Biological and Applied Environmental Research

Vol. 3 (1): 72-81, 2019

ISSN: 2002-6153
Biol. Appl. Environ. Res.
www.baerj.com
editor@baerj.com

Intestinal Parasites among Diarrheic Children Attending a Hospital in Al-Rusafa Side, Baghdad City, Iraq

Adel O. Salman[1], Furhan T. Mhaisen[2*] & Abdul-Rahman A. Al-Tae[3]

[1]Technical Directorate, Ministry of Health and Environment, Baghdad, Iraq
[2]Tegnervägen 6B, 641 36 Katrineholm, Sweden
[3]College of Medicine, Iraqi University, Baghdad, Iraq

*Corresponding author: mhaisenft@yahoo.co.uk

Abstract: An epidemiological survey was carried out to investigate the species and percentage incidence of infection with intestinal organisms causing diarrhoea among children attending Ibn Al-Baladi hospital for Pediatrics and Gynecology, Al-Rusafa side, Baghdad during the period from October 2000 till July 2001. A total of 1132 faecal samples from children aged from seven days to 12 years old were examined. The following parasites and their percentage incidence of infections were recorded: *Entamoeba histolytica* (33.9%), *Giardia lamblia* (11%), *Blastocystis* sp. (10.2%), *Entamoeba coli* (7.5%), *Pentatrichomonas hominis* (2.6%), *Chilomastix mesnili* (2.3%), *Iodamoeba bütschlii* (0.9%), *Hymenolepis nana* (1.3%) and *Enterobius vermicularis* (0.6%). No significant differences were noted in the overall percentage incidence of infection of males and females. Significant differences were noted in the overall percentage incidence of infection with intestinal agents in relation to age of patients. Most infections were in age groups seven and eight years (90%), while the lowest were in age group of less than one year old (32.5%). The highest overall percentage of infection occurred during summer and autumn. Significant differences between infection with the intestinal agents and family size were noticed. Also, significant differences were noticed in the relationship between overall infection and the scientific level of the parents. Most infections with the intestinal organisms were single infections (32.3%). The double infections were 11% and the triple or more infections were 4.7%. The present study revealed that the highest overall infections were detected in bottle- feeder infants (48.5%), while the lowest infections were among breast- feeding infants (13.5%). The results indicated clear imprint of the economic sanctions imposed against Iraq in 1990.

Keywords: Intestinal parasites, Children, Diarrhoea, Al-Rusafa side, Baghdad, Iraq.

Introduction

Diarrhoea is considered as one of the most widely distributed disease worldwide especially in developed and underdeveloped countries (Jousilahti et al., 1997). Diarrhoea remains the second leading cause of death among children under five globally. Nearly one in five child deaths (about 1.5 million each year) is due to diarrhoea. It kills more young children than AIDS, malaria and measles combined (UNICEF/WHO, 2009).

Fecal-oral transmission pathways are shown to take place via water, hands, arthropods and soil. To make it easier to remember, words starting with the letter "F" are used for each of these pathways, namely fluids, fingers, flies, food, fields and fomites (Penakalapati et al., 2017). Tropical and subtropical areas are most suitable areas for proliferation of intestinal parasites and the development of their different life stages (Roberts & Janovy, 2009).

In Iraq, diarrhoea is one of the main factors that directly cause the deaths of new births, especially after the severe economic sanctions against Iraq that was imposed by UN resolution number 661 of 6 August 1990 as a result of the Iraqi invasion of Kuwait. The data

Received Dec. 11, 2018, accepted Jan. 29, 2019

obtained from the Department of Health and Life Statistics at the Ministry of Health in Baghdad (personal contact by the first author) showed that number of cases of diarrhoea in Baghdad hospitals among children under five years of age, for the years from 1996 to 2000 reached 1,036,688 of which death was resulted in 20,616 children.

Because of the importance of the issue of diarrhoea in Iraq and the multiplicity of its causes, especially under the state of the economical sanction against Iraq, the present study was conducted to investigate cases of diarrhoea due to some organisms and how such cases are affected by factors like sex, age and months of the year, type of breastfeeding, educational level of child's parents and number of family members. Ibn Al-Baladi Hospital for Paediatrics and Gynecology in Al-Rusafa side, Baghdad city was selected to perform this study.

Materials and Methods

During the period from October 2000 till the end of July 2001, a total of 1132 stool specimens were collected from children attending Ibn Al-Baladi Hospital for Paediatrics and Gynecology in Baghdad, The age of these children ranged from seven days to 12 years. All the children who were examined during the study complained intestinal infections such as diarrhoea, severe or chronic dysentery with high temperature and abdominal pain.

Samples were collected from outside patients and inpatients in dry, clean, large-hole plastic containers equipped with sterile covers that allow the sample to retain its moisture and thus prevent its dryness and contamination with bacteria. Containers were labeled with name, sex, age, family size and other information (Davey & Crewe, 1973; Ichhpujani & Bhatia, 1994). Specimens were microscopically examined on the same day of collection at the laboratory of Parasitology of the hospital by using direct smear method in normal saline and Lugols iodine and sedimentation method to examine fecal samples (Davey & Crewe, 1973; Garcia & Ash, 1975). The results were statistically analyzed by using χ^2 test to find any statistical differences in various parasitic infections (Sanders et al., 1985).

Results and Discussion

A total of 1132 faecal samples from children attending this hospital were examined. The overall percentage of infection with all intestinal parasites was 48% (48.8% in males and 46.8% in females). No significant differences in the percentage incidence of infection between males and females were noticed. The absence of significant differences in this case is due to the fact that both sexes have the same chance of exposure to the infective stages through food and water contamination. Some researchers in Iraq had arrived to the same result (Al-Dulaimi, 1996; Al-Izzi, 1998; Al-Mamouri, 2000; Al-Mussawi, 2001; Hussein, 2009; Al-Qadhi et al., 2011; Jaeffer, 2011; Al-Warid, 2012; Al-Aboody et al., 2015; Al-Saqur et al., 2016). Generally, the overall percentage incidence of infection rates were high during both summer and autumn and low during winter. This result is close to that of some other researchers (Al-Dulaimi, 1996; Al-Mamori, 1997; Roberts & Janovy, 2009; Al-Saqur et al., 2016). This can be explained as the intestinal parasites are more widespread in the tropics compared to cold areas (Ichhpujani & Bhatia, 1994) and the tropical and subtropical areas are the most suitable areas for the intestinal organisms as well as for the development of their different stages (Roberts & Janovy, 2009). However, Hussein (2009) demonstrated high total infections among children attending two hospitals in Al-Karkh side of Baghdad city during autumn and early winter.

In connection with the monthly variations in the overall infection, the highest infection (65%) was recorded during October. Then, the infection showed a decline till March (except with a slight increase in February). Starting from April, the infection showed a gradual increase till the termination of the present investigation during July, when it achieved 56.8% (Table 1).

Table (1): Monthly changes in the infection of male and female patients with different intestinal parasites.

Months	Males			Females			Both sexes			Significant Comparisons
	No. examined	No. infected	Infection (%)	No. examined	No. infected	Infection (%)	No. examined	No. infected	Infection (%)	
Oct. 2000	90	59	65.6	47	30	63.8	137	89	65.0	0.040
Nov.	88	47	53.4	57	28	49.1	145	75	51.7	0.255
Dec.	74	26	35.1	61	24	39.3	135	50	37.0	0.254
Jan. 2001	58	22	37.9	60	20	33.3	118	42	35.6	0.272
Feb.	51	26	51.0	28	13	46.4	79	39	49.4	0.150
Mar.	57	24	42.1	32	6	18.8	89	30	33.7	5.003*
Apr.	54	21	38.9	35	19	54.3	89	40	44.9	2.035
May	56	28	50.0	58	27	46.6	114	55	48.2	0.136
June	50	25	50.0	51	27	52.9	101	52	51.5	0.087
July	71	39	54.9	54	32	39.3	125	71	56.8	0.234
Total	649	317	48.8	483	226	46.8	1132	543	48.0	0.468

* Significant differences at 0.05.

In connection with the changes of infection in relation with the age of patients (Table 2), the lowest infection (32.5%) was recorded in the lowest age group (less than one year). A continuous increase was achieved within the older age groups which reached 90% in both age groups 7 and 8 years, except with a slight decrease within both age group 4 and age group 9 and more. Significant differences were noted in the infection of different age groups as the calculated χ^2 value was 177 while the tabulated value at 0.05 was 16.92. The decrease in the overall incidence of intestinal parasites in young ages, especially under one year, can be explained by the fact that young infants are in direct contact with their mothers and are fully dependent on them, that is, they are under the direct care of the mother and the rest of the family. The high rates of infection in older ages may be due to the fact that these children are more active in the street or school. This result is consistent with the findings of some researchers in Iraq (Rissan, 1997; Al-Tae et al., 1998, Jaeffer, 2011; Al-Saqur et al., 2016).

Table (2): Changes in the infection of different age groups of male and female patients with intestinal parasites.

Age (years)	Males			Females			Both sexes		
	No. examined	No. infected	Infection (%)	No. examined	No. infected	Infection (%)	No. examined	No. infected	Infection (%)
>1	340	115	33.8	263	81	30.8	603	196	32.5
1	123	58	47.2	89	45	50.6	212	103	48.6
2	58	38	65.5	37	23	62.2	95	61	64.2
3	47	34	81.0	27	20	74.1	69	54	78.3
4	14	11	78.6	13	8	61.5	27	19	70.4
5	19	16	84.2	9	9	100	28	25	89.3
6	14	12	85.7	5	4	80.0	19	16	84.2
7	13	12	92.3	7	6	85.7	20	18	90.0
8	6	5	83.3	4	4	100	10	9	90.0
9-12	20	16	80.0	29	26	89.7	49	42	85.7
Total	649	317	48.8	483	226	46.8	1132	543	48.0

Nine species of intestinal parasites and commensals were recorded in the stool specimens of the diarrheic children as shown in the following systematic account according to GBIF (2018), except for *Blastocystis hominis* where both EOL (2018) and Index Fungorum (2018) were followed:

Kingdom Fungi
Phylum Ascomycota
Class Blastocystae
Order Blastocystida
Family Blastocystidae
Blastocystis sp.
Kingdom Protozoa
Phylum Amoebozoa
Class Lobosa
Order Amoebida
Family Entamoebidae
Entamoeba histolytica Schaudinn, 1903
Entamoeba coli (Grassi, 1879)
Iodamoeba buetschlii (Prowazek, 1912)
Phylum Metamonada
Class Trepomonadea
Order Distomatida
Family Hexamitidae
Giardia lamblia Kofoid & Christiansen, 1915
Class Retortamonadea
Order Retortamonadida
Family Retortamonadidae
Chilomastix mesnili (Wenyon, 1910)
Class Trichomonadea
Order Trichomonadida
Family Trichomonadidae

Pentatrichomonas hominis (Davaine, 1860) Wenrich, 1931
Kingdom Animalia
Phylum Platyhelminthes
Class Cestoda
Order Cyclophyllidea
Family Hymenolepidae
Rodentolepis nana (Siebold, 1852)
Phylum Nematoda
Class Secernentea
Order Ascaridida
Family Oxyuridae
Enterobius vermicularis (Linnaeus, 1758)

In recent years, various genetic analysis have shown that *Blastocystis hominis* as a unique entity does not exist, i.e. there is no single species of *Blastocystis* that infects humans (Noël et al., 2005). *B. hominis* is a parasite whose taxonomic status is unclear (Roberts & Janovy, 2009). According to Amin & Amin (2014), *B. hominis* refers to parasites isolated from humans, while *Blastocystis* spp. is used for isolations from animal hosts.

In connection with the validity of these species, it is appropriate to mention here that the trichomonadid *Pentatrichomonas hominis* is the valid name of the previously known *Trichomonas hominis* which appeared in some old literature such as Kudo (1939).

According to EOL (2018) and GBIF (2018), the dwarf tapeworm *Hymenolepis nana* is considered as a synonym of *Rodentolepis nana*. Nevertheless, Global Cestode Database (2018) still considers *Hymenolepis nana fraterna* Stiles, 1906 as a valid species. According to Dr. David Gibson (correspondence with F. T. Mhaisen on 4th Dec. 2018), some people have returned to referring to *Rodentolepis nana* as *H. nana*.

Tables 3 and 4 show the rate of infection with these agents within different age groups and different months, respectively of diarrheic children. Among these agents, *E. histolytica* showed the highest percentage incidence (33.9%), while the lowest value (0.6%) was recorded by *E. vermicularis*. The overall percentage incidence of infection recorded in the present study (48%) is higher than that reported by previous workers in Iraq (Jassan et al., 1986; Al-Dujaili, 1993; Al-Mallah, 1998; Issa, 1998) as well as some other later researchers (Hussein, 2009; Al-Warid, 2012; Al-Saqur et al., 2016). This increase in infection is related mainly to the effect of economic sanctions imposed on Iraq in 1990 which had effected negatively the general hygiene of the Iraqis in different fields of their life (Popal, 2000).

No significant differences were recorded in the relationship between the family size of the diarrheic children and the overall percentage of infection with the intestinal agents, except in the case of the infection with both *G. lamblia* and *E. vermicularis* which showed significant differences (Table 5). The highest incidence (60.4%) was noted in children whose families consisted of 19-21 members in comparison with 35.3% in children belonging to families of 1-3 members. The high incidence of intestinal infections in children living in overcrowded families is due to the fact that the increase in the number of family members facilitates the spread of disease factors by direct contact between individuals or by the use of supplies in the house, especially if appropriate conditions such as the presence of some animals in the houses, like rodents and insects, contribute to the contamination of the common utensils of family members. These results are in agreement with the findings of a number of researchers (Al-Dujaili, 1993; Abbas, 1997; Al-Mamouri, 2000; Al-Warid, 2012; Al-Aboody et al., 2015).

Table (3): Rate of infection (%) with various intestinal parasites in different ages of diarrheic children.

Age (years)	Total number examined	*E. histolytica*	*G. lamblia*	*B. hominis*	*E. coli*	*P. hominis*	*C. mesnili*	*I. bütschlii*	*H. nana*	*E. vermicularis*	Total Infection (%)
>1	603	30.0	1.8	1.2	3.2	0.0	1.0	0.2	0.0	0.0	32.5
1	212	36.3	14.2	3.3	7.5	1.4	1.4	0.0	0.0	0.0	48.6
2	95	39.0	23.2	20.0	14.7	3.2	6.3	2.1	2.1	1.1	64.2
3	69	43.5	29.0	21.7	17.4	7.2	5.8	4.3	2.9	1.4	78.3
4	27	33.3	26.9	37.0	11.1	14.8	0.0	3.7	3.7	0.0	70.4
5	28	25.0	39.3	53.6	14.3	7.1	10.7	0.0	17.9	3.6	89.3
6	19	42.1	31.6	36.8	10.5	10.5	10.5	5.3	5.3	5.3	84.2
7	20	50.0	20.0	50.0	25.0	15.0	0.0	2.5	15.0	5.0	90.0
8	10	50.0	30.0	40.0	30.0	0.0	0.0	0.0	10.0	0.0	90.0
9-12	49	40.8	18.4	45.0	14.3	14.3	4.1	4.1	0.0	4.1	85.7
Total	1132	33.9	11.0	10.2	7.5	2.6	2.3	0.9	1.3	0.6	48.0
Calculated χ^2 value		14.59	140.39	285.76	55.27	86.23	32.50	29.37	109.66	32.82	177.00
Tabulated χ^2 (0.01)		21.67	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*
Tabulated χ^2 (0.05)		16.92	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**

* Significant differences at 0.01, ** Significant differences at 0.05.

Table (4): Monthly changes in rate of infection with various intestinal parasites in diarrheic children.

Months	Total number examined	*E. histolytica*	*G. lamblia*	*B. hominis*	*E. coli*	*P. hominis*	*C. mesnili*	*I. bütschlii*	*H. nana*	*E. vermicularis*	Total Infection (%)
Oct. 2000	137	43.8	15.3	15.3	8.0	4.4	2.9	0.7	1.5	0.0	65.0
Nov.	145	44.8	6.2	4.8	4.1	1.4	2.1	0.7	1.4	0.7	51.7
Dec.	135	27.4	11.9	6.7	4.4	2.2	0.0	0.0	4.4	0.7	37.0
Jan. 2001	118	26.3	6.8	12.7	4.2	0.0	3.4	0.8	1.7	0.0	35.6
Feb.	79	34.2	12.7	8.9	6.3	3.8	2.5	2.5	1.3	0.0	49.4
Mar.	89	22.5	4.5	10.1	7.9	0.0	2.2	0.0	0.0	0.0	33.7
Apr.	89	31.5	12.4	4.5	15.7	2.2	2.2	0.0	0.0	0.0	44.9
May	114	33.3	11.4	8.8	9.6	2.6	1.8	0.0	0.0	2.6	48.2
June	101	29.7	13.9	17.8	9.9	4.0	0.0	3.0	2.0	0.0	51.5
July	125	38.4	14.4	12.8	8.0	4.8	5.6	1.6	0.0	1.6	56.8
Total	1132	33.9	11.0	10.2	7.5	2.6	2.3	0.9	1.3	0.6	48.0
Calculated χ^2 value		14.59	140.39	285.76	55.27	86.23	32.50	29.37	109.66	32.82	177.00
Tabulated χ^2 (0.01)		21.67	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*	21.67*
Tabulated χ^2 (0.05)		16.92	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**	16.92**

* Significant differences at 0.01, ** Significant differences at 0.05.

Table (5): Relationship of total infection (%) with intestinal parasites and number of family members of diarrheic children.

Number of family individuals	Total number examined	*E. histolytica*	*G. lamblia*	*B. hominis*	*E. coli*	*P. hominis*	*C. mesnili*	*I. bütschlii*	*H. nana*	*E. vermicularis*	Total Infection (%)
1-3	34	29.4	2.9	0.0	5.9	2.9	2.9	2.9	5.9	0.0	35.3
4-6	248	36.3	10.9	9.7	8.1	3.2	3.2	0.4	0.0	0.4	48.4
7-9	273	34.4	8.1	14.3	10.3	2.9	1.8	1.1	1.8	0.0	49.1
10-12	248	36.7	8.9	10.9	7.7	2.4	2.4	1.2	0.8	0.8	50.4
13-15	128	29.7	14.1	4.7	3.9	1.6	2.3	0.0	1.6	0.0	43.8
16-18	78	20.5	9.0	11.5	3.8	0.0	1.3	1.3	2.6	1.3	38.5
19-21	53	39.6	30.2	9.4	7.5	3.8	1.9	0.0	1.9	5.7	60.4
22 and more	70	34.3	15.7	8.6	5.7	2.9	1.4	1.4	1.4	0.0	48.6
Total	1132	33.9	11.0	10.2	7.5	2.6	2.3	0.9	1.3	0.6	48.0
Calculated χ^2 value		9.864	28.999	13.616	7.439	3.525	1.931	4.736	10.881	25.955	9.948
Tabulated χ^2 (0.01)		18.48	18.48*	18.48	81.48	18.48	18.48	18.48	18.48	18.48*	18.48
Tabulated χ^2 (0.05)		17.07	14.07**	14.07	14.07	14.07	14.07	14.07	14.07	14.07**	14.07

* Significant differences at 0.01, ** Significant differences at 0.05.

Significant differences were recorded in the relationship between the educational level of children parents (both fathers and mothers) and the overall percentage of infection with the intestinal organisms. The overall percentage incidence of infection showed a significant decrease with increasing the educational level of the children's fathers and mothers as in the following:

58% and 54.7% for illiterates,
50.4% and 48.1% for those of primary school educational level,
45.8% and 44.1% for secondary school educational level,
37.8% and 34.9% for those of higher educational level.

The above result is in consistency with the findings of a number of researchers in Iraq (Al-Bayati, 2000; Al-Mussawi, 2001; Jassim & Hamd, 2011).

Significant differences were noted in the relationship between the kind of breastfeeding and the overall percentage incidence of infection. Highest rates were detected among children who used mixed industrial feeding and breastfeeding (38%), and the lowest were among children who used natural breastfeeding (13.5%). This explains the importance of the preventive mechanism given by breast milk as well as the value of its antimicrobial immunological properties. Infants who do not receive breast milk are more exposed, by about 14 times, to die from diarrheal-related diseases compared with infants who are fed only breast milk (W.H.O, 1991).

The advantage of the mother's milk as containing all the required nutrients for the growth of the child is good and moderate proportions except iron elements and fluoride and vitamin D, which are located a few percentages, but sufficient for the child (Al-Nasir, 2000). Despite the lack of iron in breast milk, it is best absorbed in the infant intestine. Lactoferrin, which is a protein present in milk and other secretions, with bactericidal and iron-binding properties, helps the body to defend against various pathogens. The natural breastfeeding leads to a lack of incidence of many lesions in children, especially gastroenteritis, infections of the middle ear, respiratory diseases, meningitis, allergic diseases, deficiency of calcium and sodium, and obesity (Al-Nasir, 2000).

The percentage of the single infections (infection with one particular agent) among diarrheic children was 32.3% in comparison with 11% for the double infections and 4.7% for

the triple and more infections. The highest double infection was demonstrated by the association between *E. histolytica* and *E. coli* (36.3% of the total 124 cross cases). The highest triple infection was that between *E. histolytica*, *E. coli* and *B. hominis* (13.2% of the total cross infections).

Finally, it is reliable to indicate here the clear imprint of the economic sanctions which were imposed against Iraq in 1990, as high rates of malnutrition, lack of medical supplies, and diseases from lack of clean water were reported during sanctions (Popal, 2000). Boone et al. (1997) investigated the effect of sanctions on the Iraqi economy and the livelihood and well-being of its population. A recently published study (Saheb, 2018), based on records gathered from the Communicable Diseases Control Center, Parasitology and Helminthology Units in Baghdad during the period from January to June 2016 indicated that 715 cases of *G. lamblia* and 2883 cases of *E. histolytica* were recorded from the whole sector of Al-Rusafa (Baghdad province). Such numbers may represent the slight increase in health as well as other life sectors in Iraq after the cancellation of UN sanction against Iraq.

Acknowledgements

Sincere thanks are due to Dr. David I. Gibson of the British Museum (Natural History) and Dr. Omar M. Amin of the Parasitology Center, Scottsdale, Arizona for their comments on some of the parasite species and for providing us with some relevant articles.

References

Abbas, E.M. (1997). Epidemiology of intestinal parasites and head lice among pupils of some primary schools in Baghdad city. M. Sc. Thesis, Coll. Educ. (Ibn Al- Haitham), Univ. Baghdad: 56 pp. (In Arabic).

Al-Aboody, B.A.; Kareem, S. & Al-Rekabi, N.J. (2015). Study the infection with intestinal protozoa *Entamoeba histolytica* and *Giardia lamblia* among patients who attending Bint Al-Huda for maternity and children hospital and Al-Hussin hospital in Nassriyia city in Thi-Qar province. Baghdad Sci. J., 12 (3): 468-473. (In Arabic).

Al-Bayati, N.Y. (2000). Intestinal parasites and pediculosis among pupils of some primary schools in Al-Khalis town center, Diyala province. M. Sc. Thesis, Coll. Educ. (Ibn Al-Haitham), Univ. Baghdad: 81 pp. (In Arabic).

Al-Dujaili, A.A.I. (1993). Prevalence of intestinal parasitic infection among primary school children in Kerbala. Dipl. Community Med. Thesis, Coll. Med., Al-Nahrain Univ., Baghdad: 52 pp.

Al-Dulaimi, S.S. (1996). Parasitic etiology of diarrhea in Al-Anbar province. Al-Mustansiriya J. Sci., 7 (2): 64-68.

Al-Izzi, N.S. (1998). Prevalence of intestinal parasitic infection in preschool children in Mosul city. J. Fac. Med. Baghdad, 40 (4): 478-480.

Al-Mallah, O.A. (1998). Parasite- related diarrhoea in children under five years of age in Mosul (Iraq). J. Fac. Med. Baghdad, 40 (2): 335-341.

Al-Mamori, T.K.I. (1997). Distribution of infection with parasitic protozoans among patients in two hospitals in Baghdad city. M. Sc. Thesis, Coll. Educ. (Ibn Al-Haitham), Univ. Baghdad: 76 pp. (In Arabic).

Al-Mamouri, A.K. (2000). Epidemiology of intestinal parasites and head lice among pupils of some primary schools at Mahaweel district, Babylon province. M. Sc. Thesis, Coll. Sci., Univ. Babylon: 122 pp. (In Arabic).

Al-Mussawi, K.A.-H. (2001). Distribution of parasitic infection in Karbala city. M. Sc. Thesis, Coll. Educ. (Ibn Al-Haitham), Univ. Baghdad: 105 pp. (In Arabic).

Al-Nasir, F.A.L. (2000). The properties and the importance of breast feeding. J. Arab Board Med. Specializations, 2 (4): 43-46. (In Arabic).

Al-Qadhi, B.N.; Al-Warid, H.S.J. & Al-Qadhi, M.N. (2011). Enterobiasis and its relationship with enuresis among one of orphanage care children in Baghdad- Iraq. Iraqi J. Sci., 52 (3): 394-399.

Al-Saqur, I.M.; Al-Warid, H.S. & Al-Bahadely, H.S. (2016).The prevalence of some gastrointestinal nematodes and cestodes in Iraqis. Asian Biomed., 10 (1): 61-66. DOI: 10.5372/1905-7415.1001.466.

Al-Tae, A.A.; Risan, F.A. & Merza, M.Y. (1998). Prevalence of intestinal parasites in children attending Saddam Medical City. J. Fac. Med. Baghdad, 40 (4): 441-446.

Al-Warid, H.S.J. (2012). Study of some epidemiological aspects of giardiasis in north of Baghdad. Bagh. Sci. J., 9 (2): 251-258.

Amin, K.O. & Amin, O.A. (2014). The changing pattern of enteric protozoan infections in the Los Angeles area between 1996 and 2013. Int. Res. J. Microbiol., 5 (5): 80-87.

Boone, P.; Gazdar, H. & Hussain, A. (1997). Sanctions against Iraq: Costs of failure. A report prepared for the Center for Economic and Social Rights on the impact of United Nations-imposed economic sanctions on the economic well-being of the civilian population of Iraq. Cent. Econ. Soc. Rights, New York: 57 pp.

Davey, T.H. & Crewe, W. (eds.) (1973). Blacklock and Southwell a guide to human parasitology for medical practitioners, 9th edition, H.K. Lewis & Co., Ltd., London: 218 pp.

EOL (2018). Encyclopedia of Life on-line database, http://www.eol.org. (Accessed 6 Dec. 2018).

Garcia, L.S. & Ash, L.R. (1975). Diagnostic parasitology: Clinical laboratory manual. C.V. Mosby, Saint Louis: 112 pp.

GBIF (2018). Global Biodiversity Information Facility, on-line database, http://www.gbif.org. (Accessed 6 Dec. 2018).

Global Cestode Database (2018). A survey of the tapeworms (Cestoda: Platyhelminthes) from vertebrate bowels of the earth. http://tapewormdb.uconn.edu (Accessed 6 Dec. 2018).

Hussein, A.B. (2009). Study of prevalence of intestinal parasite in patient visit some hospital of Baghdad. J. Univ. Anbar Pure Sci., 3 (2): 1-11. (In Arabic).

Ichhpujani, R.L. & Bhatia, R. (1994). Medical parasitology. Jaypee Bros. Med. Publ., New Delhi: 384 pp.

Index Fungorum (2018). www.indexfungorum.org. https://doi.org/10.15468/ts7wsb (Accessed 6 Dec. 2018).

Issa, A.H. (1998). Incidence of rotavirus and parasitic infection of inpatient children suffering from diarrhoea in Basrah city. Basrah J. Sci., B., 16 (2): 11-16.

Jaeffer, H.S. (2011). Prevalence of *Gairdia lamblia* and *Entamoeba histolytica/ Entamoeba dispar* infections among children in Al-Shulaa and Al-Khadimya– Baghdad- Iraq. J. Univ. Anbar Pure Sci., 5 (2): 6-10.

Jassan, B.A.; Al-Dujaily, A.A. & Saleh, M.M. (1986). Prevalence of intestinal parasites in schoolchildren of Kirkuk city, Iraq. J. Biol. Sci. Res., 17 (2): 119-125.

Jassim, A.N. & Hamd, H.K. (2011). Some a survey study on the role of women in controlling parasites contaminated with vegetables. Baghdad Sci. J., 8 (1): 388-391. (In Arabic).

Jousilahti, P.; Madkour, S.M.; Lambrechts, T. & Sherwin, E. (1997). Diarrhoeal disease morbidity and home treatment practices in Egypt. Public Health, 111: 5-10.

Kudo, R.R. (1939). Protozoology, 2nd ed., Charles C. Thomas Publ., Springfield: 689 pp.

Leksomboon, U.; Echeverria, P.; Suvongse, C. & Duangmani, C. (1981). Viruses and bacteria in pediatric diarrhea in Thailand: A study of multiple antibiotic-resistant enteric pathogens. Am. J. Trop. Med. Hyg., 30 (6): 1281-1290.

Noël, C.; Dufernez, F.; Gerbod, D.; Edgcomb, V.P.; Delgado-Viscogliosi, P.; Ho, L.-C.; Singh, M.; Wintjens, R.; Sogin, M.L.; Capron, M.; Pierce, R.; Lionel Zenner, L. & Viscogliosi, E. (2005). Molecular phylogenies of *Blastocystis* isolates from different hosts: Implications for genetic diversity, identification of species, and Zoonosis. J. Clin. Microbiol., 43 (1): 348-355.

Penakalapati, G.; Swarthout, J.; Delahoy, M.J.; McAliley, L.; Wodnik, B.; Levy, K. & Freeman, M.C. (2017). Exposure to animal feces and human health: A systematic review and proposed research priorities. Environ. Sci. Technol., 51: 11537-11552.

Pickering, L.K. & Snyder, J.D. (1996). Gastroenteritis. In: Behrman, R.E.; Kliegman, R.M. & Arvin, A.M. (eds.). Nelson textbook of pediatrics, vol. 2, 15th edition, W.B. Saunders, Philadelphia: 721-724.

Popal, G.R. (2000). Impact of sanctions on the population of Iraq. East Mediterr. Health J., 6 (4): 791-795.

Rissan, F.A. (1997). Some aspects on giardiasis among children attending Medical Saddam City/ consultant clinic. J. Fac. Med. Baghdad, 39 (4): 366-371.

Roberts, L.S. & Janovy, J., Jr. (2009). Gerald D. Schmidt & Larry S. Roberts' foundations of parasitology, 8th edition, Wm. C. Brown Publ., Dubuque: 701 pp.

Saheb, E.J. (2018). The prevalence of parasitic protozoan diseases in Iraq, 2016. Karbala Int. J. Mod. Sci., 4: 21-25.

Sanders, D.H.; Eng, R.J. & Murph, A.F. (1985). Statistics: A fresh approach, 3rd edition, McGraw- Hill Book Co., Singapore: 524 pp.

UNICEF/WHO (2009). Diarrhoea: Why children are still dying and what can be done? ISBN: 978-92-806-4462-3 (UNICEF), ISBN: 978-92-4-159841-5 (NLM classification: WS 312) (WHO): 58 pp.

W.H.O. (1991). Basic laboratory method in medical parasitology. W.H.O., Geneva: 114 pp.