E-NAMTILA Publishing
DLS **1** (2020) 76-82

DYSONA - Life Science
DOI: 10.30493/DLS.2020.227799

Retrospective study of bacterial Infections among children under six years in Diyala governorate, Iraq

Safa F. Abood[1]*; Areej A. Hussein[2]; Shaima'a R. Al-Salihy[1]

1, Department of Microbiology, College of Medicine, University of Diyala, Diyala, Iraq

E-mail:
Fadhilsafa833@gmail.com

Received: 20/04/2020
Acceptance: 10/06/2020
Available Online: 10/06/2020
Published: 01/07/2020

Keywords: Bacterial infection, Children, Iraq

Abstract

Background: Bacterial infections are the major cause of pediatric admissions to hospitals, and probably the major cause of morbidity in the underdeveloped communities. **Objectives:** To determine the main bacterial infections among children under 6 years in Diyala governorate, Iraq. **Materials and Methods:** A retrospective study was conducted in Al-Batool Teaching Hospital for Maternity and Children during the period from 1st of January 2019 till 31st of December 2019. Hospital admission sheets were used to collect the information of patients with positive bacterial cultural infections. **Results:** Gastrointestinal tract infection was the most common type with 378 cases (37.80%) followed by bacteremia with 293 (29.30%), urinary tract infections with 255 (25.50%), and finally respiratory tract infections with 74 cases (7.40%). A high percentage of infection was recorded among males than females such as gastrointestinal tract infections (55.02%), bacteremia (55.98%), respiratory tract infections (60.81%), while in urinary tract infections a higher percentage was noticed among females (59.60%). The highest percentages of bacterial infections were recorded in the age group of (1-2 years) followed by (3-4 years), especially in bacteremia (85.67%), gastrointestinal tract infections (64.81%), urinary tract infections (51.77%); while on the other hand, respiratory tract infections were more common in the age group of 5-6 years (48.95%). Gram-negative bacteria were mostly associated with infection than gram-positive bacteria. The major gram-negative bacteria isolated from pediatric bacteremia cases were *Klebsiella* (31.74%) and *Escherichia coli* (15.36%) while the main gram-positive bacteria were *Staphylococcus haemolyticus* (15.36%). In respiratory tract infections, the most common isolated pathogens were the gam positive *Streptococcus pneumoniae* (37.84%), and *Staphylococcus* spp (35.14%) in addition to the gram-negative *Pseudomonas* spp and *Enterobacter* spp. As for gastrointestinal tract infection, the most common pathogens were *Escherichia coli* 82.80%, *Salmonella*, and *Klebsiella* 5.03%. In urinary tract infection, the most common isolated bacteria was *Escherichia coli* 41,51%. **Conclusion:** Bacterial infections are highly common in our community and the mode of transmission plays a critical role. Therefore, the prevention and control of these infections require a great social effort and a better performance of the health sector.

1. Introduction

Acute bacterial infections are among the main causes of children's admissions to the emergency department [1]. The exposure to bacterial pathogens and lack of vaccine-induced immunity can increase the risks of bacterial infections among infants of less than 60 days of life [2].

Acute gastroenteritis is among the major causes of mortality among youngsters worldwide with 1.34 million deaths annually in children younger than five years. The cause of infections might be viral, bacterial, and/or parasitic microorganisms and the severity of the infection varies in different geographical regions depending on comorbidities and the immune status of the host [3].

DYSONA Life Science ISSN: 2708-6291

The urinary tract infection (UTI) is defined as infection or colonization of the urinary tract (urethra, bladder, ureter and kidney) by microorganisms. The most commonly identified UTI causing pathogen is *E. coli* (52.2%), *Enterobacter* spp. (23.9%), *Proteus* spp. (14.9%), *Klebsialle* spp. (4.7%), *Pseudomonas* spp. (1.5 %) and *Staphylococcus* spp. (1.5 %) [4].

Mycoplasma pneumoniae is a significant respiratory bacterial pathogen, particularly among youngsters as it is responsible for the acute upper and lower respiratory infections [4]. The most prevalent reported bacteria associated with diarrhea are *Salmonella*, *E. coli*, and *Campylobacter* [5].

The increased risk for serious infections among youngsters of less than 4 years of age is usually associated with the uncompleted schedules of vaccines resulting in a weakened immunity against microorganisms; and thus, a peak of infection cases among this group [6]. However, the rapid development in the health sector in some countries has resulted in approximately 2 million fewer deaths among children under 5 years between 2000 and 2010 [7].

If not diagnosed and treated properly, a bacterial infection can lead to severe complications according to the type and site of infection. The commonest serious infections usually involve bacteremia, meningitis diarrhea, pyelonephritis, and respiratory infections [8]. In Iraq, the mortality rate of children under 5 years was reduced from 38.6% in 2008 to 30.4 % in 2017 [7]; however, this rate is still relatively high. The true magnitude of the problem is not known as the health system has been badly damaged in Iraq after years of war and sanctions accompanied by a significant deterioration in water purification, sewage system, and electricity, which in turn have a strong impact on the prevalence of infectious diseases [9]. Therefore, this study aims to monitor the current severity and prevalence of some bacterial infections among children under 6 years old in Diyala governorate, Iraq.

2. Materials and Methods

2.1. Data collection

A retrospective study was conducted in Al-Batool Teaching Hospital for Maternity and Children during the period from 1st of January 2019 till 31st of December 2019. The specific formula sheet was used to collect the information from 1000 children under 6 years of age with positive bacterial cultures isolated from different types of samples (i.e. blood, sputum, throat swab, stool, and urine samples) on proper media and identified using the general workflow at the hospital's bacteriological and biochemical laboratory.

2.2. Statistical analysis

The statistical analysis was carried out using the statistical package of social sciences (SPSS) version 16. Chi-square test was used to assess the relationship between the studied variables (sex and age group) and type of infection. P-values < 0.05 were considered statistically significant.

3. Results

The number and type of bacterial infections among the studied groups are summarized in (Table 1). Gastrointestinal tract infection (GIT) was the most common type of infections with 378 cases (37.80%) follows by 293 cases (29.30%) of bacteremia, 255 cases (25.50%) of urinary tract infections (UTI) and finally, 74 cases (7.40%) of respiratory tract infections (RTI).

Table 1. Distribution of bacterial infections in Al-Batool Teaching Hospital for Maternity and Children during 2019

Type of infections	Number and percentage of cases
Bacteremia	293 (29.30%)
Respiratory tract infections (RTI)	74 (7.40%)
Gastrointestinal tract infection (GIT)	378 (37.80%)
Urinary tract infection (UTI)	255 (25.50%)
Total	1000 (100%)

Gender distribution results revealed that the type of infection was gender-linked as higher percentages of Bacteremia, GIT, and RTI infections were recorded among males with 55.02%, 55.98%, and 60.81% of the cases respectively; while in contrast, UTI cases were more prevalent among females with 59.60% of the total cases (Table 2).

Table 2. Distribution of bacterial infections according to gender in Al-Batool Teaching Hospital for Maternity and Children during 2019

Sex	Type of infection				P-value
	Bacteremia	RTI	GIT	UTI	
Males	164 (55.98%)	45 (60.81%)	208 (55.02%)	103 (40.40%)	0.00236*
Females	129 (44.02%)	29 (39.19%)	170 (44.98%)	152 (59.60%)	
Total	293 (100%)	74 (100%)	378 (100%)	255 (100%)	

*The result is significant at p <0.05

Age disruption analysis results showed that there is a relationship between age and type of infection. The highest percentages of bacteremia, GIT, and UTI infections were recorded in the age group of (1-2 years) followed by (3-4 years); while RTI was more common (48.95%) in the age group of 5-6 years (Table 3).

Table 3. Distribution of bacterial infections according to the age of patients in Al-Batool Teaching Hospital for Maternity and Children during 2019

Age Group (years)	Type of infection				P-value
	Bacteremia	RTI	GIT	UTI	
1-2	251(85.67%)	10(13.51%)	245(64.81%)	132(51.77%)	< 0.00001*
3-4	31(10.58%)	28(37.84%)	72(19.05%)	66(25.88%)	
5-6	11(3.75%)	36(48.65%)	61(16.14%)	57(22.35%)	
Total	293(100%)	74(100%)	378(100%)	255(100%)	

*The result is significant at p <0 .05

The identified bacterial isolates from the studied cases (Table 4) illustrated that 203 infection cases of bacteremia, 5 of RTI, 377 of GIT and 202 of UTI were associated with gram-negative bacteria; while gram-positive bacteria resulted in 90 cases of bacteremia, 69 of RTI, 1 case of GIT, and 53 cases of UTI.

The major gram-negative bacteria isolated from pediatric bacteremia cases were represented by (31.74%) *Klebsiella*, (15.36%) *Escherichia coli,* and (13.99%) *Acinetobacter baumannii* isolates; while the most isolated gram-positive bacteria were (15.36%) *Staphylococcus haemolyticus* and (12.29%) other *Staphylococcus* spp.

As for RTI, the most common isolated pathogens were *Streptococcus pneumonia*, *Staphylococcus aureus* and other *Staphylococcus* spp (gram-positive) with other gram-negative isolates of *Pseudomonas* spp and *Enterobacter*. The most common pathogens in gastrointestinal tract infection were *Escherichia coli* (82.80%), *Salmonella* (5.03%), and *Klebsiella* (5.03%) while only one case was attributed to *Staphylococcus haemolyticus*; whereas in UTI, The most common isolated bacteria were *Escherichia coli* 41.51%, Proteus 18.82%, and *Klebsiella* 14.51% while *Streptococcus* spp was the cause of only one of the cases.

4. Discussion

The result of the present study demonstrated that gastrointestinal tract infection bacterial infections were the most common type of infections followed by bacteremia, urinary tract infection, and respiratory tract infection. These results might correspond with the fact that gastrointestinal tract infections are among the major cause of mortality among youngsters [3]. Additionally, this could be related to the low level of education among parents which leads to an increased risk of frequent diarrhea [10].

According to the results of gender distribution analysis, significantly higher percentages of infection were recorded among males for GIT, bacteremia, and RTI. Similar findings were reported in other studies in Iraq such as [11] in Baghdad and [12] in Erbil, as it was found that infection incidence in males was higher than females for all pathogens which were attributed to the physiological differences between genders. Additionally, [13] reported a higher number of isolates among male patients (58.3%) when compared to those in females (41.7%). Furthermore, [14][15] showed higher ARI infection cases among males than females. Previously, [14] reported that although 50% more ARI cases were found in males, no significant correlation between gender and the ARI infection severity was noticed [14]. In general, male patients were more than female due to the social condition where males are more exposed to the

surrounding environment than females from a young age. The contrary UTI results with more isolates in females than males are in agreement with other reports [16]. This is related to anatomical differences between the sexes and the short length of the urethra in females which makes the bladder more prone to urinary tract infections [17].

Table 4. The most common bacterial agents isolated from various infections in Al-Batool Teaching Hospital for Maternity and Children during 2019.

Types of bacteria	Bacteremia No. (%)	RTI No. (%)	GIT No. (%)	UTI No. (%)
Gram-positive				
Staphylococcus aureus	4(1.37%)	15(20.27%)	-	37(14.51%)
Staphylococcus haemolyticus	45(15.36%)	-	1(0.26%)	8(3.14%)
Other Staphylococcus spp	36(12.29%)	-	-	7(2.75%)
Streptococcus pneumoniae	-	28(37.84%)	-	-
Other Streptococcus spp	5(1.71%)	26(35.14%)	-	1(0.39%)
Total	90	69	1	53
Gram-negative				
Escherichia coil	45(15.36%)	-	313(82.80%)	105(41.18%)
Klebsiella	93(31.74%)	-	19(5.03%)	37(14.51%)
Pseudomonas spp	8(2.73%)	2(2.70%)	3(0.79%)	2(0.78%)
Proteus	7(2.38%)	-	3(0.79%)	48(18.82%)
Salmonella	1(0.34%)	-	19(5.03%)	-
Shigella	-	-	8(2.12%)	-
Acinetobacter baumannii	41(13.99%)	1(1.35%)	2(0.53%)	7(2.74%)
Enterobacter	8(2.73%)	2(2.70%)	10(2.65%)	3(1.18%)
Total	203	5	377	202
Collected total	**293(100%)**	**74(100%)**	**378(100%)**	**255(100%)**

The current study showed that GIT is more prevalent in 1-2 years of age group and decreases in older ages which is in correspondence with [18] who reported the highest rates of diarrhea among the ages from a few months to less than 2 years. The greater risk of diarrhea in the first 2 years of life was previously attributed to various factors such as the low levels of maternally acquired antibodies, the low active immunity in the infants, in addition to the non-hygienic contaminated food [19] and the decreased passive immunity after 6 months of age [20]; however, the responsible pathogens stimulate a partial immunity against similar later infection or illness, which explains the low occurrences in older children [19].

In the current study, bacteremia was more common in the age group of 1-2 years which is in agreement to another study that done by [21] in Karbala who reported that bacteremia cases were more common (63. 1%) in the age group of 0-1 month-neonates [21]. The high susceptibility of infants to bacteremia might be due to immaturity in humoral, phagocytic, and cellular immunity [22]. Additionally, previous reports showed that children of these ages become highly exposed to infections, especially respiratory and urinary tract infections which lead to cases of secondary infection such as bacteremia [23]. However, [24] reported that bacteremia was most frequently encountered in the age group of 5-10 years which was not represented fully in the current study.

As for urinary tract infection, most cases were noticed in the age group of 1-2 years. This result agrees with that obtained from [16] who reported the highest rate of bacterial growth among children with UTI to be found at the age group of 4 days to 2 years; while the lowest rate was within the age group of 6-8 years old. Additionally, [25] found that 48% of children who had UTI were under 1 year and noticed a decrease in infection occurrence above one year until the fourth year. Another study found that the highest percentage of UTI in children was in infants at the age of 2 months to 2 years [26]. The main reason behind these results and reports are the infants' immature immune system that develops later on [27].

High frequency of respiratory tract infections was recorded in the age group of 5-6 years which disagrees with the study of [14] who found the majority of RTI cases in the 3-13 months age group [28] as a result to the weak immunity, narrow airways, the under-developed lungs and the relatively short bronchial tree in this age group [29]. However, the differences between the current study and [14] reports might be due to the limited number of cases from the age group of under 1 year old.

The distribution of bacterial species, according to the type of infection (Table 4) suggested that the highest rate of enteric bacteria among examined diarrheal samples was *E. coli* with 82.80% of the cases. This finding was in tune with [18] in Duhok and [11] in Kerbala. Unsurprisingly, the reasons behind this result are poor sewer systems and the contamination of drinking water with wastewater. On the other hand, bacteremia was mainly caused by *Klebsiella* with 31.74% of the cases followed by *Escherichia coli* and *Staphylococcus haemolyticus* which showed the same percentages 15.36%. A comparative study conducted in India showed that *Klebsiella* species was the predominant organism isolated in bacteremia [30] which is similar to the current study. In contrast, [21] showed that the highest infectious causative agent isolated from samples of bacteremia patients was *Staphylococcus aureus* with 19.4%. Interestingly, there were no bacteremia cases associated with *Streptococcus pneumoniae*. In UTI, the pattern of the bacterial isolates found in this study was similar to those reported in [16][31][32]. These studies have pointed to the sovereignty of *E. coli* as a cause of UTI, followed by *Proteus*, and *Klebsiella* spp., and attributed the cause of the high prevalence of these bacteria to their natural presence in the human gut causing endogenous infections. *Streptococcus pneumoniae* represented the highest infection rate among RTI with 37.84% of the cases followed mainly by *Pseudomonas* spp and *Staphylococcus aureus*. This result is consistent with [33] in Baghdad as they found that *Streptococcus pneumoniae* was the main pathogen responsible for RTI cases followed by *Staphylococcus aureus*. Additionally, they reported that *Klebsiella* species and *Pseudomonas aeruginosa* were the commonest isolates among Gram-negative pathogens [33]. The current results are approximately in agreement with [34][35] and contradiction with [36][37].

5. Conclusion

In conclusion, bacterial infections are still common in our community, the mode of bacterial infection transmission is usually through direct contact (person to person); ingestion of contaminated and non-hygienic food and water, or poorly cooked food. Therefore, this situation requires a great social effort and for the health sector to perform better in terms of prevention and control. Additionally, it is epidemiologically important to pinpoint how often a bacterium generates a health problem in each population individually, which requires further and elongated studies.

Conflict of interest statement

The authors declared no conflict of interest.

Funding statement

The authors declared that no funding was received in relation to this manuscript.

Data availability statement

The authors declared that all related data are included in the article.

References

1. Alter SJ, Vidwan NK, Sobande PO, Omoloja A, Bennett JS. Common childhood bacterial infections. Current problems in pediatric and adolescent health care. 2011;41(10):256-83. DOI
2. Woll C, Neuman MI, Pruitt CM, Wang ME, Shapiro ED, Shah SS, McCulloh RJ, Nigrovic LE, Desai S, DePorre AG, Leazer RC. Epidemiology and etiology of invasive bacterial infection in infants≤ 60 days old treated in emergency departments. J. Pedi. 2018;200:210-7. DOI

3. Mathew S, Smatti MK, Al Ansari K, Nasrallah GK, Al Thani AA, Yassine HM. Mixed viral-bacterial infections and their effects on gut microbiota and clinical Illnesses in children. Sci Rep 2019;9(1):1-2. DOI

4. Al-Saadi BQ, Kadhum SJ, Muhaiesen SH. Isolation of uropathogens from pediatric associated UTI, with special focus on the detection of. Proteus vulgaris. Iraqi J Biotech. 2015;14:77-84.

5. Al-Jumaily E, Zgaer SH. Multidrug resistant Proteus mirabilis isolated from urinary tract infection from different hospitals in Baghdad City. Int. J. Curr. Microbiol. App. Sci. 2016;5(9):390-9. DOI

6. Harb A, Abraham S, Rusdi B, Laird T, O'Dea M, Habib I. Molecular detection and epidemiological features of selected bacterial, viral, and parasitic enteropathogens in stool specimens from children with acute diarrhea in Thi-Qar Governorate, Iraq. Int. J. Environ. Res. Public Health. 2019;16(9):1573. DOI

7. Van den Bruel A, Bartholomeeusen S, Aertgeerts B, Truyers C, Buntinx F. Serious infections in children: an incidence study in family practice. BMC Fam. Pract. 2006;7(1):23. DOI

8. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;379(9832):2151-61. DOI

9. unicef.org [Internet]. Child mortality estimates (UN IGME) in 2018 [cited 2020 Jun 5]. Available from: Link

10. Alaa H, Shah SA, Khan AR. Prevalence of diarrhoea and its associated factors in children under five years of age in Baghdad, Iraq. Open J Preven Med. 2014;4(1):17-21. DOI

11. Al-Abbas AK. Etiology of bacterial diarrhea in children under five years in Kerbala Province, Iraq. Iraqi J. Public Health. 2018;2(1):2-6.

12. Al-Sorchee SM, Rabat AA, Juma IM. Microbial causatives of diarrhea in children in Erbil city. Al-Nahrain Journal of Science. 2013;16(3):19-29. DOI

13. Ali AA, Abdul-Mahdi RJ, Al-Khafaji JKT. Etiology and risk factors of bacteremia in pediatric intensive care unit. JUB. 2007;14(4), 286-93.

14. Yousif TK, Khaleq BA. Epidemiology of acute respiratory tract infections (ARI) among children under five years old attending tikirit general teaching hospital. Middle East J Fam Med. 2006;4(3):4-23.

15. Al-Jassar NF. Clinico-epidemiological study of acute respiratory infections (ARI) in children under 5 years of age. Iraqi J. Med. Sci. 1994;10:200-7.

16. wasmy Shahab N, Ali CI, Salih SM. Isolation and Identification of bacteria causing urinary tract infections in children in Kirkuk city. Tikrit j. pure sci. 2017;22(2):8-12.

17. Inabo HI, Obanibi HB. Antimicrobial susceptibility of some urinary tract clinical isolates to commonly used antibiotics. African Journal of Biotechnology. 2006;5(5):487-9.

18. Badry AH, Jameel AY, Mero WM. Pathogenic Microorganisms Associated With Diarrhea in Infants And Children in Duhok Province, Kurdistan Region/Iraq. Sci J Univ Zakho. 2014;2(2):266-75.

19. Okolo MO, Garba DE, Stephen E. Isolation and prevalence of bacteria associated with diarrhoea in children visiting hospitals in Anyigba. Am J Res Commun. 2013;1(8):121-9.

20. AL-SEKAIT MA. A study of factors affecting incidence of diarrhoeal disease in children under 5 years in Saudi Arabia. Saudi Med J. 1988;9(5):491-7.

21. Al-mousawi MR. Bacterial profile and antibiogram of bacteremic Children in Karbala city, Iraq. karbala J. Pharm. Sci. 2016(11):131-9.

22. Janjindamai W, Phetpisal S. Time to positivity of blood culture in newborn infants. Southeast Southeast Asian J Trop Med Public Health. 2006;37(1):171.

23. Behrman RE, Kliegman RM, Jenson H. Nelson S. Textbook of Pediatrics, W.B Saunders Co., Philadelphia, 16th Edition, 2000:328.

24. Tsering DC, Chanchal L, Pal R, Kar S. Bacteriological profile of septicemia and the risk factors in neonates and infants in Sikkim. J Glob Infect Dis. 2011; 3(1): 42-45.

25. Kaur R, Walia G, Mehta M. Prevalence of Urinary tract infections in children and their sensitivity to various antibiotics. J Acad Indus Res. 2012;1(4):161-3.

26. Herr SM, Wald ER, Pitetti RD, Choi SS. Enhanced urinalysis improves identification of febrile infants ages 60 days and younger at low risk for serious bacterial illness. Pediatrics. 2001;108(4):866-71. DOI

27. Keren R, Carpenter MA, Hoberman A, Shaikh N, Matoo TK, Chesney RW, Matthews R, Gerson AC, Greenfield SP, Fivush B, McLurie GA. Rationale and design issues of the Randomized Intervention for Children With Vesicoureteral Reflux (RIVUR) study. Pediatrics. 2008;122(Supplement 5):S240-50. DOI

28. Al-Azzawi HK, Saadallah S, Mukhlis FA. Bacterial etiology of acute lower respiratory tract infections in young Iraqi children. Iraqi J. Med. Sci. 2003;3:314-9.

29. Mickenzie S, Silverman M. respiratory disorders. In. Forfor K, Arenil R. Forfor and Arenil's textbook of pediatrics. 5th Ed. Edinburgh, Churchill living Stone. 1998:489-583.

30. Tiwari DK, Golia S, Sangeetha KT, Vasudha CL. A study on the bacteriological profile and antibiogram of bacteremia in children below 10 years in a tertiary care hospital in Bangalore, India. Journal of clinical and diagnostic research: JCDR. 2013;7(12):2732. DOI

31. Shabib Akhtar M, Mohsin N, Zahak A, Ruhal Ain M, Pillai PK, Kapur P, Zaki Ahmad M. Antimicrobial sensitivity pattern of bacterial pathogens in urinary tract infections in South Delhi, India. Rev Recent Clin Trials. 2014;9(4):271-5.

32. Majumder MI, Ahmed T, Hossain D, Begum SA. Bacteriology and antibiotic sensitivity patterns of urinary tract infections in a tertiary hospital in Bangladesh. Mymensingh Med J. 2014;23(1):99-104.

33. Mohammed AM. The Pattern of Bacterial Pathogens & their Antibiotics Sensitivity among Patients with Respiratory Tract Infections. Iraqi J. Med. Sci. 2013;11(2):181-6.

34. Okesola AO, Ige OM. Trends in bacterial pathogens of lower respiratory tract infections. Indian J Chest Dis Allied Sci. 2008;50(3):269-72

35. Khan S, Priti S, Ankit S. Bacteria etiological agents causing lower respiratory tract infections and their resistance patterns. Iran Biomed J. 2015;19(4):240-6. DOI

36. Ozyılmaz E, Akan OA, Gulhan M, Ahmed K, Nagatake T. Major bacteria of community-acquired respiratory tract infections in Turkey. Jpn. J. Infect. Dis. 2005;58(1):50-2.

37. Liebowitz LD, Slabbert M, Huisamen A. National surveillance programme on susceptibility patterns of respiratory pathogens in South Africa: moxifloxacin compared with eight other antimicrobial agents. J Clin Pathol. 2003;56(5):344-7. DOI