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Epidemiological Study of the Microbial Causes of Diarrhea in Children in Najaf Governorate, Iraq

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Abstract

The current study included a survey of the microbial causes of diarrhoea among children attending Al-Zahra Teaching Hospital for Maternity and Children in Najaf Governorate and Al-Furat Al-Awsat Hospital in Kufa District. 150 samples were collected, ranging in age from one day to seven years, over a three-month period, from 1/10/2024 to 30/12/2024. The direct swab and stool concentration method was used to examine the stool. The results showed significant differences in favour of the age group (4–6 years) between males and females, in favour of females for bacterial infections ($P < 0.05$). The study also showed significant differences in favour of males for fungal, parasitic, and viral infections ($P < 0.05$) at a rate of 65%, while there were significant differences in favour of Salmonella bacteria ($P < 0.05$) at a rate of 63%, 53%, and 60%, respectively. The results also showed significant differences in the age group (4–6 years) for E. histolytica ($P < 0.05$) at a rate of 77.8%, and significant differences in the age group (day–2 years). In Favor of fungal infections, there was a rate of 96.7% within the age group (4–6 years) ($P < 0.05$) at a rate of 93.6%, and significant differences. The study also showed that the highest infection rate was during the month of December. First, most of the injuries occurred in the age group (4–6 years).

Keywords: Fungi, bacteria, diarrhoea, infection, fertilizer

INTRODUCTION

Diarrhoea is a serious public health problem. It is associated with fluid loss, with more than three loose, loose bowel movements per day considered diarrhoea. Replacing lost fluids is an effective treatment, and the increasing use of dehydration medications has significantly reduced child mortality. This has led to an increasing recognition of the relative importance of diarrhoea lasting more than two weeks as a cause of death from this disease. (Caccio et al., 2003) Diarrhoea is more serious in rural areas where poor sanitary conditions, poor or unavailable drinking water hygiene, and low educational level of mothers are all factors that increase the incidence of diarrhoea. Also, the use of human waste and untreated sewage water as fertilizer for many crops is a cause of parasite transmission [1]. Intestinal (Caccio et al., 2003) and also Jonnalagadda (1995) and Bhat mentioned that 70% of diarrhoea cases in developing countries are caused by food contamination with intestinal parasites because of lack of health awareness and poor hygiene. Diarrhoea is caused by many types of pathogens. These pathogens cross the barrier represented by gastric acidity and multiply in the intestine, followed by uncontrolled secretion of water and mucus by the mucous membrane. At the same time, the ability of intestinal cells to absorb water decreases. This remaining water in the intestine increases the fluidity of the focal content and is excreted with it. The first studies on rotaviruses causing diarrhoea in infants were conducted by Bishop and his group (Bishop. r.: g. i. b. 1973) in Australia and were identified in England by Flewett and his group (Flewett. T.: a. h. 1973). It was also identified by electron microscopy in duodenal tissue taken from children with diarrhea. Rotaviruses were initially

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given several names, including reo like viruses, duoviruses, and rotaviruses, but the most common name, given to them in 1974, is the most common and widely used. It is taken from The Latin word "Rota" means "wheel" because of its resemblance to the wheel (Parashar. U.d.: j. s. Bresee: j. r. gentsch and i. glass, 1998) [2].

There is no cure for diarrhoea. Diarrhea, especially viral diarrhoea, stops spontaneously after the lifespan of the bacteria causing it has passed, which lasts from 1 to 14 days. Furthermore, diarrhoea is a natural process by which the body and intestines rid themselves of the infected lining and the bacteria it contains. (2008 American University of Beirut)

In breastfed infants, breast milk contains many beneficial substances that help restore the intestinal lining and other substances that fight bacteria. Therefore, it is the best thing to offer an infant with diarrhoea. (American University of Beirut, 2008). For infants who are formula-fed, some doctors recommend switching from formula to an oral rehydration solution for 12–24 hours, then returning to formula. Therefore, a doctor should be consulted regarding this matter. For older infants, it is preferable to feed them the following foods during the first 24 hours: bananas, applesauce, rice or rice water, and toast. Then, other foods are added (American University of Beirut, 2008).

Objectives of the Current Study Are

To identify the microbial causes of diarrhoea in children and which are most prevalent among them. To determine the relationship between diarrhoea and the child's age and gender.

METHOD

There are two methods for general stool examination:

- *The Direct (or Macroscopic) Exam:* This method is used to examine stool and note: Yellow, greenish, or yellowish-green if brown: (Liquid, soft, or semi-solid (if solid:(Appearance: alkaline or basic (if acidic): pH 3.
- *The Indirect Exam:* This method is used to examine stool and note RBC – Red blood cells Pus – Pus Bacteria – Bacteria Monillia4 – Fungi Yeast – Yeast.

Indigested food – Undigested food Fat drop – Fat droplets Fiber 8 – Fiber: including parasites – Parasites *Gardia lamblia* _ *Entamebia histolytica* _Entropies vermicularis and Ascaris pinworms such as the Warm worm. 10 – Worms ova Eggs.

Procedure Steps:

- –Prepare a clean slide to examine the stool.
- Apply a drop of normal slide on it.
- Place the patient's sample on the slide.
- Then place the slide cover over the slide.
- Examine the slide under a microscope to see what the stool contains [3].

RESULTS AND DISCUSSION

Diarrhoea is a major cause of death among children in developing countries, especially those under five years of age (Gyr and Merier, 1987). Given the importance of intestinal pathogens of all kinds, including bacteria, parasites, fungi, and viruses, in causing diarrhoea, the current study focused on the most important of these pathogens, which are considered the main causes of diarrhoea. This study showed that the age group most affected by the infection is the group (4–6 years), with significant differences evident among males, as the infection rate within this age group was 64%, while the infection rate among females within the same age group was 39% (Table 1).

Table 1. Sample distribution by gender and age groups.

Age group	Male (n)	Male (%)	Female (n)	Female (%)	Total (n)	Total (%)
Day–2 years	11	44	14	56	25	16.7
2 years–4 years	28	56	22	44	50	33.3

4 years–6 years	39	61	25	39	64	42.7
6 years–8 years	5	45	6	55	11	7.3
Total	83	55	67	45	150	100

Note: Arithmetic χ^2 4.8, Tabular χ^2 $P < 0.05$, 2.3 Significant differences in favor of the 4–6-year category Males.

These results generally vary and sometimes approach the results of Mawloud and others (1997) in Diyala Governorate, Al-Sharifi (2000) in Al-Tamimi Governorate, and Al-Dawudi (1998) in Nineveh Governorate. Statistical analysis showed significant differences in infection between males and females in favor of males within the age group (4–6 years). This may be attributed to the fact that males within this age group are more exposed to factors causing diarrhea than females. The reason for this increase among males may be due to the fact that males are more present among their peers outside the home, as well as inside and outside schools, in addition to many games that are more prevalent among male boys than females, which increases their chances of catching the infection, whether through practicing some different popular games or through eating uncovered foods sold by street vendors, which exposes them to infection at rates higher than females. This differs from what was found by Al-Daoudi (1998) and Al-Sharifi (1998). 2000) where they found no significant differences between males and females regarding infection with intestinal parasites. As for comparing infection with the rest of the Middle Eastern Arab countries, it was like what was recorded by (Khan et al, (1989) in Saudi Arabia [4, 5]).

Tables 2 & 3 indicate that out of 20 bacterial diarrhoea cases, only 7 (35%) were males and 13 (65%) were females with significant differences in favour of females, while out of 63 fungal diarrhea cases, 40 (63%) were males and 23 (37%) were females with significant differences ($p < 0.05$) in favor of males. The table also indicates that out of 62 parasitic diarrhoea cases, 33 (53%) were males while 29 (47%) were females with significant differences ($p < 0.05$) in favour of males. The results indicated that out of 150 diarrhoea cases, only 5 were viral with significant differences ($p < 0.05$) in favour of males (60%) and females (40%). The table also shows that cases of diarrhoea due to fungal causes recorded the highest infection rate of 42.1%, followed by parasitic causes at 41.3%, while cases of bacterial and viral diarrhoea recorded rates of 13.3% and 3.3%, respectively [6].

Table 2. Comparison between infected males and females according to the pathogen.

Sex	**Bacteria (n)**	**Bacteria (%)**	**Fungi (n)**	**Fungi (%)**	**Parasites (n)**	**Parasites (%)**	**Viruses (n)**	**Viruses (%)**	**Total (n)**	**Total (%)**
Male	7	35	40	63	33	53	3	60	83	55
Female	13	65	23	37	29	47	2	40	67	45
Total	20	13.3	63	42.1	62	41.3	5	3.3	150	100

Parameter	*Bacteria*	*Fungi*	*Parasites*	*Viruses*	*Total*
Calculated t-value	6.3	5.8	2.6	2.9	3.1
Critical t-value ($P < 0.05$)	2.02	2.02	2.02	2.02	2.02
Interpretation	Female differences	Male differences	Male differences	Male differences	Male differences

From the results, we can note that the highest infection rate in general was caused by fungi (Monilia). This may be due to the frequent use of antibiotics, which eliminate the beneficial bacteria present in the mouth and intestines, which balance these fungi and prevent their reproduction under normal conditions, especially within the age groups covered by the study. Followed by infections with intestinal parasites, especially Entamoeba histolytica and Giardia lamblia, as these parasites are widespread in crowded popular areas. Infection with intestinal parasites may occur because of eating contaminated food, due to the lack of health awareness among children, and due to the lack of adherence to hygiene requirements by many street vendors and fast-food outlets. In cases of viral diarrhea, we find that the cases are few compared to other intestinal causes. This is because the infection often coincides with the winter season. It is also possible that a bacterial or fungal infection will accompany the viral infection, as diarrhea caused by viruses does not last more than three days and does not respond to antibiotics that are randomly given to the child, which causes the activation of intestinal fungal infection in addition to the general weakening of immunity caused by the virus [7–9].

Table 3 indicates the relationship between bacterial causes of diarrhoea and age groups. The comparison was made based on three types of bitter bacteria that were detected when analysing stool, namely *E. coli*, Salmonella, and Enterobacteria. The results showed significant differences ($P < 0.005$) in favour of infection with Salmonella bacteria in the age group (1 day–2 years) with a percentage of 77.8%, 7 infections out of a total of 12 cases, followed by the age group (4–6 years) with a percentage of 57.1%, 4 infections out of 12 cases, and finally one infection in the age group (6–8 years). The results indicated that among 2 cases of diarrhea due to *E. coli*, the highest infection rate was in the age group (2–4 years) with a percentage of 33.3%, with significant differences from the rest of the age groups. The results also indicated that among 6 cases of diarrhoea due to Enterobacteria, 66.7% in the age group (2–4 years) and 28.6% and 22.2% in the age groups (4–6 years) and (1–2 years), respectively, with significant differences in favour of the age group (2–4 years). This percentage is higher than the results of the study (Bakheshwain et al., 1999) which reached 45.4% and the results of Deubbert and Peterson (1985) by 40%. The difference in the incidence of salmonella may be due to several reasons, including differences in geographical areas and environmental conditions, as well as differences in the level of health awareness. The study by Creve and his group in 2001 confirmed the impact of these factors on the spread of many types of salmonella, the disappearance of other types, and the remarkable development of certain types [10, 11]. And in successive waves. Many reports have confirmed that the spread of salmonella infection in any region of the world is a result of several factors, including water pollution (Doyle et al., 1997) and food pollution. Many types of salmonella have been isolated in England, the most prominent of which is *Salmonella emek* from poultry meat (Allen et al., 1999). The feed used as food for animals plays a role. Fish, meat, and bone play an important role in maintaining salmonella infections among animals, which may in turn be transmitted to humans. Non-typhoidal salmonella has been isolated from many animals, and people who come into close contact with these animals are at risk of salmonella infection, including children (Rahman et al., 1992). S. typhimurium is one of the most frequent causes of salmonella epidemics in various parts of the world. An epidemiological study in Türkiye over 12 years showed a trend in the frequency of this type of bacteria and its increased resistance to various antibiotics (Gyr and Merier, 1987).

Table 3. Comparison between bacterial pathogens based on age groups.

Age group	***E. coli* (n)**	***E. coli* (%)**	***Salmonella* (n)**	***Salmonella* (%)**	***Enterobacteria* (n)**	***Enterobacteria* (%)**
1 day–2 years	0	0.0	7	77.8	2	22.2
2 years–4 years	1	33.3	0	0.0	2	66.7
4 years–6 years	1	14.3	4	57.1	2	28.6
6 years–8 years	0	0.0	1	100.0	0	0.0
Total	2	10.0	12	60.0	6	30.0
Statistical parameter	*Value*					
Calculated χ^2	5.2					
Tabulated χ^2 ($P < 0.05$)	2.3					
Interpretation	Significant differences in favor of the *Salmonella* category in the 1 day–2-years age group.					

Regarding the relationship between the rate of infection with salmonella and age, it became clear that the highest infection rate was within the age group (one day – 2 years), and this may be attributed to many reasons related mainly to the weakness of the immune system in children within this age group, in addition to the breastfeeding method adopted during childhood, as milk and its derivatives sold in local markets are not free of salmonella bacteria, and those materials Foodborne pathogens may be a potential vector for transmission in our environment [12].

Entamoeba histolytica is widespread worldwide, particularly in tropical and subtropical regions where clean drinking water sources and efficient sewage disposal systems are often unavailable. This leads to environmental contamination with faces, creating favourable conditions for the persistence of pathogenic parasites that can be fatal to many individuals, especially young children [13–15].

Table 4 compares two types of intestinal parasites: Entamoeba histolytica and Giardia lamblia. The results showed significant differences ($P < 0.005$) in favor of infection with histolytic amoeba for the age group (4–6 years) at a rate of 92.6%, while the infection rates for the age groups (2–4 years), (1 day–2

years) were 75%, 66.7%, respectively. This percentage contradicts many studies (Al-Hanoon and Hayatee, 1980, Al-Mallah, 1999, and Al-Naimi, 2001). The widespread spread of this parasite is due to several reasons, including its direct life cycle, as its cysts are transmitted through contaminated food and water, lack of sufficient attention to cleanliness, and a low standard of living and social well-being. The population of the region and the widespread habit of raising animals in homes, which in turn provides an opportunity for the growth and presence of house flies, which are considered mechanical vectors of parasite cysts (Niazi et al., 1976). The high percentage of tissue amoebas may be due to special non-pathogenic isolates that cannot penetrate the tissue. As for the Giardia parasite, the highest infection rate was in the age group (day – The age group (2 years) with a percentage of 33.3%, followed by the age group (2–4 years) and (4–6 years) with a percentage of 25% and 7.4%, respectively. We conclude that the rate of infection with Giardia lamblia was lower, reaching 33.3%. This result is consistent with the results of several studies (Arif, 1996; Chai et al., 1982, Risan, 1998), but it does not agree with the results of other studies (Mangali et al., 1993). The spread of this parasite is attributed to the lack of health awareness. Cultural and lack of interest in the cleanliness of fresh fruits and vegetables, in addition to the pollution in the food containers used by the family and the habit of random defecation in places other than those designated (Lopes, 1982) (Table 4).

Table 4. Comparison between parasitic causes based on age groups.

Age group	***E. histolytica* (n)**	***E. histolytica* (%)**	***Giardia* (n)**	***Giardia* (%)**	**Total (n)**	**Total (%)**
1 day–2 years	4	66.7	2	33.3	6	9.5
2 years–4 years	18	75.0	6	25.0	24	38.1
4 years–6 years	25	92.6	2	7.4	27	42.9
6 years–8 years	6	100.0	0	0.0	6	9.5
Total	53	84.1	10	15.9	63	100.0
Statistical Parameter	*Value*					
Calculated χ^2	5.2					
Tabulated χ^2 ($P < 0.05$)	2.3					
Interpretation	Significant differences in favor of the *E. histolytica* category in the 4–6 years age group.					

Comparison of Infections Caused by Fungi and Viruses Based on Age Groups

Tables 3 & 5 indicate the relationship between viral and fungal intestinal infections and age. The study showed significant differences in Favor of fungal infection in the age group (4–6 years) with a percentage of 96.7%, followed by the age group (1 day–2 years), (2–4 years) with a percentage of 90%, 87.5%, respectively. As for viruses, the infection rate was highest within the age group (2–4 years) with a percentage of 12.5%, followed by the age group (1 day–2 years) with a percentage of 10%, and finally the age group (4–6 years) with a percentage of 3.3%. We conclude from the above that the incidence of fungal infections is higher than that of viruses, as the incidence of fungal infections was 92.6% compared to the incidence of viral infections, which was 7.4%. These results indicate significant differences between intestinal fungal infections and viral infections [16, 17]. This result indicates that diarrhea may be chronic, following a viral infection, or as a result of excessive antibiotic use, which leads to an imbalance in the natural flora of the intestine, resulting in a predominance of intestinal fungi (Table 5).

Table 5. Comparison between fungi and viruses based on age groups.

Age group	**Fungi (n)**	**Fungi (%)**	**Viruses (n)**	**Viruses (%)**	**Total (n)**	**Total (%)**
1 day–2 years	9	90.0	1	10.0	10	14.7
2 years–4 years	21	87.5	3	12.5	24	35.3
4 years–6 years	29	96.7	1	3.3	30	44.1
6 years–8 years	4	100.0	0	0.0	4	5.9
Total	63	92.6	5	7.4	68	100.0
Statistical Parameter	*Value*					
Calculated χ^2	7.3					
Tabulated χ^2 ($P < 0.05$)	2.3					
Interpretation	Significant differences in favor of the fungi category in the 4–6 years age group.					

CONCLUSIONS

Most cases of diarrhoea are caused by fungal, parasitic, and bacterial causes, The age group (4–6 years) is the most affected, Viral infections are rare and limited to certain seasons of the year. The population of the region and the widespread habit of raising animals in homes, which in turn provides an opportunity for the growth and presence of house flies, which are considered mechanical vectors of parasite cysts.

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