacterial culture [11], [12] [13]. Diagnosis of allergic conjunctivitis was achieved by noticing symptoms of bilateral itchiness and either burning sensation, tearing, ropy/clear mucinous discharge, or photophobia [9][14]. The ocular signs hinged on the presence of at least two of these: papillae, redness, brownish limbal hyperpigmentation, visible limbal spots and chemises [15]. The Kurdish & Arabic versions of ISAAC (International Study of Asthma and Allergies in Childhood [7][8] questionnaire were prepared and distributed and collected through each daycare center. Parents filled out the ISAAC questionnaire at home and returned it within few days. For each case of infectious conjunctivitis, a questionnaire was applied to obtain demographic information regarding age, sex, duration of infection, features of the infection like pus, visual acuity, redness, irritation and history of any drug, or previous eye operation.

## Statistical analysis

The data analysis was performed using descriptive statistics, including frequency, and frequency percentage. Comparisons were made using Chi x2 test using standard equations. The results were reported with $p \leq 0.05$ or $p \leq 0.01$ as the accepted level of significance accordingly.

## Results

The total numbers of urban and rural primary school pupils who had included in this study were1129 and1093 respectively. Out ofthe1129 and1093 examined, 127 (11.2%) and 211(19.3%) had features of infective conjunctivitis while 247(21.9 %) and 81(7.4%) had signs and symptoms of allergic conjunctivitis Table(1). It is noted here that allergic conjunctivitis was more prevalent in urban school children while the percent of infective conjunctivitis was higher in rural school children.

**Table (1):** Distribution of infective& allergic conjunctivitis in urban and rural school children

| Diagnosis | Urban | | Rural | |
|---|---|---|---|---|
| | N | % | N | % |
| Infective conjunctivitis | 127 | 11.2 | 211 | 19.3 |
| Allergic conjunctivitis | 247 | 21.9 | 81 | 7.4 |
| No conjunctivitis | 755 | 66.9 | 801 | 73.3 |
| Total | 1129 | 100 | 1093 | 100 |

In this study,all conjunctival swabs from children who had features of conjunctivitis were subjected for culturing on Blood agar base, MacConky agar and Chocolate agar. The results of culturing of both urban and rural samples were as such illustrated in Table (2).

Sixty nine (54.3% ) of the urban isolate yield positive culture growth while regarding the samples from rural children 143(67.8%) swabs showed positive culture results . In both urban and rural, Staphylococcus aureus was the most common isolated bacteria. The isolated bacterial species from urban swabs were as such: (37, 53.6%) isolates of Staphylococcus aureus,(17, 24.6%) isolates of Staphylococcus epidermidis, (12, 17.4%) isolates of Psuedomonous aeruginosa and (3,4.4%) isolates of Haemophilus influenza. While the isolated bacterial species from rural samples were as such: (79,55.2%) isolates of Staphylococcus aureus, (41,28.7%) isolates of Staphylococcus epidermidis , (23,16.1%) isolates of Psuedomonous aeruginosa and (0,0%) isolates of Haemophilus influenza .The differences in the distribution of positive and negative culture results in both urban and rural samples were highly significant ($p \leq 0.01$).

**Table (2):** Distribution of positive, negative results and bacterial isolates in urban and rural school children

| Results | Urban | | Rural | | Total |
|---|---|---|---|---|---|
| | N | % | N | % | |
| Positive | 69 | 54.3 | 143 | 67.8 | 212 |
| Negative | 58 | 45.7 | 68 | 32.2 | 126 |
| Total | 127 | 100 | 211 | 100 | 338 |
| Statistical analysis | df=1 chi square value= 6.126 Highly significant($p \leq 0.01$) | | | | |
| Bacterial isolates | | | | | |
| *Staphylococcus aureus* | 37 | 53.6 | 79 | 55.2 | |
| *Staphylococcus epidermidis* | 17 | 24.6 | 41 | 28.7 | |
| *Psuedomonous aeruginosa* | 12 | 17.4 | 23 | 16.1 | |
| *Haemophilus influenzae* | 3 | 4.4 | 0 | 0 | |
| Total | 69 | 100 | 143 | 100 | |

Tables (3) & (4) illustrate the distribution of infective conjunctivitis according to age ranges and gender in both urban and rural school children. The highest frequency of infection was in the age range of 6-8 years of both urban and rural children (47, 37%), (69, 32.7%) respectively. The highest frequency of infection was in the males of both urban and rural children (83, 65.3%), (112, 53.1%) respectively. The differences in the distribution of infective conjunctivitis in these different age ranges and in both genders were significant ($p \leq 0.05$).

**Table (3):** Distribution of infective conjunctivitis according to the age range in urban and rural school children

| Age range (years) | Urban N | Urban % | Rural N | Rural % | Total |
|---|---|---|---|---|---|
| 6- 8* | 47 | 37 | 69 | 32.7 | 116 |
| >8-10 | 40 | 31.5 | 53 | 25.1 | 93 |
| >10-12 | 29 | 22.8 | 47 | 22.3 | 76 |
| >12-14 | 11 | 8.7 | 42 | 19.9 | 53 |
| Total | 127 | 100 | 211 | 100 | 338 |
| df=3 chi square value =8.0034 *significant ($p \leq 0.05$) | | | | | |

**Table (4):** Distribution of infective conjunctivitis according to the gender in urban and rural school children

| Gender | Urban N | Urban % | Rural N | Rural % | Total |
|---|---|---|---|---|---|
| Male* | 83 | 65.3 | 112 | 53.1 | 195 |
| Female | 44 | 34.7 | 99 | 46.9 | 143 |
| Total | 127 | 100 | 211 | 100 | 338 |
| df=1 chi square value =4.893 *significant ($p \leq 0.05$) | | | | | |

Tables (5) & (6) illustrate the distribution of allergic conjunctivitis in both age ranges & gender of pupils in the study. The highest percent was in the age group of > 12-14 years (81, 32.8 %) in urban while it was (34, 42%) in rural. The highest percent of children afflicted with allergic conjunctivitis were in males as followings urban (136 , 65.3% ) and rural ( 45, 53.1%) In spite of the increasing percent of allergic conjunctivitis with increasing ages and in male children in both urban and rural cases, It is noted here that the differences in the distribution of allergic conjunctivitis in both different age ranges and gender were not significant ($p \geq 0.05$) .In Table (7), the frequency of the major symptoms and signs of allergic conjunctivitis is illustrated; students suffered multiple symptoms. Itching was the most frequent symptom which was complained by all urban and rural school children.

**Table (5):** Distribution of allergic conjunctivitis according to the age range in urban and rural school children

| Age range (years) | Urban N | Urban % | Rural N | Rural % | Total |
|---|---|---|---|---|---|
| 6- 8 | 37 | 15 | 7 | 8.6 | 44 |
| >8-10 | 59 | 23.9 | 11 | 13.6 | 70 |
| >10-12 | 70 | 28.3 | 29 | 35.8 | 99 |
| >12-14 | 81 | 32.8 | 34 | 42 | 115 |
| Total | 247 | 100 | 81 | 100 | 328 |
| df=3 chi square value =7.4545 Non-significant (p≥ 0.05) | | | | | |

**Table (6):** Distribution of allergic conjunctivitis according to the gender in urban and rural school children

| Gender | Urban N | Urban % | Rural N | Rural % | Total |
|---|---|---|---|---|---|
| Male | 136 | 65.3 | 45 | 53.1 | 181 |
| Female | 111 | 34.7 | 36 | 46.9 | 147 |
| Total | 247 | 100 | 81 | 100 | 338 |
| df=1 chi square value =0.006 Non-significant (p≥ 0.05) | | | | | |

**Table (7):** Frequency of major features of Allergic Conjunctivitis in urban and rural school children

| Features | Urban Number | Urban % | Rural Number | Rural % |
|---|---|---|---|---|
| Itching | 247 | 100 | 81 | 100 |
| Redness | 185 | 74.9 | 64 | 79 |
| Grittiness | 120 | 48.6 | 43 | 53.1 |
| Tearing | 110 | 44.5 | 30 | 37 |
| Clear Mucinous Discharge | 97 | 39.3 | 21 | 25.9 |

## Discussion

To our knowledge, this is the first comparative study on the prevalence of conjunctivitis among urban and rural childhood students in Erbil. Bacterial conjunctivitis is the most widespread pattern of infective conjunctivitis [2].Such conjunctivitis manifests when the pathogenic bacteria vanquish conjunctival defenses leading to inflammation. Microbial populations in the normal flora of the conjunctiva can shelter the eye by restraining colonization of pathogenic organisms [16]. Considerable studies displayed that metabolic outcomes of the normal flora can curb the growth of pathogens [11] [17] [18].

Bacterial conjunctivitis can be contracted directly from infected persons or can result from abnormal proliferation and generation of the local conjunctival flora [2]. Contaminated fingers, oculogenital spread, and contaminated fomites are wide spread ways of transporting [13]. In addition, special conditions such as compromised tear production, perturbation of the natural epithelial hurdle, abnormality of adnexal structures, trauma, and immunosuppressed situations are more susceptible to bacterial conjunctivitis [17] [18].

Rural school children had a higher rate of infective conjunctivitis (19.3%) with higher rate of bacterial isolation (67.8%). This ratio of 19.3% was higher than that was marked by Ohnsman on their study on American children in which the rates were (13.5%) [16]. The present result was less than from studies achieved by Liang Q, Lu X,et al. ;Yang B, Li X, et al. in China and Mohager, et al. in Sudan in which the rates were 34%, 22.6% and 59.2% respectively[17] [18] [10]. The high ratio of positive bacterial growth (67.8%) of rural swabs conclude that bacterial conjunctivitis is still the most common cause of infective conjunctivitis .This result is in accordance with that of [20] [21] . The causes of the absence of bacterial growth in clinically diagnosed cases might be bacterial causes which are not identified by the conventional laboratory parameters or a nonbacterial causes like viruses and fungi [11].

The ration of bacterial conjunctivitis in children living the rural district of Makhmur was higher than that of children living in urban Erbil. This is probably linked with poor hygienic practices. Considerable studies stated that recurrence, allocation and reasons of acute bacterial conjunctivitis are affected by age; climate, social conditions in addition to other factors manipulating the propagation of microbiologic agents in patients with conjunctivitis include geographic location, season, age and associated synchronous maladies [3][11][17] [18][19]. The present study illustrated that Gram positive cocci is the most common isolates. The higher ratio of Staphylococci isolation in this study is in harmony with the study by Rahama et al. in Iraq which determined that Staphylococcus aureus showed the highest percentage (20.5%) of isolation [19]. Another study by Al-Dorri which was achieved in Tikrit, Iraq concluded that Staphylococcus aureus had the highest percentage of occurrence (42%), followed by Streptococcus pneumoniae (27%) and Staphylococcus epidermidis (12%) [20].In conformity with the current results, a study in Egypt by Hashish et al. had concluded Staphylococcus aureus was the most commonly isolated organism either separately or in the course of a mixed infection (24.65%) followed by Streptococcus pneumoniae in(21.83%), Pseudomonas aeruginosa in (12.68%) [21].

The higher ratio of Staphylococci isolation in this study is in harmony with the study by Cao et al. in China which determined that Staphylococci are the most recurrent microorganisms giving rise to infectious conjunctivitis in children, followed by

Coryneform spp. bacteria and Enterobacteria spp. [22].Other studies in Iraq by Al-Rubaey et al.; Alash SA. showed that Haemophilus influenzae & Pseudomonas aeruginosa represented the highest among the isolates respectively [23] [24].

Many studies reported that the frequency, etiology, distribution and causes of acute bacterial conjunctivitis are influenced by age; climate, social conditions and coexisting epidemic diseases in addition to other factors influencing the prevalence of microbiologic agents in patients with conjunctivitis include geographic location, season, age and associated concurrent illness [2] [11] [17].

The present study clarified that infective conjunctivitis affects younger ages and male students significantly. These results are in concert with that of Okesola et al.; Mohager *et al*.; Tesfaye et al.; Salman MS. where a higher prevalence of infective conjunctivitis was present in the young age group with male predominance [3] [10] [12] [25].The reason for this observance may be related to the high contagiosity of infective conjunctivitis and its affiliation with close contact between patients, a situation common in kindergartens, schools and childcare [11] [19]. Additionally boys are more exposed to environmental contaminants as they spend most of their time outdoors; in contrast to girls they stay indoors due to cultural, social as well as religious reasons [17] [21] [25].

Regarding allergic conjunctivitis, the prevalence of allergic conjunctivitis in urban and rural children samples were 21.9%, 7.4% respectively. The present study, to the best of our knowledge, is the first to report on the significant burden of allergic conjunctivitis in school children in the city of Erbil. The city is facing a numerous environmental challenges due to the rapid urbanization. The burdens of allergic conjunctivitis and related allergic diseases have been increasing worldwide. It is speculated that environmental factors are essentially responsible for this increase [8] [26] [27]. As a result of the environmental degradation, children especially in urban cities in developing countries are facing a range of new dilemma of allergic diseases including allergic conjunctivitis [28].

Allergic conjunctivitis is a condition seldom associated with visual loss; however, it is important from the perspective of quality of life [8].

Estimates of prevalence of this allergic condition have been published previously in various studies. A study conducted among 1280 primary-school children in the Bushehr region of Iran found that 12.5% of the children had allergic conjunctivitis [28]. A survey of a sample of 38, 955 children in Korea showed a prevalence of about 10% for rhino- conjunctivitis [29].Several studies have consistently related the increase in allergic conditions to urbanization. Because of environmental deteriorations, especially in urban cities within developing countries, air pollutants like urban dust contain polycyclic aromatic hydrocarbons which have been embroiled in allergic conjunctivitis [7] [27] [29]. For example, in Mongolia, a population-based survey revealed a striking

association between the prevalence of allergic conjunctivitis and the extent/degree of urbanization, the prevalence was 9.3% in villages, 12.9% in rural towns and 18.4% in the cities [30]. A small hospital-based case-control study conducted in Nigeria identified living close to major commercial centers as a risk factor for chronic allergic conjunctivitis as it increases the risk of exposure to smoke and other air pollutants [14].

The present study showed an increasing older age prevalence of allergic conjunctivitis although the differences in the distribution between different age groups was non-significant .Other studies had found a strong association between age and prevalence of allergic conjunctivitis as the older age had more prevalence [27] [28] [29].

The high prevalence in the present study in older child strengthens the argument that an increasing duration of exposure increases the risk of this disease in addition [27] [29]. When examined for gender, a male predilection was seen in this study. However, it was statistically not significant. The association between gender and allergic conjunctivitis remains non- conclusive [27] [28].

The relatively high disease burden among boys in our study is consistent with the findings of other studies and it could be because boys are more exposed to environmental pollutants as they spend most of their time outdoors; by contrast girls by and large stay indoors due to cultural, social as well as religious reasons [27] [29] [30] [31] [32]. The current study stated that itching was the main symptom which was complained by students with allergic conjunctivitis .This result is comparable to those results obtained by the studies [28] [30] [31]. Itching is a recurrent and almost invariably marks that the inflammation of the conjunctiva is allergic in origin [8] [9] [15]. This annoyance may swerve a child's attentiveness from the teacher to rubbing the eye to alleviate the symptoms and this may influence the process of learning [32].

The limitation of the present study were, the impact of seasonal differences in the ocular morbidity, the questionnaire used for reconnoitering for cases of allergic conjunctivitis had the restrictions of fulfilling the credibility of answers provided, using the conventional procedures for bacterial identification, diagnosis of allergic conjunctivitis was achieved mainly clinically, while it was better if sensitization tests were applied for more precise identification of such cases.

## Conclusions

It was concluded from this study that allergic and bacterial conjunctivitis was the most common associated comorbidities that had an influence on the health of children. The present study suggests that checking of school children for ocular problems should be carried out at organized periods and it should be one of the leading ingredients of the school health program. For this, school teachers should be educated and trained in recognizing common eye problems among school children so that these children can be referred for instant treatment. They should

also impart awareness regarding ocular hygiene among school children.

## Acknowledgements

Author would like to thank the Health and Education Directorates of Erbil and the heads of the selected basic schools for giving permission to conduct the study. Special thanks are directed to Rizgary Hospital for their aids. The author appreciates the co-operation of parents who allowed children to participate in the study.

## Conflict of interest

The author acknowledges no conflict of interest in this study

## References

[1]Rose P. Management strategies for acute infective conjunctivitis in primary care: a systematic review.Expert opinion on pharmacotherapy. 2007 Aug 1; 8(12):1903-21.

[2]Buznach N, Dagan R, Greenberg D. Clinical and bacterial characteristics of acute bacterial conjunctivitis in children in the antibiotic resistance era.The Pediatric infectious disease journal. 2005 Sep 1; 24(9):823-8.

[3]Okesola AO, Salako AO.Microbiological profile of bacterial conjunctivitis in Ibadan, Nigeria.Annals of Ibadan postgraduate medicine. 2010; 8(1):20-4.

[4]Smith AF, Waycaster C. Estimate of the direct and indirect annual cost of bacterial conjunctivitis in the United States.BMC ophhalmology. 2009 Dec; 9(1):13.

[5]Bremond-Gignac D, Mariani-Kurkdjian P, Beresniak A, El Fekih L, Bhagat Y, Pouliquen P, Delval L, Goldschmidt P, Bingen E, Cochereau I. Efficacy and safety of azithromycin 1.5% eye drops for purulent bacterial conjunctivitis in pediatric patients. The Pediatric infectious disease journal. 2010 Mar 1; 29(3):222-6.

[6]Azari AA, Barney NP. Conjunctivitis: a systematic review of diagnosis and treatment. Jama. 2013 Oct 23; 310(16):1721-30.

[7]Lee C, Kim H, Lim Y, Yang J, Yu S, Lee J, Chang J, Son H, Park J, Shin D. Evaluation of the relationship between allergic diseases in school children at Seoul's roadside elementary schools and air pollution. Atmospheric Pollution Research. 2015 Nov 1; 6(6):1004-12.

[8]Leonardi A, De Dominicis C, Motterle L. Immunopathogenesis of ocular allergy: a schematic approach to different clinical entities.Current opinion in allergy and clinical immunology. 2007 Oct 1; 7(5):429-35.

[9]Kari O, Saari KM. Diagnostics and new developments in the treatment of ocular allergies.Current allergy and asthma reports. 2012 Jun 1; 12(3):232-9.

[10]Mohager MO, Kaddam LA, Mohager SO.External ocular bacterial infections among Sudanese children at Khartoum State, Sudan.African Journal of Microbiology Research. 2016 Oct 28; 10(40):1694-702.

[11]Anagaw B, Biadglegne F, Belyhun Y, Mulu A. Bacteriology of ocular infections and antibiotic susceptibility pattern in Gondar University Hospital, North West Ethiopia. Ethiopian medical journal. 2011 Apr; 49(2):117-23.

[12]Tesfaye T, Beyene G, Gelaw Y, Bekele S, Saravanan M. Bacterial profile and antimicrobial susceptibility pattern of external ocular infections in Jimma University specialized hospital, Southwest Ethiopia.American Journal of Infectious Diseases and Microbiology. 2013; 1(1):13-20.

[13]Amsalu A, Abebe T, Mihret A, Delelegne D, Tadesse E. Potential bacterial pathogens of external ocular infections and their antibiotic susceptibility pattern at Hawassa University teaching and referral Hospital, Southern Ethiopia.African Journal of Microbiology Research. 2015 Apr 8; 9(14):1012-9.

[14]Malu KN. Allergic conjunctivitis in Jos-Nigeria. Nigerian medical journal: journal of the Nigeria Medical Association. 2014 Mar; 55(2):166..

[15]Ma Y, Zhao J, Han ZR, Chen Y, Leung TF, Wong GW.Very low prevalence of asthma and allergies in schoolchildren from rural Beijing, China.Pediatric pulmonology. 2009 Aug; 44(8):793-9.

[16]Ohnsman CM. Exclusion of students with conjunctivitis from school: policies of state departments of health.Journal of pediatric ophthalmology and strabismus. 2007 Mar 1; 44(2):101-5.

[17]Liang Q, Lu X, Wang M, Tian L, Labbé A, Hu A. Study of infectious conjunctivitis among children in rural areas of Qinghai province.Science China Life Sciences. 2016 Jun 1; 59(6):548-54.

[18]Yang B, Li X, Liang Q, Zhang S, Deng S. Characteristics of pathogenic microorganisms found in 99 cases of conjunctivitis from the Qinghai Tibetan area. Sci China Life Sci. 2016 Jun 1; 59:571-2 .

[19]Rahama HA, Ali QA, Mustafa AA. Molecular Study of Most Common Pathogenic Bacteria Isolated From Conjunctivitis Patients In Baghdad. Medical Journal of Babylon. 2017; 14(4):706-13.

[20]Al-Dorri AZ. Microbiological study of patients with conjunctivitis in Tikrit Teaching Hospital . Medical Journal of Tikrit . 2005; 2(112):28-34.

[21]Hashish AA, Elbakary MA, Allam WA. Resistant Infantile Bacterial Conjunctivitis in Egypt: A Microbiology Study.Journal of pediatric ophthalmology and strabismus. 2018 Mar 16; 55(2):135-9.

[22]Cao S, Pei B, Li Y. Analysis on drug resistance of the pathogenic bacteria isolated from secretions of the eyes of 715 children. Chin Med Guide. 2010; 8:31-2 .

[23] Al-Rubaey NK, Razzak MS, Al-Rubaey QK. Isolation and Characterization of Bacteria from Patients with Conjunctivitis in Hilla Province . Medical Journal of Babylon. 2007; 4(1-2):36-44.

[24]Alash SA. Study the prevalence of bacterial conjunctivitis in Iraq. Iraqi Journal of Science . 2015; 56(4C):3371-5.

[25]Salman MS. Pediatric eye diseases among children attending outpatient eye department of Tikrit Teaching Hospital. Tikrit J Pharm Sci. 2010; 7(1):95-103.

[26]Bekibele CO, Olusanya BA. Chronic allergic conjunctivitis: an evaluation of environmental risk factors. Asian J of Ophthalmol . 2006;8:147-50.

[27]Baig R, Ali AW, Ali T, Ali A, Shah MN, Sarfaraz A, Ahmad K. Prevalence of allergic conjunctivitis in school children of Karachi. Journal of the Pakistan Medical Association. 2010; 60(5):371.

[28]Zamanfar D, Ghaffari J, Behzadnia S, Yazdani-charati J, Tavakoli S. The prevalence of allergic rhinitis, eczema and asthma in students of guidance schools in Mazandaran Province, Iran. Open access Macedonian journal of medical sciences. 2016 Dec 15; 4(4):619.

[29]Suh M, Kim HH, Sohn MH, Kim KE, Kim C, Shin DC. Prevalence of allergic diseases among Korean school-age children: a nationwide cross-sectional questionnaire study. Journal of Korean medical science. 2011 Mar 1; 26(3):332-8.

[30]Viinanen A, Munhbayarlah S, Zevgee T, Narantsetseg L, Naidansuren TS, Koskenvuo M, Helenius H, Terho EO. Prevalence of asthma, allergic rhinoconjunctivitis and allergic sensitization in Mongolia. Allergy. 2005 Nov; 60(11):1370-7.

[31]Singh AJ, Loh RS, Bradbury JA. Demographic study of paediatric allergic conjunctivitis within a multiethnic patient population. British journal of ophthalmology. 2003 Sep 1;87(9):1195-6.

[32]Kabir ML, Rahman F, Hassan MQ, Ahamed F, Mridha MA. Asthma, atopic eczema and allergic rhino-conjunctivitis in school children. Mymensingh medical journal: MMJ. 2005 Jan; 14(1):41-5.

[33]Mitchell EA, Beasley R, Björkstén B, Crane J, García-Marcos L, Keil U, ISAAC Phase Three Study Group. The association between BMI, vigorous physical activity and television viewing and the risk of symptoms of asthma, rhinoconjunctivitis and eczema in children and adolescents: ISAAC Phase Three. Clinical & Experimental Allergy. 2013 Jan; 43(1):73-84.