Prevalence of Intestinal Protozoa and Parasites Infestations among Under five Children in Jabel Aweleia Governorate, Khartoum State

By

Dr. Amir Eltayeb Ismail
M.B.B.S. (Omdurman Islamic University)

A thesis submitted in partial fulfillment for the requirements of the Degree of Clinical M.D. in Pediatrics and Child Health
March 2005

Supervisor

Prof. Zein A. Karrar
FRCP (London), FRCPCH (UK), MRCP (UK)
Professor of Pediatrics
Department of Pediatrics & Child Health
Faculty of Medicine, U. of K.
بسم الله الرحمن الرحيم

"اقرأ وربك الأكرم (٣) الذي علم بالقلم (٤)
علم الإنسان مالم يعلم (٥)"

سورة العلق
Dedication

To My Mother & Grand Mother

To My Father

To My Brothers and Sisters

To My Friends everywhere
# Contents

<table>
<thead>
<tr>
<th>Acknowledgement</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English abstract</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arabic abstract</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>iv</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of tables</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>vi</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of figures</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>vii</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of abbreviations</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>viii</td>
<td></td>
</tr>
</tbody>
</table>

## CHAPTER ONE:

### 1. INTRODUCTION AND LITERATURE REVIEW..

#### 1.1 General concept and definition

1

#### 1.2 Classification of human parasites

2

#### 1.3 Prevalence and epidemiology of intestinal protozoa and Parasites

4

- **1.3.1 Global**
  
  4

- **1.3.2 In Africa**
  
  9

- **1.3.3 In Arab word**
  
  13

- **1.3.4 In Sudan**
  
  16

#### 1.4 Pathogenesis of intestinal protozoa and parasites infestation

20

- **1.4.1 Effect of the parasites on the host**
  
  20

- **1.4.2 Effects of the host on the parasite**
  
  20

#### 1.5 Intestinal parasitic infestation and nutritional status

21
1.6  Prevention and control of intestinal parasitic infestation ………
23
1.7  Some types of intestinal parasites……………………………………
25
   1.7.1  Giardia lamblia………………………………………………
   25
   1.7.2  Entameba histolytica………………………………………..
   31
   1.7.3  Cryptosporidium …………………………………………..
   35
   1.7.4  Amsars lumbricoides……………………………………
   37
   1.7.5  Hookworms infestation……………………………………
   40
   1.7.6  Strongloides stercolis……………………………………
   43
   1.7.7  Trichuris trichuria…………………………………………
   46
   1.7.8  Enterobious vermicularis……………………………………
   47
   1.7.9  Taenia saginata……………………………………………
   50
   1.7.10 Hyenolepis nana……………………………………………
   52
   1.7.11 Schistosoma mansoni………………………………………
   53

2.  JUSTIFICATIONS………………………………………………
57
3.  OBJECTIVES……………………………………………………
57

CHAPTER TWO:

2- MATERIAL AND METHODS………………………………
58
  2.1  Study design………………………………………………..
   58
  2.2  Study area…………………………………………………
   58
  2.3  Study duration…………………………………………..
   59
  2.4  Study population…………………………………………
CHAPTER THREE:

3- RESULTS ................................................................. 71

CHAPTER FOUR:

4- DISCUSSION ......................................................... 126
CONCLUSION ................................. 136
RECOMMENDATIONS ...................... 138
REFERENCES .................................................. 139
APPENDIXES
Acknowledgement

I am most grateful to my supervisor Prof. El-Zein A/Rahim Karrar for his valuable advise, support and encouragement throughout the study.

I am thankful to Fadia A/Galil who support all time and typed the thesis.

I thank the PHC authorities in Gabel Awelia Governorate and to localities PHC offices for their consent and support.

I express my thanks to children and their parents for their consent and cooperation.

I appreciate the help in one form or another of colleagues and in particular Dr. Soad Mursi, Dr. Mohamed Hamad, Dr. Sara Maamoun, Dr. Ali A/Alla and Dr. Muatasim Eldaw.

I thank Mr. Hassan Ali, the statistician for helping in data analysis.

Lastly express my thanks to everyone who did cooperate and assist me.
Abstract

A prospective community based comparative study conducted in Gabel Aweleia Governorate Khartoum State to estimate the prevalence of intestinal protozoa and parasitic infestation among under-five children.

Three areas from Gabel Aweleia governorate were randomly selected, Gabel Aweleia town representing the urban setting, Treaa Elbiga village area representing rural setting and Mayo camp area - Mandela representing displaced camp area were included.

A questionnaire was completed and clinical examinations for 390 children (130 child from each area)

Stool samples were also collected and examined by an expert.

The findings revealed that intestinal parasites were isolated from 186 children (47.7%), 51 (39.2%), 58 (44.6%) and 77 (59.2%) in urban, rural and displaced camp areas respectively.

The commonest intestinal parasite among under-five children was G. lamblia (33.3%). Its rates were 26.2%, 34.6% and 39.2% for urban, rural and displaced camp area respectively. The prevalence rates for H. nana were 8.5%, 4.6% and 18.5% in urban, rural and displaced camp areas respectively.

For non pathogenic E. coli the prevalence was 6.2% in urban, 6.9% in rural and 12.3% in displaced camp areas, while E. vermicularis were 3.8%, 1.55% and 6.2%, E. histolytica was not commonly isolated 0.0%, 0.8% and 1.5% , while schistosoma
mansoni was the least isolated (0.0%, 0.8% and 0.0% in urban, rural and displaced camp areas respectively).

Infection by one parasite was found in 86.3% in urban area, 89.7% in rural area and 75.3% in displaced camp area, while 13.7%, 10.3% and 18.2% in urban, rural displaced camp area respectively had two parasites isolated.

Infection by three parasites was found only in the displaced camp area (6.5%).

The most infected age group was 1-2 year in urban area (26.9%), in rural area 3-4 years (26.9%) and in displaced camp > 2-3 years. Males predominated in urban and rural areas while females predominated in displaced camp area.

There was no correlation between intestinal parasitic infection and personal habits, nutrition, hygiene and other social factors.
يرجى تقديم النص العربي للملف.
لا يمكنني قراءة النص العربي بشكل طبيعي.
List of Tables

Table 1: Distribution of children according to age group by living area ......................................................... 75

Table 2: Prevalence rates of intestinal parasites among children by living area ..................................................... 80

Table 3: Distribution of infected children by type of parasite and living area ......................................................... 82

Table 4: Distribution of infected children by intestinal parasite according to age group by living area ....................... 87

Table 5: Distribution of infected children by intestinal parasite according to gender by living area ......................... 90

Table 6: Distribution of infected children by intestinal parasite according to father’s education by living area ........... 93

Table 7: Distribution of infected children by intestinal parasite according to father’s occupation by living area .......... 96

Table 8: Distribution of infected children by intestinal parasite according to mother’s education by living area ........ 99

Table 9: Distribution of infected children by intestinal parasite according to mother’s occupation by living area ....... 101

Table 10: Distribution of infected children by intestinal parasite according to family income by living area .......... 105

Table 11: Distribution of infected children by intestinal parasite according to sewage system by living area .......... 118

Table 12: Distribution of infected children by intestinal parasite according to presenting symptoms by living area ... 121

Table 13: Distribution of infected children by intestinal parasite according to clinical signs detected by living area .... 124
# List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1:</td>
<td>Distribution of children by gender in the study</td>
<td>72</td>
</tr>
<tr>
<td>Figure 2:</td>
<td>Distribution of children according to age group by living area</td>
<td>74</td>
</tr>
<tr>
<td>Figure 3:</td>
<td>Distribution prevalence rates of intestinal parasites among children by living area</td>
<td>78</td>
</tr>
<tr>
<td>Figure 4:</td>
<td>Distribution of types of parasites among children by living area</td>
<td>83</td>
</tr>
<tr>
<td>Figure 5:</td>
<td>Mode of infections in the infected children by living area</td>
<td>85</td>
</tr>
<tr>
<td>Figure 6:</td>
<td>Distribution of prevalence rate of children infected by intestinal parasites according to age group by living area</td>
<td>88</td>
</tr>
<tr>
<td>Figure 7:</td>
<td>Prevalence of infected children by intestinal parasites according to gender and living area</td>
<td>89</td>
</tr>
<tr>
<td>Figure 8:</td>
<td>Distribution of children infected by intestinal parasites and fathers education by living area</td>
<td>92</td>
</tr>
<tr>
<td>Figure 9:</td>
<td>Distribution of children infected by intestinal parasites and fathers occupation by living area</td>
<td>95</td>
</tr>
<tr>
<td>Figure 10:</td>
<td>Distribution of children infected by intestinal parasites and mothers education by living area</td>
<td>98</td>
</tr>
<tr>
<td>Figure 11:</td>
<td>Prevalence rate of infected children by intestinal parasites according to mothers occupation by living area</td>
<td>102</td>
</tr>
<tr>
<td>Figure 12:</td>
<td>Distribution of infected children by parasitic infection and family income by living area</td>
<td>104</td>
</tr>
<tr>
<td>Figure 13:</td>
<td>Distribution of infected children by parasitic infection and family size by living area</td>
<td>108</td>
</tr>
<tr>
<td>Figure 14:</td>
<td>Distribution of children infected by intestinal parasites according to personal habits by living area</td>
<td>111</td>
</tr>
<tr>
<td>Figure 15:</td>
<td>Distribution of children infected by intestinal parasites according to sources of drinking water at home by living area</td>
<td>115</td>
</tr>
<tr>
<td>Figure 16:</td>
<td>Distribution of children infected by intestinal parasites according to sewage system at home by living area</td>
<td>117</td>
</tr>
</tbody>
</table>
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. duodenale</td>
<td>Ancylostoma duodenale</td>
</tr>
<tr>
<td>A. lumbricoides</td>
<td>Ascaris lumbricoides</td>
</tr>
<tr>
<td>E. coli</td>
<td>Entamoeba coli</td>
</tr>
<tr>
<td>E. dispar</td>
<td>Entamoeba dispar</td>
</tr>
<tr>
<td>E. histolytica</td>
<td>Entamoeba histolytica</td>
</tr>
<tr>
<td>G. lamblia</td>
<td>Giardia lamblia</td>
</tr>
<tr>
<td>H. nana</td>
<td>Hymenolepis nana</td>
</tr>
<tr>
<td>N. americanus</td>
<td>Necator americanus</td>
</tr>
<tr>
<td>PHC</td>
<td>Primary Health Care</td>
</tr>
<tr>
<td>S. mansoni</td>
<td>Schistosoma mansoni</td>
</tr>
<tr>
<td>S. Stercoralis</td>
<td>Stronglyloids stercoralis</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package For Social Sciences</td>
</tr>
<tr>
<td>T. sanginata</td>
<td>Taenia saginata</td>
</tr>
<tr>
<td>T. solium</td>
<td>Taenia solium</td>
</tr>
<tr>
<td>HAC</td>
<td>Humanitarian aid corporation</td>
</tr>
</tbody>
</table>
Chapter One

1- INTRODUCTION AND LITERATURE REVIEW

1.1 General Concept and Definition:

Parasitism included any reciprocal association in which a species depends upon another for its existence. This association may be temporary or permanent. In symbiosis there is a permanent association of two organisms that cannot exist independently, in mutualism both organisms are benefited, and in commensalisms one partner is benefited and the other is unaffected. The term parasite, however, is ordinarily applied to a weaker organism that obtains food and shelter from another organism and derives all the benefit from the association. Parasites often lack the necessary organs for assimilating raw food material and depend upon the host for predigested food. An adequate supply of moisture is assured inside the host, but during the free-living existence of the parasite inadequate moisture may either prove fatal or prevent larval development.

Various descriptive names denote special types or functions of parasites. An ectoparasite lives on the outside (infestation) and
endoparasite within the body of the host (infection). Parasites are termed facultative when they are capable of leading both a free and a parasitic existence and obligate when they take up a permanent residence in and are completely dependent upon the host. An incidental parasite is one that establishes itself in a host in which it does not ordinarily live. A temporary parasite is free-living part of its existence and seeks its host intermittently to obtain nourishment.

A permanent parasite remains on or in the body of the host from early life until maturity, sometimes for its life. A pathogenic parasite causes injury to the host by its mechanical, traumatic, or toxic activities. A pseudoparasite is an artifact mistake for a parasite. A coprozoic, or spurious, parasite is a foreign species that has passed through the alimentary tract without infecting the host (1).

1.2 Classification of Human Parasites:

Human parasites in the Kingdom protozoa are classified
under three phyla:

- Sarcomastigophora containing the flagellates and amebas.
- Ciliophora containing the ciliates.
- Apicomplexa containing the sporozoans.

Within these great assemblages are found the important human parasites conveniently listed as subphyla.

- Mastigophora, the flagellates, have one or more whip-like flagella, includes intestinal or genitourinary flagellates (Giarida, Trichomonas, dientamoeba, chilomastix).
- Sarcodina are typically ameboid and are represented by entamoeba, endolimax, iodamoeba, naegleria and acanthamoeba.
- Sporozoa, one of these cryptospoidum
- Ciliophora represented by only one human parasite (Balantidium coli)

The parasitic worms or helminthes of human belong to two phyla:
(1) Platyhelminthes (flat worms). Lack a true body cavity and are characteristically flat in dorsoventral section. Species belong to the classes Cestoda (tape worms) and Trematoda (flukes).

- The important tissue and intestinal cestodes of human belong to the genera diphyllobothrium, spirometra, taenia, echinococcus, hymenolepis and dipylidium.

- Medically important trematode genera include schistosoma, paragonimus, heterophyes, fasciolopsis and clonorchis.

(2) Nemathelminthes (worms-like, separate-sexed, unsegmented round worms) include A. lumbricoids, E. vermicularis and hookworm.

1.3 Prevalence and epidemiology of Intestinal Protozoa and Parasites

1.3.1 Global :-

Intestinal parasitic and protozoan infections are amongst the most common infections world-wide. It is estimated that some
3.5 billion people are affected, and that 450 million are ill as a result of these infections, the majority being children (3).

The following estimates are based on those of the WHO between 1975 and 1995: Approximately 1% of world population infected with amoebiasis with an annual deaths; 40,000 to 110,000. For giardiasis: the population currently infected, 200 million. Approximately 150 million infected with schistosomiasis (includes combined cases): S. mansonii, approximately 60 million infected; annual deaths 500,000 to million from schistomiasis. Ascariasis: one to three billion infected; annual deaths (intestinal obstruction), 1550. Hookworm: one to three billion infected. Trichuriasis: 900 million infected. Strongtoidiasis: 35 million infected. Trichostrogyliass: 5, 5 million infected (4).

A small scale survey was performed to know the infections status of intestinal parasite in children of the residential institutions and street communities in Metro Manila, Philippines. The study was conducted among 289 children, overall prevalence was (62%) of the children were positive for one or more intestinal parasites. Multiple infections were observed in (34.2%) of the children. The prevalence for A. lumbricoides, T. trichuria and
hookworms was (36%), (44.8%) and (7%) respectively. Of the children examined, (47.7%) were found to be harboring parasitic protozoans such as E. histolytica, G. lamblia and Blastocystis hominis. The most prevalent of these protozoans was B. hominis with an infection rate of (40%) (5).

A study conducted among Aboriginal communities in the Kimberley region of Western Australia to determine the prevalence of Giardia duodenalis and other intestinal parasites in children, dogs and cats. It revealed that Giardia duodenalis was the most prevalent parasites in children (32.1%, n = 361). Human infection with H. nana (20.5%) and E. coli were also common. Ancylostoma duodenale (1.3%), Pentatrichomonas hominis (1.0%), Chilomastix mesnill (0.52%), Entamaeba hartmanni (0.52%), Sarcocystis sp. (0.52%), T.trichiura (0.26%), E. vermicularis (0.26%), Strongyloides stercoralis (0.26%) and Isosporabelli (0.26%) were present at low rates (6).

One hundred and fifty stool samples were collected from seven villages of communities living on the fringes of the Crocker range park Sahaba, Malaysia. The prevalence rates for intestinal protozoan were E.histolytica (21%), G.lamblia (8.6%), and E.coli
only (3, 3%). The prevalence rates for soil-transmitted helminthes were T. trichiura (10.0%), A. lumbricoides (8.7%) and hookworm (3, 3%). The age group 11-20 years old had the highest rate of infection with both helminthes and protozoa (8).

A survey was made to find the extent of intestinal parasite infection among 251 primary school children from Kampongcham, Cambodia. The overall infection rates were (54.2%). The infections rate of intestinal helminthes by the species was as follows: A. lumbricoides (26.3%), Echinostoma sp. (15.6%) hookworm (6.4%), Opisthorchis sp. (4.0%), Rhabditis sp. (2.4%) and T. trichiura (0.4%). The infection rates of intestinal protozoa were as follows: E. coli 7.6%, G. Lamblia 3.2%, and E. histolytic (0.8%). More than one parasite were found in (16.7%) of the stool sample (7).

A pilot study to evaluate the occurrence of intestinal parasites among 103 students from Martinesia District, Uberlandia Municipality, Minas Geris State, Brazil. The overall prevalence rate was (22.3%) and the highest indices of infections were observed in 8-9 age groups (34.8%). Helminthiasis and protozoosis showed similar prevalence rates (10.7%) and (12.6%),
respectively. Giardia lamblia was the unique protozoan parasite verified and only one case of polyparasitism was found (9).

Assessment of prevalence of malnutrition and intestinal parasites in preschool slum children in Lucknow, North India. It revealed that among 1061 children overall intestinal parasites were (17.5%). Of these, A. lumbricoides was found in 124 (68.1%) and G. lamblia in 60 (32.9%) (10).

A small-scale survey on the status of intestinal parasite infection in rural village in Nepal among a total of 300 school children revealed that the prevalence rate of intestinal parasite infections in the surveyed area was (44%). E. coli was the most commonly found protozoan parasite (21%) followed by G. lamblia (13.7%) and others (5.3%). Hookworm was the most prevalent intestinal helminthes (13%) followed by T. trichura (3%) and others (5%). Forty-three children (14.3%) showed mixed infections (11).

A study done to document patterns of intestinal parasitism in the United States, they analyzed results of 216, 275 stool specimens examined by the state diagnostic laboratories in 1986; parasites were found in (20%), Percentages were highest for protozoans: G. Lamblia (7.2%), E. Coli and Endolimax nan (4.2%
The most commonly identified helminthes were nematodes: hookworm (1.5%), T. trichiura (1.2%), and A. lumbricoides (0.8%). Seasonally, Giardia identifications increased in the summer and fall, especially in the Midwest (12).

Using an anti-oocyst wall monoclonal antibody-based immunofluorescence assay, the presence of Cryptosporidium parvum was evaluated in children with diarrhea from rural areas and from urban areas in the State of Puebla, Mexico. Prevalence of (9.4%) in a rural population (n = 85) and (29.6%) in an urban population (n = 81) (13).

In another study done in four Aymara communities in the Bolivian Altiplano to determine the prevalence of Cryptosporidium. Single stool specimens were randomly collected from 377 students ages 5-19 years old, all apparently asymptomatic. The total prevalence (31.6%) is possibly the highest reported among healthy humans (a maximum of 9.8% and 2% in coprologic surveys in underdeveloped and developed countries, respectively) (14).
1.3.2 In Africa:

A survey of five primary schools and one secondary school in southern Sierra Leone, among 1820 school children was done. The result revealed that A. lumbricoides was the most common helminthes (33.3%) followed by T. trichiura (14.6%) and Hookworm infection (10.4%). Multiple infections were quite common, with (53.1%) having one type of helminthes infections, (40%) had two types of helminthes infections, while (6.9%) had three or more helminthes infections\(^{(15)}\).

In a cross-sectional study of helminthes infections in a rural village in the Gambia, West Africa, hookworm and A. lumbricoides were found to be the most prevalent helminthes present of prevalence levels of (30%) and (25%) respectively. Others parasites present were T. trichiura (2.4%) and S. amansoni (1.5%)\(^{(16)}\).

A cross-sectional study was conducted in Aynalem village, Tigray, Ethiopian on a total of 330 under-five children showed the overall prevalence of infection was (48.1%). The most common parasite was E. histolytica (18.3%) followed by H. nana (17.3%), G. lamblia (7.7%) and A. lumbricoides (5.8%). Fewer proportion
(1.9%), (1%), and (1%) harbored Strongloides stercoralis, S. mansoni and E. vermicularis respectively (17).

Another study done in Ethiopia among 259 schoolchildren in a rural area close to the southeast of Lake Langano. Of the 259 students surveyed for intestinal parasites, 217 (83.8%) had one or more parasites. Prevalence of hookworm was the highest (60.2%), followed by S. mansoni (21.2%), T. trichuris (14.7%) Taenia spp (13.9%), E. histolytica/dispar (12.7%), A. lumbricoides (6.2%), G. duodenalis (6.2%) and S. stercoralis (5.8%), in that order (18).

A study was conducted to evaluate 242 children came from the Democratic Sahara Republic to Spain for vacation. Stool examination was done for intestinal parasites, and between 1 to 3 parasites were found in (75%) of children. Isolated were: E. coli (38%), Blastocystic hominis (22%), G. lamblia (18%), Erdolimax nana (17%), H. nana (11%) and Oxiuros (5%) (19).

A cross-sectional survey on intestinal parasite infections was carried out in 5313 pupils in 98 primary schools in Kampala, to identify the types and to estimate the prevalence. T. trichiura (28%), A. lumbricoides (17%) and Hookworms (12.9%) were
common infections among the children. Others less commonly found parasites were S. mansoni, S. tercolaris, Taenia spp., E. vermicularis, G. lamblia, E. coli and E. histolytica (20).

Prevalence of helminthes parasites was assessed in a Nigerian village among three different age groups, children between 5 and 14 years were 120 children, and had the highest prevalence of Ascaris (65.7%), T. trichiasis (15.8%) and hookworms (13.3%) (21).

A study near Enyau River in Arua, Uganda, using the Kato-Katz to assess the prevalence of S. mansoni in the population showed that the prevalence overall was 62%. The highest prevalence was found in the age group 10-14 years (73.8%) (22).

A study done to define the frequency of parasitic infections in HIV-seropositive Zambian children with diarrhea revealed that the commonest parasites identified were Ascaris and Cryptosporidium. Cryptosporidium spp. was isolated from 6 out of 44 (14 %) HIV-seropositive children (23).

A stool examination was performed on 286 randomly selected children aged 1-18 years from three rural villages in Guinea, Africa to identify the prevalence and relationship to
geophagia. Fifty three percent of children were infected by at least one type of soil-transmitted nematode. Geophagia was reported by parents to occur in (57%), (53%) and (43%) of children ages (1-5), (6-10) and (11-18) years, respectively. The pattern of geophagia by age and gender of the children more closely resembled the infection pattern for the two orally acquired and soil transmitted nematodes (A. lumbricoides, T. trichiura) than it did the infection pattern for the two soil-transmitted nematodes that infect by skin penetration (Hookworm, S. stercoralis)\(^{(24)}\).

1.3.3 In the Arab World:

A stool specimens from 424 primary school children in two districts of Arbil (northern Iraq), were examined for intestinal parasites. Of these 266 (62.7%) were positive. In Koran district, more children were infected (77.58%) with a greater variety of parasites than children from Azadi district (46.27%). G. lamblia was the commonest pathogenic intestinal protozoan, accounting for (35.39%) of samples from Koran district and (27.2%) from Azadi district. E. histolytica accounted for (18.6%) in Koran and (6.93%) in Azadi. E. coli was the commonest and (26.27%) in Azadi. H. nana and A. lumbricoides were the most commonly
reported helminthes. They were found respectively in (28.37%) and (14.57%) of children in Koran and in (19.72%) and (10.12%) of children in Azadi\(^{(25)}\).

A prevalence study of parasites in native-born Saudi Arabia of different ages attending the Riyadh Military Hospital during one year showed that in 8736 specimens of faeces were examined; 843 parasites were isolated from 815 specimens. The prevalence overall was (9.3%). The highest prevalence (25.9%) was in the (0-5) year age group. \(G.\) lamblia, \(H.\) nana and \(S.\) mansoni were the commonest organisms\(^{(26)}\).

In a retrospective study among the patients of Shamasan Primary Health Centre in Abha region the prevalence rates of intestinal parasites were (29.4%), with higher rates in children less than 10 years of age\(^{(27)}\).

A community based study conducted in urban (Aden) and rural (Yahr) in Yemen to determine the prevalence of intestinal parasites infections among school children. Stool specimens were collected from 502 children from the urban and 501 children from rural area randomly. The overall prevalence rates were 61.2%. In Aden it was (58.4%) and in Yahr was (64.1%). Positive samples for
two types of parasites were (10.5%); three types of parasites were detected only in (1.2%) of samples. The commonest intestinal parasites were G. lamblia (25.5% and 36.3%) and E. histolytica (29.3% and 24.2%) in urban and rural area respectively. Prevalence of other parasites were: E. vermicularis (13.5% and 8.4%), H. nana (2.2% and 4.6%), Cryptosporidium (1.2% and 1.8%), A. lumbricoides (0.8% and 0.8%) and T. trichiura (0.4% and 0.0%) among urban and rural areas respectively (28).

A study conducted in Al-Medina district, Saudi Arabia, showed that the overall prevalence of pathogenic intestinal parasites among 8000 preschool children was (18.4%). The most common parasite isolated was G. lamblia (14.5%). Other parasites were E. histolytica (2.7%), E. vermicularis (1.4%), A. lumbricoides (1.0%) and others. Out of the 1462 children positive for parasites, 183 (12.5%) had mixed parasitic infections (29).

In a study on 205 patients in Basrah hospitals, Iraq to consider the relationship of the parasitic infections including Cryptosporidium with chronic diarrhea, children were 135 (65.8%) of patients. The result revealed that, cryptosporidium oocysts were found to be excreted in 20 (9.7%) patients. the most common
other parasites were E.histolytica (23.8%) , G.lamblia (13.6%) and Blastocystis hominis (28.4%) (30).

In a retrospective study done among 360 patients presented to pediatric clinic in the Saudi Hospital at Hajjah, Yemen with a history of bloody stool, S.mansoni was found in 156 patients (43%). It was the most common identified cause of blood in the stool. Other parasitic infections among Schistosoma and non-schistosoma patients presenting with bloody stool were Ascaris 103 (29%), Giardia 82(23%), Pinworms 41 (11.5%), E. histolytica 27(7.5%), Hookworms 19(5%) and T. Trichuri 6 (2%)(31)

1.3.4 In Sudan:

A community based prospective study done in Khartoum State, Sudan in 1990 among randomly selected 300 under-five children from three camps of the police force. The study was planned to determine the prevalence and type of parasitic infestation among children. The overall prevalence was (44%). The commonest infestations were Giardiasis (21.1%), Taeniasis (10.4%) and Enterobiasis (7.4%). Nonpathogenic E. coli, E. histolytica and Taenia saginata were detected in (2.7%) in (2.7%), (0.7%), and (1.7%) of stools specimen respectively. Children aged
between three years and above were the most affected age group.

A study was conducted in Southern Sudan to determine the prevalence of intestinal parasites among school children. A total of 275 stool samples were examined using formal-ether concentration techniques yielded 15 different species of parasites. Hookworm with a prevalence of (13.1%) was the predominant nematode followed by S. mansoni (2.2%) and T. trichiura (1.8%). Intestinal protozoans were common. E. coli (37.8%), E. histolytica (28.4%) and G. lamblia (9.8%)\(^{(33)}\).

A parasitological survey of refugees based in Juba, involving 241 faecal samples, revealed that 66% of the population harboured intestinal helminthes. The age-prevalence profiles differ considerably between species. Hookworm shows a maximum prevalence (60%) in the oldest age group, while H. nana is the most common (30%) in very young children. S. mansoni is the most prevalence (52%) among older teenagers while S. stercoralis shows (44%) in the five to nine-year-old group and significantly more prevalence in children than adults (P < 0.02%). Many of the
specimens (42%) harboured a single infection, (21%) had double, (2%) triple and (1%) quadruple infections (34).

In study conducted by Al Safi in Elengaz area, Khartoum among a total of 500 pupils from four primary school the overall prevalence was (64.4%). The commonest intestinal parasites were G. lamblia (33.4%). Others parasites were as follows: H.nana (26%), T. Saginata (8.6%), E. histolytica (3.6%) S. mansoni (4.4%) and E. vermicularis (6.2%). Positive samples for two parasites were (15.8%) and for three parasites were (1%) (35).

A cross-sectional study done to determine the prevalence of Cryptosporidium in children with diarrhea and in their family contacts in Khartoum Emergency Hospital. The result shows that 16 of 100 children with diarrhea, and one asymptomatic mother had stool specimens containing cryptosporidium oocysts. Among the 16 index cases, three were infected with G. lamblia (36).

A school survey conducted by Salim (1999) in Khartoum State to determine the prevalence of intestinal parasites infections among school children. It was done in urban setting (Arkaweet) and rural area (Soba Alaradi). The findings revealed an overall prevalence rate was (37.5%). It was (35.7%) and (39.4%) in urban
and rural areas, respectively. The commonest parasite was G. lamblia; its rates were (18.5%) and (18.9%) in urban and rural areas, respectively. The prevalence rates of other parasites were (12.4%) and (15.4%) for non pathogenic E. coli, (8.3%) and (8.5%) for H. nana, (1.6%) and (0.2%) for E. vermicularis and (0.0%) and (1.4%) for S. mansoni in urban and rural areas, respectively. Infections by a single parasite was found in (30.2%) and (30%) while by two parasites were in (5.7%) and (9.2%) of school children in urban and rural areas, respectively (37).

A study by Bannga (1992) among street children in Khartoum to assess their health profile. Identified that the prevalence of intestinal parasites was (91.0 %), giardiasis, flagellates and amoebic dysentery were the commonest accounting for (47.7%), (15%), (32%) respectively (38).

In a study done by Elsadig to document the epidemiology and to identify the organisms that cause bloody diarrhea in Sudanese children in Khartoum State, the commonest etiological organisms was E. histolytica (6.2%) (39).

A parasitological study by Babiker (2001) on a total of 1500 food handlers attending the public health laboratory (STAC) for
annual check up revealed that the overall infection of intestinal parasites was (30.5%). The commonest intestinal protozoa was E. coli (15.3%), whereas G. Lamblia was detected in (9.7%) and E. histolytica in only (4.3%) of the samples examined. Food handlers harbouring intestinal helminthes constituted only (2.7%)\(^\text{(40)}\).

1.4 Pathogenesis of intestinal protozoa and parasitic infestation:

1.4.1 Effect of the Parasites on the Host:

A parasite, by definition is an organism that to some degree injures its host; however injury may be brought about in many ways. The most widespread type of injury is that brought about by interference with the vital processes of the host through the action of secretions, excretions or other products of the parasite. Parasites producing such effects may be in the tissues or organs of the host, the blood stream, or within the GIT, or they may even be ectoparasite. Invasion and destruction of the host tissue may be distinguished from injury that does not involve gross physical damage, although both types of injury reflect biochemical changes brought about in the host tissue by the parasites\(^\text{(4)}\).
1.4.2 Effects of the Host on the Parasite:

The effects of the host on the parasite are less obvious, but they are important. The genetic constitution of the host may profoundly influence the host-parasite relationship. The diet or nutritional status of the host may be of major importance in determining the outcome of a parasitic infection, also may be of considerable importance both in determining whether a particular infection will be accompanied by symptoms and in influencing their severity if present.

Major nutritional disturbance many influence resistance through their effects on the immune mechanisms of the host. Every species of animals is naturally resistant to infection by many organisms that parasitize different species. In some cases it has been possible to adapt parasites to hosts that normally infect poorly or not at all. Absolute immunity to reinfection rarely occurs following protozoal infections and probably never occur following helminth infections of man. Acquired immunity may be very important in modifying the severity of disease in endemic areas particularly diseases such as malaria and schistomiasis (4).
**1.5 Intestinal parasitic infestation and nutritional status:**

Parasites that infest the GIT are not only pathogenic but also result in the loss of a wide range of nutrients, and this predisposes to poor nutritional status in both children and adults. Infections with *Giardia lamblia* damages the intestinal mucosa and results in malabsorption of nutrients, particularly fat. It seems to be commonly seen in children with undernutrition and results in impaired growth and weight loss in children.

*E. histolytica* infections occur mostly in adults, although they are seen in children. Since the parasite infects the large intestine, severe infection result in serious loss of blood and also may cause systemic problem such as liver abscesses due to infection of the liver by the parasites, amoebiasis can cause nutrient loss and can lower the levels of circulating proteins, this sometimes leads to undernutrition.

Infection with *S. mansoni* is associated with severe weight loss and lowered serum proteins levels. Chronic infections can result in impaired growth and the children are typically both thin and short.
Cryptosporidium affects the mucosal morphology and hence can cause malabsorption of nutrients and undernutrition, especially post-measles diarrhoeal disease in Rwanda was reported.

A. lumbricoides infection cause malabsorption of fat and proteins, lactose deficiency, loss of appetites through immunological reactions was reported in India, Tanzania and Kenya.

Hookworms are a major cause of iron deficiency and anaemia in many countries was reported in St Lucia and Malaysia. Trichuris was associated with body-weight loss, stunted growth and anaemia\(^{(41)}\).

### 1.6 Prevention and Control of Intestinal Parasitic Infection:

Healthy immune system is the best defense against parasites and disease. Schistosomiasis and soil-transmitted infections are invariable more prevalent in the poorest section of the population in endemic areas of the least developed countries. The goal of prevention and control is to reduce morbidity from these parasites to level such that these infections are no larger of
public health importance. An additional goal is to improve the
developmental, functional and intellectual capacity of affected
children. Highly effective, safe single dose drugs can be dispensed
through health services, school health programmes and
community intervention directed at vulnerable groups (3).

Use proper sewage disposal and water treatment
(flocculation, sedimentation, filtration, and chlorination).
Consume only bottled or treated water by boiling, portable
camping filter, use iodine disinfection of non bottled water (105)
wash all fruits and vegetables in ozonated water, hydrogen
peroxide or bleach will kill parasites. Do not eat raw or uncooked
meats or fish. Practice good personal hygiene by washing hands
before eating and often going to the bathroom. Keep your finger
nails short and clear because parasites can live for two months
under the finger nails.

During swimming in rivers, lakes, ponds, or public swimming
pools avoid swallowing or drinking the water while swimming
anywhere. Do not walk bare foot on warm, moist soil or while
working in the garden. Use gloves and shoes for protection (106).
1.7 Some types of intestinal parasites:

1.7.1 Giardia Lamblia:

G. lamblia was first observed in 1681 by Leeuwenhoek, but only in the last 40 years has it been recognized as an important human pathogen. It is a ubiquitous gastrointestinal protozoan that may be identified in individuals with asymptomatic colonization or acute or chronic diarrhoeal illness. The classification of Giardia remains controversial, but most experts currently recognize three species (G. ogilis, G. muris and G. duodenalis) based on morphologic criteria\(^\text{(42, 43)}\).

Life cycle has two stages, trophozoites and cyst. The life cycle begins with ingested cysts, which release trophozoites in the duodenum. These trophozoites attach to the surface of the intestinal epithelium by using a ventral sucking disk and then reproduce by binary fission. The trigger for encystment is unclear, but the process results in the inactive, environmentally resistant form Giardia, a cyst that is excreted in feces\(^\text{(44)}\).

1.7.1.1 Epidemiology:

Children are infected more frequently than adults. Prevalence is higher in areas of poor sanitation and in institutions
with children not toilet trained, including day care centers. The prevalence of stool positivity in different areas may range between 1% and 30%, depending on the community and the age group surveyed. Endemic infection in the UK, US and Mexico most commonly occur in July – October among children less than 5 years of age and adults 25-39 years old.

Transmission occurs by a fecal-oral-route. The infective dose of Giardia for humans is low: 10 – 25 cysts caused infection in 8 of 25 subjects; more than 25 cysts caused infection in 100%. This allows person-to-person spread, which may be the most common means of transmission for humans. It is associated with drinking water from unfiltered surface water source or shallow wells, swimming in bodies of fresh water and having a young family member in day care. Large outbreaks have occurred from drinking treated but unfiltered water and smaller outbreaks have resulted from contaminated food (45, 4).

1.7.1.2 Pathology and Pathophysiology:

Small bowel aspirates and biopsies have demonstrated large number of trophozoites in the duodenum and proximal jejunum, attachment of the organisms to the intestinal mucosa, with
inflammation, and edema of the lamina propria. However, the principal lesion is derangement of normal villous architecture, with shortening of villi and inflammatory foci in the crypts and lamina propria as is seen in other types of malabsorption syndromes (46).

The mechanisms of diarrhea and malabsorption are poorly understood.

Several examination for malabsorptions have been proposed: physical blockade by large numbers of trophozoites blanketing the intestinal mucosa, deconjugation of bile acids, bacterial or fungal overgrowth, in the small intestine, increased turnover of cells on the mucosa of the villi, and epithelial damage. Altered gut motility and hypersecretion of fluids perhaps via increased adenylate cyclase activity, may also play a pathophysiologic role (43).

1.7.1.3 Clinical features:

About 20% of infections are symptomatic and most of cases cause an acute diarrhoeal illness subsiding after one or two weeks. In a small number of patients bowel disturbance persists but the symptoms and passage of cyst do not continue for more than three
months. Rarely patients may remain infected and symptomatic for many years. Fewer than 10% of cases develop clinical malabsorption with weight loss and lethargy. Diarrhoea is the main symptoms. It is usually worse in the morning, often explosive, usually offensive and with pale, almost white stools, but without blood or pus-weakness, abdominal pain, nausea, anorexia and failure to thrive in children are important symptoms. Dyspepsia with Giardia infection resembles hepatic dysfunction with dull upper epigastric pain. Malabsorption of D-xylose and fat is common but for vitamin B$_{12}$ was found in 50% of all patients$^{(47)}$.

Other symptoms and signs include vomiting, low-grade fever (infrequent), urticaria and neurological symptoms (e.g. irritability, sleep disorder, mental depression, and neuroasthenia)$^{(42)}$.

1.7.1.4 Diagnosis:

Usually made by finding cysts in formed stools and trophozoites and cysts in diarrheic feces. The distinctive morphology of G. lamblia in saline and iodine mounts and in stained smear distinguishes it from other intestinal protozoa. To
find trophozoites, one must examine specimens without delay. Concentration methods increase the chances of detection of cysts.

Examination of the duodenal contents for trophozoites gives a somewhat higher percentage of positive findings than that of the feces. Demonstration of organisms in some bowel biopsies has been reported in some patients with negative stool\(^{48}\).

1.7.1.5 Treatment:

Symptomatic patients should be treated to relieve their symptoms and to prevent the development of chronic illness. A symptomatic carrier in nonendemic areas should be treated when identified because they may transmit the infection or develop symptomatic illness. Three groups of drugs are currently being used.

(A) Nitroimidazole group:

(1) Metronidazole is the drug of choice active against various anaerobic bacteria and protozoa. Children dose: 5 mg/kg tid for 7-10 day with cure rate 85-95%.

(2) Tinidazole: pediatric dose is 50 mg/kg/day in one dose for 2 days with cure rate is 85-90%.
Albendazole: poor absorbed form GIT because of its low aqueous solubility. Pediatric dose:

15 mg/kg/day PO divided bid for 5 days.

Ornidozole Nimorozole

Nitrofuran derivatives (furazolidone): PO anti-infective agent used to treat bacterial or protozoal diarrhea and enteritis. Pediatric dose: 5-8.8 mg/kg/day PO divided qid for 10 days; not to exceed 400 mg/day.

Contraindicated in G6PD deficiency cure rate is 80%.

Acridine compounds (mepacrine and quinacrine): Indicated to treat giardiasis and cestodiasis. Occasionally used to treat and suppress malaria. There is poorly tolerated by children, dose: 7 mg/kg/day PO divided tid PC for 5 days not to exceed 300 mg/day⁴²,⁴³.

1.7.1.6 Prevention and Control:

Effective environmental sanitation is necessary to prevent water and food contamination. Sanitary methods of sewage disposal should be instituted, latrines should be screened, and a feces used as fertilizer should be stores an appropriate length of time. A properly safeguarded, filtered water supply is important,
since chlorination is not wholly effective. Boiling water is safe, effective methods of producing pleasant-tasting drinking water. Small quantities of drinking water may be treated with iodine-compound tablets. Insects may be controlled by insecticides. Food should be screened and protected from dust contamination. Uncooked vegetables should be washed. The public should be informed regarding methods of avoiding infection\(^{(48)}\).

1.7.2 Entamaeba histolytica:

Amebiasis is a parasitic infection caused by the protozoon E. histolytica. It is the third leading parasitic cause of death after malaria and schistosomiasis. Fedor Aleksandroich Losch, in St. Petersburg, Russia, first described amebiasis in 1875. He originally named the organism amoeba coli and documented its pathogenicity in a dog fed with dysenteric stool from a patient. The 1886 in Egypt, Kartulis proved ameboe to be the cause of intestinal and hepatic lesions in patients with diarrheoa. Later Councilman and Lafteur, at Johns Hopkins University Hospital, distinguished between bacillary and amebic dysentery in 1891. Walker and Sellards, in the Philippine, described the pathogenic role of ameboe in extensive studies in 1913\(^{(49)}\).
1.7.2.1 Epidemiology:

Worldwide distribution; 10% of world’s population is infected with E. histolytica; stool survey in the US indicated that 5% of the population harbors E. histolytica, higher incidence in areas of the tropics with poor sanitation. Approximately 90% of the Entamoeba infections are caused by E. dispar. The annually 40-50 million cases of amebic colitis or liver abscess with 80,000 deaths are caused by E. histolytica\(^{(50,51)}\).

High risk group includes people who have emigrated to endemic areas, of lower socioeconomic status, sexually promiscuous male homosexuals, institutionalized especially mental retardation, all people with a damaged or undeveloped immunity (AIDS) drinking or eating contaminated food or water supplies, lower socioeconomic status overcrowding and poverty\(^{(49,51,52)}\).

1.7.2.2 Pathophysiology:

The ingestion of cysts of E. histolytica is followed by excystation in the small bowel and invasion of the colon by the trophozoites. Invasive disease begins with the adherence of trophozoites to mucosa to invade the colonic epithelium to produce the ulcerative lesions typical of intestinal amebiasis.
Spread of amebiasis to the liver occurs via the portal blood. The trophozoites ascend via the portal veins to produce liver abscesses and lyse the hepatocytes and neutrophils. The neutrophil toxins may contribute to hepatocyte necrosis (49).

1.7.2.3 Clinical presentation and life cycle:

Its life cycle consists of two stages: cysts and trophozoites. They spread via the ingestion of faecally contaminated food or water. During excystation within the small intestine and nuclear division, giving rise to trophozoites, which reside in the caecum and large and passed in feaces. Approximately 90% of infected individuals are asymptotically colonized. Amaebic dysentery usually occurs gradually, with symptoms (such as abd.pain and tenderness, and painful sudden bowel evacuation (tenesmus) and diarrhoea followed by weight loss. Liver abscess is overwhelmingly the most common extra-intestinal manifestation of amoebiasis. The typical patient with amoebic liver abscess is a 20-40 years old male with a 1-2 week history of fever and diffuse or right, upper quadrant abd. pain (53).
The less common extra-intestinal form of invasive amoebiasis were CNS, lung, pericordum and Genitourinary system\(^{(49)}\).

### 1.7.2.4 Diagnosis:

Diagnosis by finding cyst in the stool examination by direct examination, flotation or sedimentation procedures, serological tests exist for long term infection. It is important to distinguish the E. histolytica cyst from the cyst of nonpathogenic intestinal protozoa\(^{(52)}\).

Endoscopy for cases with negative stool; to obtain material for examination, to assess the results of treatment or to differentiate from other causes of lower bowel disease\(^{(102)}\).

### 1.7.2.5 Treatment:

Asymptomatic infection are not treated in endemic areas but in patient with AIDS should be treated. The treatment for intestinal disease and hepatic abscess is metronidazole (35-50 mg/kg/d for 10 days) and tinidazole (5 mg/kg/d for 3 days) PO. Since these drugs may not eliminate the intraluminal cyst immediately follow this therapy with treatment with iodoquinal,
paramomycin or diloxanide furoate. Surgical treatment for intestinal perforation, amebic liver or brain abscess\(^{(49)}\).

1.7.2.6 Prevention and control:

Prevention by improved sanitation and clean water supply. Eating only cooked food or self-peeled fruits in endemic areas, minimized risk. Treating carrier can reduce infection in endemic area. Vaccination for amebiasis currently is being investigated\(^{(49)}\).

1.7.3 Cryptosporidium:

Cryptosporidium was discovered early in the twentieth century, by Tyzzer in 1909, but its importance was only realized in the 1970s by veterinary workers. In 1976, it was identified as the causative agent of human cryptoploidiosis. The pathogenic potential of the parasite was not fully appreciated until 1982, when the prevalence figures began to rise, largely as a result of the onset of the AIDS epidemic.

Infection rates predicted to be highest in developing countries and in children\(^{(55)}\). C. parvum is transmitted by the faecal oral route and infection may be acquired in many ways, from contaminated water, person to person contact, contaminated raw foods (eg. Raw meat, milk, fruit and vegetable)\(^{(56)}\).
The clinical feature after an incubation period of 7-10 days (range 5-28 d), the patient develops diarrhea, may have abd. cramps and low-grade fever. Patient with AIDS can have voluminous diarrhea (up to 17L/d). Biliary infection in patients with AIDS is associated with right upper quadrant pain, nausea, and vomiting\(^{57}\).

Food poisoning caused by cryptosporidium is moderate with large amounts of watery diarrhea lasting (2-4 days). May become a long lasting problem in people with poor immune system (such as people with kidney transplant, HIV/ADS or those on chemotherapy\(^{58}\)).

Diagnosis of c. parvum in those who are infected with it is usually accomplished by the following methods: Acid-fast staining, immuno-florescence staining and unconcentrated fecal smears. A new method being used polymerase chain reaction (PCR) in detecting cryptosporidium in water supplies\(^{59}\).

Although no antibiotic treatment has yet been shown to be affective in clinical use, some encourage results following use of paramomycin have been reported.
There is also preliminary evidence to suggest that paromomycin when used at doses of 1.5 – 2.0 g/day has led to symptom improvement, and even eradication of parasite. However, doses to produce this effect in all patients would approach toxicity.

Although Azithromycin and lactobin-R (bovine colostum immunoglobulin concentrate) have had some experimented success, no therapeutic agent has been clearly identified as effective\(^{55}\).

Since the mode of transmission for this disease is through the oral-fecal route, washing hands is the most effective means or preventing cryptosporidium transmission\(^{59}\).

For people who are immunocompromised, they should consider using 1-micron water fitters when drinking tap water. Boil or distill water in countries with high risk of transmission. Avoid newborn animals (eg. Calves, lams), including domestic animals\(^{57}\).

1.7.4 Ascaris lumbricoides

A. lumbricoides os the largest rematode (round worm) parasitizing the human intestine, and the most common human
Lehminthic infection, world-wide distribution. Highest prevalence in tropical and subtropical regions, and areas with inadequate sanitation. The WHO estimated that there were 1000 million cases of ascariasis due to A. lumbricoides infection world wide (WHO 1987).

In rural communities in Honduras Central America in 1998 the prevalence of A. lumbricoides was 45% and the most intense infection were found in children aged 2-12 years old (60,61).

Infection with Ascaris begins with the ingestion of an infective egg, which contain a stage 3 larva. The larva hatches in the small intestine and migrate via the lymphatic system to the lungs, it molts to a stage 4 larva, crawls up the trachea and reingested by the host. When the larva reaches the intestines for the second time, it develops in mature worms. There is a male and female worms can produce up to 200,000 eggs in a single day. Thus, a heavy infection is only increased by ingesting many infective eggs. Uppora excretion, Ascaris eggs are not infective. The infective stage is an embryonated egg, (after maturation) containing a stage 3 larva (62).
**Clinical features:**

Although infection may cause stunted growth, adult worms usually cause no acute symptoms. High worms borders may cause abd. Pain and intestinal obstruction. Migrating adult worms may cause symptomatic occlusion of the biliary tract or oral expulsion. During the long phase larval migration, pulmonary symptoms can occurs (cough, dyspnoea, hernoptysis eosinophilic pneumonitis – Loefflars’ syndrome)\(^{(60)}\).

**Diagnosis:**

Early infection (larval migration), CBC for eosinophilia, sputum smear for larvae, while stool examination will be normal. Established infection (adult/GI phase) stool for ova and parasites, characteristic eggs are seen easily on stool examination\(^{(6)}\).

**Treatment:**

Treatment is effective only against the adult worms and the drugs of choice are

- Albendazole – A single dose of 400 mg.
- Mebendazole – 100 mg twice daily for 3 days.
- Pyrantel pamoate – single dose of 10 mg/kg.
Surgical treatment for complication in case of intestinal obstruction\textsuperscript{(65,60)}

**Prevention and control:**

Control must be based on a combination of:

- Environmental control – safe disposal of human excreta, prevention of soil-contamination round the house.
- Health education should be based on what the people need to know, what they can do for themselves and what motivates them to participate actively. This will need a preliminary sociological survey to determine how the programme should be developed.
- Mass treatment – it objective to reduce the worms' loads and the target is young children. In the Philippines periodic mass treatment in given three times a year at four-months intervals for three years. Antihelminties are used, Meberzole, pyrantel pamoate, Albendazole\textsuperscript{(65)}.

**1.7.5 Hookworms infections:**

The disorder caused by infestation with round worms N. americanus, A. dotodenalis, A. ceylenicum, or A. biaziliense. The
first two occur in human only; the last two types also occur in animals\(^{(66)}\).

**Epidemiology:**

A. duodenale native to part of Southern Europe, North Africa and North Asia, part of Western South America, N. americanus in central and southern Africa, southern Asia, Australia and the Pacific Islands. It being estimated that there are 1200 million cases of hookworm infection to man annually, of which about 100 million of are symptomatic infection with accompanying anaemia\(^{(67)}\).

The infection is contracted by persons walking barefoot over contaminated soil. Once larvae have broken through the skin, they enter the blood stream and are carried to the lungs. The larvae migrate from the lungs up the windpipe to be swallowed and carried back down to the intestine. Maturation of the worms in the intestine before eggs appear in the stool to be recycled without intermediate host\(^{(68)}\).

**Pathology:**

The adult hookworms attach to the intestinal wall and preferred the upper small intestinal part, but in very heavy
infections the parasites may spread down as far as the lower ileum. Once attached to the intestinal wall, the hookworms mouthparts penetrate blood vessels, and obtain nutrition by sucking blood. The continuous loss of blood leads to chronic anaemia, which leads to permanent loss of iron and many blood proteins as well as blood cells\(^{(67)}\).

**Clinical features:**

Local invitation or itching at the site of skin invasion. An intensely pruritic, erythematous, or vesicular rash appears on the feet. Severe infection may produce pneumonitis manifested by cough, fever and malaise. As worms mature in the jejunum, patient may experience diarrhea, vague abd. Pain, colic or nausea\(^{(69)}\).

In susceptible children hookworms may cause intellectual, cognitive and growth retardation, as well as intrauterine growth retardation, prematurity and low birth weight among newborns to infected mothers \(^{(69)}\).

**Diagnosis:**

Direct microscopic stool examination for ova and parasites, usually reveals oval eggs with thin, colourless shells.
Concentrated techniques may be helpful for diagnosis of minimal infection. Anaemia is confirmed by CBC and peripheral blood smear, results that demonstrate signs typical of iron deficiency anaemia. Eosinophilia is present only during larval migration\(^{(69)}\).

**Treatment:**

Albendazole is the drug of choice. A recent study in Sri Lanka showed a 77.9% cure rate and 95.4% reductions in eggs counts. Mebandazole administration result in 95% cure rate and 99.9% reduction in eggs counts. Pyrantel is an alternative agent. Iron replacement should be part of the management\(^{(69)}\).

**Prevention and control:**

Improve sanitation measures in developing countries is necessary for prevention of infection. Current WHO recommendations include mass therapy to lower the overall worm burden. Community leader should be trained about WHO recommendations\(^{(66,69)}\).

**1.7.6 Strongyloides stercoralis:**

S. stercoralis is a small nematode that infects the intestine of dogs and primates (including humans). It has also been reported from cats, which may harbor at least three other members of this
genus (s. felis, splaniceps and s. tubefasciens). S. stercoralis is an unusual parasitic nematode in several aspects: it parthenogenenic females are found in the host\(^{71}\). S. stercoralis affects 30 – 100 million people worldwide; it is endemic in Africa, Asia, Southeast Asia, and central and south America\(^{72}\).

An infection occurs when the larvae of strongytoides, contained in contaminated faeces in the soil, is able to penetrate human skin, entering the bloodstream and passes through the heart into the lungs, then migrate from the lungs, then migrate from the lungs and crawl up the wind pipe. They are then swallowed and are transported to the intestine where they will develop into mature worms. Ingestion of the infective strongyloides larvae may also result in infection via the faecal-oral route\(^{73}\).

An inflammation of the skin may develop where the larvae entered. A cough or other respiratory difficulties may occur when the larvae migrate through the lung.

The intestinal illness caused by strongyloides infection in humans can range from very mild to fatal. Usually the disease is chronic and causes abd. Pain, diarrhea, nausea, vomiting, weight
loss, weakness and sometimes constipation. In some humans, especially those with suppressed immune system, the larvae that hatch from the eggs in the intestine may stay there and develop into adults. This can greatly increase the number of worms in the person and the severity of the disease. In children and others who may have poor hygiene, persons may re-infect themselves if their hand become contaminated with own fecal material\textsuperscript{(74,77)}.

Diagnosis is based on finding juveniles in freshly passed stools, by a direct smear in cases of heavy infections or following concentration by Baermann isolation or zinc flotation with centrifugation\textsuperscript{(75,76)}.

Sanitation involving proper disposal of human wastes. Infected persons and animals may be treated with appropriate anthelminties (Vernox, pgranty pamoate, thiabendazole or cambendazole)\textsuperscript{(76)}.

Strongly larvae are killed by cold temperatures and in dry environments. Good hygiene measures should be used by persons who may have contact with feces\textsuperscript{(74)}.
1.7.7 *Trichuris trichiuria*

A nematode (round worm) also called the human whipworm. The third most common round worm of humans occurs world-wide, with infection more frequent in areas with tropical weather and poor sanitation practices, and among children. It is estimated that 800 million people are infected worldwide\(^\text{(78)}\).

Ingestion of infective eggs from contaminated soils or food; eggs commonly found on vegetable from contaminated soil; eggs require 10 – 30 days of incubation in moist soil to become infective\(^\text{(116)}\) when swallowed, the infective juvenile eggs hatches in the small intestine and enters the crypts of Lieberkuhn. After a short period of development, it re-enters the intestinal lumen and migrates to the large intestine where it matures in about 3 months. Adults live for several years, so large numbers may accumulate in a person\(^\text{(80)}\).

This parasitic roundworm infection of the large intestine often has no symptoms. Heavy infections may cause intermittent stomach pain, bloody stools, diarrhea, weight loss, rectal prolapse,
failure to thrive and symptoms of anaemia (only massive infection)\textsuperscript{(81,83)}.

Mebendazole 100 mg PO bid on consecutive 3 days and pyrantel are the drugs of choice\textsuperscript{(82)}.

Training of children and adults in sanitary disposal and washing of hands is necessary to prevent re-infection. Contacts may be screened for asymptomatic carrier state\textsuperscript{(80,83)}.

1.7.8 Enterobius vermicularis(Penhorm):

Pinworm is the most common worm infection in the United States. School-age children have the highest rates of pinworm infection. They are followed on frequency by preschoolers. Institutional settings, including day care facilities, often harbor cases of pinworm infection. Sometimes, nearly half of children may be infected. Pinworm infection often occurs in more than one family member. Adults are less likely to have pinworm, infection excepts mothers of infected children\textsuperscript{(84)}.

Pathophysiology:

E. vermicularis lives in the small intestines, primarily the ileocecal region. Female migrates to anus and deposits eggs in the perional skin folds, usually at nighttime. The movement of the
female and the ova cause intense local pruitus, ova may survive for up to 3 weeks before hatching. The larvae can then migrate back into the anus and lower intestine, causing retroinfection. Embryonated eggs may be released into the air onto fomites (e.g. beds, clothing) or placed directly into the mouth and swallowed (autoinfection), after which they settle in the small intestines\(^{(85)}\).

**Clinical features:**

Ordinary infection cause relatively mild symptoms, usually intense itching in the perianal region, and feeling ‘out of sorts’. In children loss of appetite, insomnia and restlessness are the usual symptoms associated with pinworm infection. Massive infections may cause intestinal blockage but this is rare. Occasionally adult worms can be seen on a person’s poor. If you look carefully at the child’s bottom, around the opening (anus), you can sometimes see the worms there, especially at night\(^{(86,87)}\).

**Diagnosis:**

Pinworms are best diagnosed by examining the perianal skin. The stool is usually negative for ova and worms. To obtain the eggs, a tongue blade covered with clear tape is placed sticky-side down over the unwashed perianal skin in the morning.
Specimens are collected on three mornings, then taped to glass slides and taken to a laboratory for examination\(^{(88)}\).

**Treatment:**

- **Mebandazole:** 100 mg single dose for children more than two years of age. It is better to give a 3 day course to cover other heminthes. Pretreatment after 2 weeks with a single dose of 100 mg. Undergarments should be dried in sun for extended periods. Treat all family members simultaneously.

- **Albendazole** 400 mg OD single dose, followed by repeat dose after 2 weeks. Better to treat family member and close group contacts simultaneously.

- **Pyrantel pamoate** – 11 mg/kg orally for the first dose and second dose after 2 weeks\(^{(89)}\).

**Prevention and control:**

Pinworms can be prevented by proper handwashing, especially after using the bathroom and before eating. After treatment, bed liners and pajamas should be washed thoroughly and dried in the dryer on a high setting. The bathroom and all surface should be cleaned and disinfected thoroughly. It is often
recommended that children stay home from school or day care for 24 hours after being treated. Nails should be cut short\textsuperscript{(90)}.

1.7.9  \textbf{Taenia saginata (Beef tape worm)}:

The beef tape worm, Taenia saginata, is found in latin America, Africa, Russia, Asia, and throughout the western world. It is said to be “universal” in Ethiopia. It is estimated that about 40 million person are infected worldwide\textsuperscript{(94)}.

Tapeworm infection is acquired by eating raw or undercooked meat of infected animals. The larvae from the infection meat develop in the human intestine into the adult tape worm which grows and can attain lengths greater than 12 feed.

Tape worms are segmented, with each segment (proglottid) capable of producing eggs. Eggs are dispersed by individual or groups of proglottids detaching and passing out with the stool. This parasitic has cattle or related animals as its main intermediate hosts which infected by ingestion of the eggs of the tape worm, shed from the faeces the carnivorus definitive host, in this case man\textsuperscript{(95,96)} infection is asymptomatic in the majority. Usually, if symptomatic, then there may be mild epigastric and abd. pain and occasional vomiting and diarrhea. Weight loss is not used feature.
Rarely, more severe clinical manifestations may occur as a result of obstruction of the appendix (appendicitis) or pancreatic ducts (pancreatitis) by the adult worms\(^{97}\).

Identification of tapeworm segments or eggs in the stool is necessary for diagnosis of an adult tapeworm infection.

In many cases, a tentative diagnosis may be made on the basis of a patient’s description of short chains of tape segments in their stool\(^{98}\).

Treatment of batch tape worm is similar, praziquantel is considered the drug of choice (5 – 10 mg/kg PO). Niclosamide can also be used (< 2 years: 500 mg PO, 2-6 year: 100 mg PO, > 6 years: adult dose PO); both drugs are administer as a single-dose therapy\(^{99}\).

The best way to prevent infection with tape worm is to eliminate the exposure of livestock to the tapeworm eggs by properly disposing of human feces. The next best way strategy is to thoroughly cook or freeze all meat and fish before it is eaten to prevent consumption of liver tapeworm Larvae in infected sample\(^{98}\).
1.7.10 Hymenolepis Nana

Hymenolepiasis is caused by two cestodes (tape worm species) H. nana (dwarf worm) and H. dimnuta (rat tape worm). Infection with H. nana is most common in children aged 4-10 years in dry warm region of the developing world. H. nana infections affect millions of people worldwide, primarily children\(^{(91)}\).

Eggs of H. nana are immediately infective when passed with the stool and can not survive more than 10 days in the external environment. When eggs are ingested in contaminated food, water or hands contaminated with feces, the oncospheres contained in the eggs are released and penetrate the intestinal villus and develop into cysticercoid larvae, the villus rupture and the cysticercoid return to intestinal lumen, attach to the mucosa and develop into adults that reside in the ileum producing gravid proglottids and passing eggs with stool. Internal autoinfection can occur\(^{(92)}\).

The majority of infections is asymptomatic but only occur with heavy infection. Among children symptoms and signs include diarrhea and sometimes bloody, abd. pain, vomiting, loss
of appetite, weakness, irritability, restlessness, pruritus, nasal priuritus, headache, dizziness and seizures \(^{(92)}\).

Diagnosis is based on identification of characteristic eggs in the stool specimens. One third of infective children have eosinophilia exceeding 5\%. Section of the adult worm most often disintegrate before passage into the stool but rarely may be discovered \(^{(91,93)}\).

Praziquantel as a single dose is the current treatment of choice. Niclosamide for children 2-8 years of age, the dose is half the adult or 1 gm for 5 days, for children those under 2 years, it is 0.5 gm for 5 days, alternative is paromomycin 45 mg daily for 5 days \(^{(91,93)}\).

Prevention and control by good hygiene, public health and sanitation programs, washing hands and vegetables \(^{(93)}\)

1.7.11 Schistosoma Mansoni:

Human schistosomiasis is caused by the digenetic trematodes schistomona haematobium, s. intercalatum, s. japoricum, s. mansoni. An estimated 200 million people in 74 countries have schistosomiasis, 85\% of whom live in sub-Saharan
Africa, S. mansoni is endemic in north-east Brazil, Venezuela, Suriname and the Caribbean\textsuperscript{(100)}.

The life cycle of schistosomes includes two host, a definitive host (e.g. man) where the parasites undergo sexual reproduction, and a single intermediate snail host where there are a number of a sexual reproductive stages\textsuperscript{(101)}.

The infected snails release cercariae, which are fork-tailed free swimming larvae. The cercariae survive in fresh water up to 48 hours, during which time they must attach to human host, they migrate through blood to lung last to the portal veins where they mature, in the endothelium system they begin to produce eggs, which migrate through the bowel wall to be shed via feces in fresh water to enter the snail (intermediate host)\textsuperscript{(102)}.

The pathophysiology of acute schistosomiasis (ie katayama fever) is a serum sickness-like illness, is associated with marked peripheral eosinophilia and circulating immune complexes is most likely to occur in heavily infected individuals often parimary infection. The pathology of chroric schistosomiasis results from egg induced granuloma formation and associated fibrotic changes. Eggs retention and granuloma kormation in the bowel
wall may cause bloody diarrhea, cramping and inflammatory colonic polyposis. Heavy infestation is more likely to produce hepatic disease resulting in portal hypertension with the usual possible sequelae including splenomegally ascites, esophageal variceal bleeding and development of portosystemic collaterals. The central neurons system and lung also may be involved(102).

Diagnosis is made by examination of stool specimens for egg by recovery of the characteristic lateral spinal eggs. In chronic cases we used concentrated techniques because the eggs may not be found by direct examination by other concentration or in 0.5% glycerinated water, rectal scrapings, aspirates or biopsy via the proctoscope may be more rewarding than fecal examination also. When eggs can not be isolated for examination, seroimmunodiagnostic test can be useful for community servyes the keto echnique is satisfactory (104).

The drugs of choice for treatments are proziquanted and oxamniquine. There is study done for efficacy of both of them in the treatment of schistomas mansoni and the study revealed that the care rate by proziquanted (60 mg/kg/for three days) was more than 90% and for oxamniquine (20 mg/kg/day) only was 42%.
Education through implement health programs that inform the populace of way to protect themselves. The prevalence can be decreased through supply with safe water by good public health practice.

Prevention and control is by improved sanitation to decrease fresh water contamination with sewage. Behavioral intervention to decrease occupational and recreation contact with contaminated water special with children. Mass treatment of targeted population (102,105).
JUSTIFICATIONS AND OBJECTIVES

Justification:

1. Intestinal parasites and helminthes infestation is a common health problem especially among children under five years and communities with poor hygiene and unsafe water supply.

2. Intestinal parasites and helminthes infestation can be partially prevented by simple measurement of health education and are treatable.

3. Few community based studies were done.

Objectives:

1. To estimate the prevalence of intestinal protozoa and parasites infestation among under five children in Jebel Awleia Governorate.

2. To correlated infestation with personal habits, nutrition, hygiene and other social factors.
Chapter Two

MATERIALS AND METHODS

2.1 Study design:

It is a prospective community based comparative study, conducted in Jabel Aweleia Governorate, Khartoum State among under-five years children from different social groups.

2.2 Study Area:

Khartoum State consists of seven governorates. The selected governorates was Jabel Aweleia, located in the Southern of Khartoum in North of Elgezira and White Nile States.

It is consisting of three Town, thirty three villages and three major' camps of displaced people. Its population was estimated to be 834553 peoples, of which children under-five were 191653 children. The selected study areas include:

2.2.1 Jabel Aweleia town area:

Is the second town in the governorate located southern part of the State, about 40 km on the highway of Khartoum - Rabak and
on the Eastern bank of the While Nile River where there is Jabel Aweleia dam. It represents the urban area and consists of ten blocks from which two blocks were selected: Elhila Elgadida and Hai Eltugar. The town is inhabited by 38,603 people and of which under-five were 17,960 children.

2.2.2 Treaa Elbiga village area:

Represents the rural area in this study. It is about 25 km from Khartoum on the same direction line to Jabel Aweleia town. It is located by about 5,245 people, children under-five were 1220 child.

2.2.3 Mayo Camp area-Mandela:

Mayo displaced camp reside in the north-west of governorate immediately Southern Khartoum governorate. The camp was divided into four sections by PHC, the southern one is Mandela. It represents displaced camp area of the study. The population in the camp (area) was estimated to be 147,714 peoples, 21,536 out of them were under five years of age.

2.3 Study Duration:
The study was done during the period September 2003 to September 2004.

2.4 Study Population:

The study population included 390 children under five years of age, 202 were males and 188 were females.

2.5 Inclusion Criteria:

All children under-five years of age living in the study areas for more than one month before the study, after their parent’s verbal consent was taken (including children with diarrhea and exclusive breast fed).

2.6 Exclusion Criteria:

- Children who received treatment for protozoa and parasitic infestation during the last two weeks before the study.
- Refusal to give consent.

2.7 Sample Size:

The sample size was 390 under-five children.

The sample size was determined according to the advice of a statistician, it was calculated according to the formula:

\[ N = (Z \times PQ)^2 \]
\[ D^2 \]
\[ N = \text{Sample size} \]
\[ Z = 1.96 \quad (95\% \text{ confidence limit}) \]
\[ P = \text{Prevalence} = 44\% = 0.5 \]
\[ Q = I - P = \text{Probability of failure} = 0.5 \]
\[ d = \text{desired margin of error} = 0.05 \]
\[ = \text{correction factor} \]

Using this formula, with a prevalence of intestinal protozoa and parasitic infestation among under-five Sudanese in Khartoum State (44\%) (8), the minimum total sample size was found to be 385 children. So 390 children were included in the study.

2.8 Sampling Technique:

2.8.1 Questionnaire:

A standardized questionnaire was used to obtained information concerning the personal history of the child, detailed history about parents education and occupation, family size and income, No. of rooms, habits of the children and their families, hygienic conditions, health awareness, in addition to information about the source of supply and drinking water, where it was kept in, type of sewage system, house refuse, contact with animals and other hygienic indicators. The parents were asked about history of
fever, cough, anorexia, abd. Pain and distension, diarrhea, purities ani, itching, loss of weight and any others complain.(Annex 1)

**Clinical examination:**

Every child was subjected to a thorough clinical examination including a general check up for pallor, jaundice; chest was examined for wheeze, also abdominal examination for distension and organomegaly, L.L. edema and any other signs.

Anthropometrics and nutritional assessment for clinical evidence of wasting in the arm, buttock and thigh, vitamins and trace elements deficiencies.

Weight of children was measured with the underwear. The error of weighting the children with underwear was corrected by subtracted 0.1 kg.

The length of children in the first year of age or those who not stand was measured by holding the child under the mandible with the vertex against the head board and other stretching the extended legs with the foot board against the soles of the infant’s feet. Height for other children is measured while the child stands with bare feet the base of the height scale, heels against backstop with straight legs, exerts gentle pressure on mastoids to extend neck and external auditory meatus and lower rim of orbit in horizontal line and the child looks slightly down wards. The head
board of the height scale sitting on the vertex of the skull and at right angles to back rest using a measure box (Shorr Board Tm USA)\(^{(62)}\).

The questionnaire and physical examination were evacuated by the author.

2.8.2 Collection of the Stool Samples:

The areas were visited on a day prior to the collection of the sample for fulfillment of the questionnaire and each child was provided with a labeled a plastic container with cover connected with spoon, the number of area and child was written on the plastic container. The children mother's were advised to bring fresh stool immediately after collection (better morning fresh sample). The specimens collected weight about 10 grams and were examined macroscopic and microscopically within an hour in the mobile laboratory team in the field with respect to macroscopic parasites, then the same samples were sent to the parasitology department after adding 10 ml formal saline, 10% v/v (formaldehyde solution).

2.8.3 Examination of the stool specimens:

Each specimen was examined macroscopically and microscopically, using a direct smear in the field and smears
prepared by concentration methods in the National Laboratory (STAC). The samples were examined by experienced.

a. **Direct smear examination:**

For preparation of direct smear an amount of two to three grams of faecal sample was taken using a wooden applicator, and precaution was undertaken to avoid the collection of none faecal elements. Further, the sample was suspended by stirring of the faeces in a drop of fresh physiological NS (6.9%) already placed in the slide priory and an even suspension of faeces was prepared in the slide. All large particles that obstruct to place the cover slip were removed. The suspension was then carefully covered with a cover slip avoiding air bubbles. Microscopic examination of the sample was carried out in a systematic manner. Observation as commenced using time four (4 x) objective for general screening of the whole preparation. Before starting microscopic examination the sub stage condenser was lowered and closed enough to obtain the maximum illumination. The light intensity was adjusted so that the opaque parasitic structures could be seen. The lowered time-ten (10X) objective was then used to locate any parasitic object. The searching was commenced as the upper left hand corner of the sample working across the slide from the left to the
right one field width at a time, till the upper right handed edge of the sample was reached.

When any parasitic like object came into view, the fine focus was adjusted continuously so that all the depth of the sample was canned. After its location, the suspicious object was then closely examined and identified under the high power time forty (40X) objective, in order to either verified or disregarded.

b. Concentration Techniques:

1- **Formal-ether concentration technique:**

This is recommended for use in district laboratories because it is rapid and can be used to concentrate a wide range of faecal parasites from preserved faeces. Eggs that do not concentrate well by this technique are those of fasciola spp. And hymenolepsis nana (70).

One gram of faces was taken with applicator stick from different parts of the specimen, and then the faeces were further added to five ml of formalin in calibrated 15 ml conical glass centrifuge tube. The faeces were then broken up thoroughly and were emulsified with an applicator stick. The resulting suspension was strained through a nylon sieve, into 15 ml breaker and then the filtrate was poured pack into the centrifuge tube. Debris trapped on the sieve was discarded, and then the sieve and the beaker were
washed thoroughly under running tab water between processing. The tube was then centrifuged for two minutes at 3000 rpm with the penuche centrifuge. The water sedimentation process was repeated until the supernatant was clear.

After the supernatant was decanted approximately one ml of sediment faeces was left, about 9 ml of 10\% formalin solution was added to the tube and thoroughly mixed with the sediment. The suspension was allowed to stand for ten minutes and till all the faecal materials were fixed.

Three ml of ethyl acetate was added to the tube. Then it was stopped, shaked vigorously in inverted position for half a minute, and then centrifuged for two minutes at 2000 rpm. Thus, only the preparation with four layers (ethyl at the top, followed by plug of debris and formalin and sediment in the bottom) was accepted. The plug over the debris was loosen by running the circumference of the tube with an applicator stick; the three layers were decanted by inverting the tube. The last one or two drops were allowed to fall back into the tube. The filtrate was allowed to sediment to a glass slide. Then, the preparation was scanned by (4 X) and (10 X) objectives respectively. The identification of morphological features was carried under (40 X) objective.
Although the motility of the parasites will not be seen, non-mobile larva can be easily recognized because of large size.

c. Floatation technique (Zinc sulphate solution floatation technique):

About one quarter of a 15 ml tube was filled with zinc sulphate solution. Then one gram of faeces was taken with an applicator stick and added to the zinc sulphate. The faeces was then broken up thoroughly and emulsified with an applicator stick. Then the tube was filled with zinc sulphate solution, and mix well. The resulting suspension was strained through a nylon sieve to remove large faecal particles. Debris trapped on the sieve was discarded. The suspension was returned to the tube, and the tube was allowed to stand in completely vertical position in a rack. Further, the solution of zinc sulphate was added to the tube using Pasteur pipette and the tube was filled to the top.

Thereafter a clean cover glass was placed on the top of the tube avoiding trapping any air bubbles. The suspension was then left undisturbed for 30 minutes to give time for cyst and eggs to floats.

The cover glass was pull upward carefully from the tube and placed face downward on the slide.
The preparation was then scanned by time four (4 X) and by time ten objective (10 X) respectively. The identification of morphological features was carried under time forty objective (40 X).

2.9 Management of the affected children:

Any child who had symptom and signs of the infestation and confirmed by laboratory and/or diagnosed by laboratory alone had been given suitable treatments. Children infected with G. Lamblia and amboeesis were treated with metronidazole syrup, dose 15 mg/kg/day for 5 days. The daily dose was divided in three doses and was given after food.

The child who was infected with schistosomiasis received prazaqutel in a dose of 40 mg/kg/dose tables as a single dose. The same drug in a dose of 25 mg/kg tables as a single dose was given to the children with positive stool result for H.nana.

Children infected with E.vermicularis were given mebendazole syrup in a dose of 100 mg twice daily for three days. The same dose was prescribed to other children of the family.

Health education for older children, their parent’s and their relative available at the time of the visit. The health education was
about personal habit, best source of water and keeping it, animal and animal product handling and about sewage system.

The education also was about public sanitation, refuse disposal and house refuse, and reinfection.

2.10 Ethical Considerations:

• Consent was taken from the parents.

• Letters were written to HAC, PHC, Governmental administrators responsible & some of non governmental organizations working there.

2.11 Research Team:

• Author
• Three medical offer
• Lab. Technician
• Lab assistant

2.12 Data Analysis:

The questionnaire was coded, and a master sheet was constructed to arrange the raw data. Tables were then drowned and descriptive statistics measured.

Chi-square test was then computed to compare the difference between areas (urban, rural and displaced camp) using Statistical
Package for Social Sciences (SPSS) for personal computer, level of significance was set at p value < 0.05.

EPI-Info 2002 Statistical Package Computer Programme was used to determine the nutritional status of children (boys and girls)\(^{(71)}\).

**Indicators produced were:**

WHZ (weight for height or length Z – score)

SD (Standard deviation)

Z-score or Standard Deviation [SD] Score = is the deviation of the value for an individual from the median value of the reference population, divided by the standard deviation of the reference population:

\[
Z = \frac{(Observed \ value) - (median \ reference \ value)}{\text{Standard deviation of reference population}}
\]

- F WHZ was > - 2SD, i.e. mild malnutrition
- F WHZ was > - 3SD, i.e. moderate malnutrition
- F WHZ was ≤ - 3SD, i.e. severe malnutrition
- F WHZ was > - 2SD, i.e. mild malnutrition
Chapter Three
3- RESULTS

3.1 Characteristics of the Study Population:

The study populations were children under-five in three areas: the urban Jabel Aweilia town, the rural Treaa Elbiga village and the displaced camp Mandela – Mayo. The study samples were selected randomly and consisted of 390 children, 130 children from each area. The gender distribution in the study was near equal, males (51.8%) and females (48.2%) by living area males were (56.9%), (54.6%) and (43.8%) for males, and (43.1%), (45.4%) and (56.2%) for females in urban, rural and displaced camp area
respectively. The difference statistically not significant (P > 0.05). (Figure 1)

The distribution of children according to age in urban area was equal in up to 1 year (18.5%), (>2-3) year (17.7%), (>3-4) year (19.2%) and less than 5 year (17.7%) except (>1-2) year was (26.9%).

The rural area; the distribution according to age groups were (14.6%), (19.2%), (20.8%), (26.9%) and (18.5%) for up to 1 year, (>2-3) year, (>3-4) year and less than five years respectively.

The displaced camp area; the distribution of children according to age group was equal in age groups, up to 1 year (23.1%), (>1-2) year (22.3%) and (>2-3) year (24.6%) while for (>3-4) year (20%) and for less than 5 year (10%). The difference were statistically not significant (P = 0.175). (figure2) (table1)

The total number of infected children in all areas were 186 (47.7%): 51 (27, 4%) (39, 2%) in urban area, 58 (31, 2%), (44.6%) in rural area and 77 (41, 4%), (59.2%) in displaced camp area. The difference statistical significant P = 0.004. (figure3) (table2)

3.2 Stools microscopy:

3.2.1 Types of the parasites:
The types of parasites among infected children in 3 areas were as follows: the commonest parasites detected were G. lamblia (33.3%), non pathogenic E. coli (8.5%), E. histolytica (0.8%), H. nana (9.5%), E. vermicularis (3.8%) and S. mansoni (0.3%).

In the 3 areas the commonest parasites was G. lamblia 34 (26.2%), 45 (34.6%) and 51 (39.2%) in urban, rural and displaced camp area respectively, followed by H. nana in urban area 11 (8.5%) and 26 (20%) in displaced camp area while in rural area followed by nonpathogenic E. coli 9 (6.9%) comparing the displaced camp area with urban and rural areas, the prevalence rates of parasites were high in displaced camp than in the urban and rural except S. mansoni one case (0.8%) was found in rural area. E. histolytica was present in rural and displaced camp (0.8%) and (1.5%) respectively, but not found in urban area. E. vermicularis was more common in displaced camp area (6.2%) followed by urban area (3.8%) and rural area (1.5%). The difference statistical not significant (P = 0.293). (Table 3, Figure 4).

3.2.2 Mode of infection:

The common mode of infection was by a single parasite 154 (82.8%) in 3 areas. In urban areas the prevalence rate of intestinal
parasites infection were (86.3%) for single parasites, (13.7%) for two parasite while in rural area (89.7%) for single parasite and (10.3%) for two parasites but no child infected by three parasites in both areas. In displaced camp area infection by single parasite was (75.3%), two (18.2%) and three parasites (6.5%). The difference was statistical significant (P = 0.051). (figure 5)

3.3 Prevalence of Intestinal Parasites According to the Socio-demographic Characteristics:

3.3.1 Prevalence according to age group of the children:

The distribution of infected children according to age groups in the study was upto 1 year 16 (8.6%), (>1-2) year 36 (19.4%), >2-3 year 41 (24.7%), (>3-4) year 52 (28%) and less than 5 year 36 (19.4%), and was distributed by living area as follows: In urban area, the most infected age group were (1-2), (>3-4)year and less than 5 years 12 (23.5%), and the most less infected age group was upto 1 year 6 (11.8%). In rural the most infected age group was (>3-4) year 22 (37.9%) and the less age group was up to 1 year 4 (6.9%). In displaced camp area the most infected age group was (>2-3) year 26 (33.6%) the less one was up to 1 year 6 (7.8%).
The rural area the distribution of prevalence increased by increasing age group except less than 5 years which was not. The differences between age groups were not statistically significant. (P = 178). (Table 4, Figure6)

3.3.2 Prevalence according to the gender of children:

There were differences among children infected by intestinal parasites infection related to their gender with increasing the prevalence rates in males 101 (54.3%) and females 85 (45.7%).

Comparing the 3 areas of the study, the prevalence rates among male were high in urban area 36 (70.6%) and in rural area 30 (51.7%), while in the displaced camp the prevalence rates was high in females 41 (54.5%) and in males (45.5%).

The difference was statistically significant (P < 0.05). (Figure 7, Table 5)

3.3.3 The prevalence rate according to fathers’ education:

The relationship between the prevalence rates of intestinal parasites among children was studied. In general the prevalence
rates were closely related to the father’s education, with exception of children whose fathers were educated in Quraan school 5 (62.5%) and illiterate group 39 (60%), the relationship was inverse, for graduated or post graduated 15 (33.3%), for secondary school 45 (40.9%) and for primary school 82 (50.6%). The difference was statistically significant (P < 0.05).

In urban and rural areas the pattern is similar to the general pattern with higher incidence in illiterate and Quraan school 5 (50%), 1 (20%) and 1 (50%), 3 (60%) in urban and rural respectively. The difference was not statistically significant (P > 0.05).

In displaced camp area no differential relationship between father’s education level and prevalence rate intestinal parasite among children. Prevalence rates were 33 (66%) for illiterate, 1 (100%) for Quraan school, 31 (55.4%) for primary school 11 (50%) for secondary school and 1 (100%) for graduate or post graduate and lower incidence in postgraduate 8 (29.6%), 6 (35.3%) in urban and rural respectively. The difference was not statistically significant. (Figure 8, Table 6).

3.3.4 Prevalence rate according to father’s occupation:
The prevalence of intestinal parasites in children according to their father’s occupation was obtained, which was high and proportional related to father’s occupation with prevalence rates 12 (52.2%) for unemployed, 122 (49.2%) for unskilled laborer, 21 (48.8%) for skilled laborer and the lower one for civil job 30 (41.7%). The difference was not statistically significant. (P > 0.05)

In urban and rural areas the prevalence were similar to general pattern with exception in unemployed 0(0.0%) in urban area and skilled laborer 8(53%) in rural area. The difference was not statistically significant. (P > 0.05).

In contrast in displaced camp area there were no relation between father’s occupation and children infected by intestinal parasites infection and the prevalence rates were unemployed 8 (53.3%), unskilled laborer 54 (58.7%), skilled laborer 4 (57.1%) and civil job 10 (76.9%). The difference was not statistically significant. (P > 0.05) (figure 9, table7)

3.3.5 Prevalence rate according to mother’s education:

The majority of mother in the study either primary school education 154 (39.5%) or illiterate 108 (27.7%). The prevalence rate of intestinal parasites infection among children not related to
mother’s education and the prevalence rates were 63 (58.3%) illiterate, 6 (85.7%) Quraan school, 73 (47.4%) primary school and 9 (39.1%) graduated or post graduate level. The difference was statistically significant. (P < 0.05)

In urban and rural areas, the prevalence rate the pattern similar to the general pattern with higher incidence in illiterate and Quraan school education 7(53.8%), 8(57.1%) and 2(66.7%), 1(100%) in urban and rural area respectively, and lower incidence in postgraduate 4(33.3%) and 5(50%) in urban and rural areas respectively. The difference was not statistically significant. (P > 0.05)

In contrast in displaced camp area the prevalence rates was not related to mother’s education except for graduated or postgraduate which was (0.00%). The difference was not statistically significant. (Figure 10, table8)

3.3.6 Prevalence rate according to mother’s occupation:

The majority of mothers were housewives 337 (86.8%). The prevalence rates of intestinal parasite infection were not related to mother’s occupation and the prevalence rates were 160 (47.5%) housewives, 18 (62.1%) unskilled laborer, 1 (50%) skilled laborers
and 7 (31.8%) civil job. The difference was not statistically significant.

In urban and rural area, there was no relation between mother’s occupation and infection of children by intestinal parasites. The prevalence rates were 1 (0.00%), 1(50%) unskilled laborer, 4 (28.6%), 3(42.9%) civil job and 47 (40.9%), 54(44.6%) housewives in urban and rural area respectively. The difference was not statistically significant. (P > 0.05)

In displaced camp area, the prevalence rates of infected children according to mother’s occupation were 17 (65.4%) unskilled laborer, 1 (50%), skilled laborer, 59 (58.4%) and no children of civil job mother’s occupation infected. The difference was not statistically significant. (P > 0.05) (Table 9, figure 11)

3.3.7 Prevalence rate according to family income:

The majorities of families in the study have low income 147 (37.7%) and moderate income 137 (35.1%). The prevalence of intestinal parasitic infection was proportional related to family income with exception of very high income group 16 (45.7%), the prevalence rates were 78 (53.1%) low income, 61 (44.5%) moderate
income and 31 (43.7%) high income. The difference was not statistically significant (P > 0.05).

In urban and rural area was no relationship between family income and prevalence of infected children by intestinal parasites, prevalence were 12 (54.5%), 15 (46.9%) low income, 20 (34.5%), 18 (40%) moderate income, 9 (34.6%), 19 (45.2%) high income and 10 (41.7%), 6 (54.5%) very high income in urban and rural respectively. The difference was not statistically significant (P > 0.05).

In displaced camp area, the prevalence of intestinal parasites infection among children was inversely proportional to family income and prevalence rates were 51 (54.8%) low income, 23 (67.6%) moderate income, 3 (100%) high income in displaced camp area no family has very high income. The difference was not statistically significant. (P > 0.05) (Figure 12, table 10)

3.3.8 Prevalence of intestinal among children according to family size:

The author considered (3-5) members as small family, (6-8) members as average family, (9-11) members as large family. Accordingly the prevalence of intestinal parasitic infection among children in study has relationship to family size, and the
prevalence rates were 84 (43.3%) small family, 81 (53.6%) average family and 21 (46.7%) large family. The difference was not statistically significant. (P > 0.05)

In urban area, the prevalence rate of infection approximately related to family size with equal prevalence in average family 20 (40%) and large family 6 (40%), in small family prevalence was 25 (38.5%). The difference was not statistically significant. (P > 0.05).

In rural area, there was clear relationship between family size and the size of the family with increase prevalence among children of large family size 11 (57.9%) and average family size 25 (52.1%) and lower prevalence among children of small family size. The difference was not statistically significant. (P > 0.05).

In displaced camp area there was no relationship between family size and prevalence of intestinal parasitic infection among children, and the prevalence were 37 (56.1%) small family size, 36 (67.9%) average family size and 4 (36.4%) large family size. The difference was not statistically significant. (P > 0.05). (figure13)

3.3.9 Prevalence rates according to number of room in the house:

figure13

81
The majority of families have (2-3) rooms 222 (59.9%). The prevalence rates was related to numbers of rooms, and were 61 (43.6%) for one room, 113 (50.9%) for (2-3) rooms and 12 (42.9%) for more than 3 rooms. The difference was not statistically significant (P > 0.05).

In displaced camp area the prevalence rates were 37 (56.1%) for one room, 39 (61.9%) for (2-3) rooms and 1 (100%) for more than 3 rooms in the house. The difference statistically was significant for one room and (2-3) (P < 0.5) but for more than 3 rooms the difference was not statistically significant (P > 0.05).

3.3.10 Prevalence according to personal habits:

In the study the frequencies of personal habits were 389 (99.7%) washing hand before and after meals, 388 (99.5%) washing vegetables, 46 (11.8%) eating raw meat, 375 (96.2%) boiling milk, 173 (44.4%) had history of pica and 75 (19.2%) control of fillies.

In the study, the prevalence rates of intestinal parasites infections among children who used to wash their hand before and after meals 186 (47.8%), washing vegetable 185 (47.7%) boiling of milk 178(95.7%) , had history of pica 88 (50.9%) and control of
fillies 29 (38.7%). The difference was not statistically significant. (P>0.05)

The prevalence rates of infections among children who used to eat raw meat were 30 (65.2%). The difference was not statistically significant. (P < 0.05)

In urban and rural area, the prevalence rates were 51 (39.2%), 58 (45%) washing hand before and after meals, 51 (39.2%), 57 (44.5%) washing vegetables, boiling of milk 51 (39.5%) 55 (45.1%) and 28 (40.6%), 17 (44.7%) history of pica, in urban and rural area respectively. The differences statistically were significant (P < 0.05).

The prevalence rates for raw meat eating 6 (60%), 16 (69.6%) and control of fillies 11 (37.9%), 17 (38.6%), in urban and rural area respectively. The difference was not statistically significant. (P > 0.05).

In displaced camp area, the prevalence rates were 77 (59.2%) washing hand before and after meals, 77 (59.2%) washing vegetables, 72 (58.1%) boiling of milk and 43 (65.2%) history of pica. The difference was not statistically significant. (P < 0.05). The prevalence rate of raw meat eating was 8 (61.5%) and control of
fillies 1 (50%). The difference was not statistically significant. (P > 0.05)

In comparing the prevalence rates of children infected by intestinal parasites according to personal habits and living area, we found the relationship between them goes proportional with living as those the prevalence rates were higher in displaced camp area and lower urban area. *(Figure 14)*

### 3.3.11 Prevalence according to water supply:

In the study 242 (62.1%) had their water supply piped in door, 78 (20%) piped out door and 70 (17.9%). In the study there was no relationship between type of water supply and prevalence of infection by intestinal parasites among children, the prevalence rates were 102 (42.1%) piped in door, 51 (65.4%) piped outdoor and 33 (47.1%) deep well. The difference was statistically significant. (P <0.05)

In urban area the rate was not related to water supply and the prevalence rates were 47 (40.9%) piped in door and 2 (28.6%) deep well. The difference statistically was not significant (P > 0.05) prevalence rate for piped out door 2 (25%). The difference statistically was significant (P < 0.05).
In rural area the prevalence rate also was no relation between water supply and prevalence rate of infection and the rural area was not supply by deep well. The prevalence rate of infection were 55 (43.3%) piped in door (the difference statistically not significant) (P > 0.05) and 3 (100%) piped out door (statistically difference was significant (P > 0.05).

In displaced camp area no water supply by piped in door, and there was no relationship between supply and prevalence rate of infection. The prevalence rates were 46 (68.7%) piped out door and 31 (49.2%) deep well. The difference was statistically significant for piped out door (P < 0.05).

3.3.12 Prevalence according to source of drinking water at home:

Prevalence rates according to source of drinking water at home in the study related proportional to source of drinking water, the higher prevalence rate was other 27 (62.8%) and lower was refrigerator 20 (31.7%). Prevalence rate for tap was 2 (33.3%) and zeer 137 (49.3%). The difference was statistically significant (P < 0.05).
In urban area, the prevalence rate related to source of drinking water, and were refrigerator 12 (32.4%), tap 2 (40%) and zeer 37 (42%). The difference was statistically not significant (P > 0.05).

In rural area no relation between the prevalence rate and the source of drinking water, the prevalence rate were refrigerator 8 (30.8%), Zeer 49 (49.5%) and others 1 (25%). The difference was not statistically significant (P > 0.05).

In displaced camp area, there was no tap and refrigerator. The prevalence rates were 51 (56%) zeer and 26 (66.7%). The difference was not statistically significant (P > 0.05).

The was two children infected in urban and no one from rural area of whom drinking from the tap because tap water treated centrally and children drinking directly from it. (Figure 15)

3.3.13 The prevalence according to contact with animal:

The prevalence of intestinal parasites among children was studied. The prevalence rates for contact with domestic animal were 15 (40.5%) in urban, 23 (50%) in rural and 15 (71.4%) in displaced camp area. Prevalence rates for contact with pet animal was 4 (80%) in displaced camp area and no contact with it in urban
and rural area. For domestic animal the difference was not statistically significant ($P > 0.05$) and $P$ value for pet animal.

3.3.14 Prevalence according to sewage system at home:

The common type of sewage system in the study was private pit latrine 249 (63.8%). The prevalence rates was not related to sewage system and the prevalence rates were 5 (55.6%) siphon, 100 (40.2%) private pit latrine, 77 (61.6%) common pit latrine, 0 (0.00%) open space and 4 (66.7%) others. The difference was statistically significant ($P < 0.05$).

In urban and rural area the prevalence rates of infected children according to sewage system were 2 (50%), 3 (60%) siphon, 48 (39%), 49 (41.9%) private pit latrine, 1 (33.3%), 2 (100%) common pit latrine and 0 (0.0%), 4 (66.7%) others, in urban and rural area respectively. The difference was not statistically significant ($P > 0.05$).

In displaced camp area, the prevalence rates were 3 (33.3%) private pit latrine, 74 (61.7%) common pit latrines and 0 (0.00%).
The difference was not statistically significant (P > 0.05), *(Figure 16, Table 11).*

### 3.3.15 Prevalence according to refuse disposal:

The common type of refuse disposal was frequent 264 (67.7%). The prevalence rates of infected children according to refuse disposal were 110 (41.7%), frequent 76 (60.8%) and 0 (0.00%) none. The difference was statistically significant (P < 0.05).

In urban and rural area the prevalence rates were 50 (39.1%), 56 (43.8%) frequent and 1 (50%), 2 (100%) unfrequented in urban and rural area respectively.

In displaced camp area the prevalence rates infected children according to refuse disposal were 4 (50%) frequent and 73 (60.3%) unfrequented and 0 (0.00%) none. The difference statistically was not significant. (P > 0.05).

### 3.3.16 Prevalence rates according to sending of house refuse:

In study family sent house refuse to refuse disposal area 239 (61.3%). The prevalence rates of infected children according to house refuse were 101 (42.3%) sent to refuse disposal, 11 (40.7%)
buried and 74 (59.7%) burnt. The difference statistically equal the significant (P = 0.05).

In urban and rural area the prevalence rates were 48 (38.7%), 53(46.1%) sent to refusal disposal area, 1 (100%),4(30.8%) buried and 2(40%), 1(50%) burnt in urban and rural area respectively.

In displaced camp area the prevalence rates were 6 (46.2%) buried and 71 (60.7%) burnt. The difference were not statistically significant (P > 0.05)

4.4 Clinical findings:

4.4.1 Presenting symptoms:

The most frequent symptoms in the study was cough 207 (53.1%) followed by fever 137 (35.1%), anorexia 107 (27.4%), abd. distension and diarrhea 100 (25.6%).

The presenting symptoms were fever 76 (55.5%), cough 104 (50.2%), anorexia 54 (50.5%), abd. Pain 45 (45%), abd distension 37 (52.1%), diarrhea 50 (50%), burities ani 23 (46.9%), itching 17 (51.5%), loss of weight 27 (43.5%) and others 37 (50.7%).

In urban and rural area the most frequent presenting symptoms of infected children was cough 23 (35.9%), 27(50.9%)
and less frequent one were itching 1(14.3%) and abd. distension 6(54.5%) in urban and rural area respectively. The difference was not statistically significant for all symptoms except for itching in rural area (P < 0.05).

In displaced camp area the most frequent presenting symptom was cough 54(60%), and less frequent one was loss of weight 6 (46.2%) among children infected by intestinal parasites. The difference was only statistically significant for itching symptoms (P > 0.05), (Table 12).

4.4.2 Physical signs detected:

The most frequent clinical signs in the study was pallor 118 (30.3%).

The physical signs detected among infected children by intestinal parasites were 61 (51.7%) pallor, 2 (50%) jaundice, 2 (66.7%) keratitis, 8 (42.1%) wheezes, 28 (66.7%) abd. distension on examination, 9 (64.3%) hepatomegaly, 3 (75%) splenomegaly, 2 (40%) LL edema, 5 (83.3%) wasting in the arm and buttock and 4 (44.4%) signs of vitamin deficiency. The difference was only statistically significant for abd. Distension on examination (P < 0.05).
In urban and rural area the most frequent sign detected among the infected children by intestinal parasites was 24 (40%) pallor and less frequent were , 1 (100%) jaundice, 1 (100%) hepatomegaly, 1 (100%) wasting in the arm and buttock and 1 (20%) signs of vitamin deficiency in urban area while in rural was 1(100%) wasting in the arm & buttock. The differences were not statistically significant (P > 0.05).

In displaced camp area, the most frequent physical sign detected among infected children by intestinal parasites was 30 (68.2%) pallor and less frequent were 1 (100%) jaundice and 1 (14.3%) wheezes. The differences were statistically significant only for wheezes sign (P < 0.05). *(Table 13)*

### 4.4.3 Prevalence according to anthropometric finding by Z-score

#### 4.4.3.1 Height or length for age

The prevalence rates of infected children according to height for age by Z-score in the study were 15 (44.1%) (< - 3) z-score, 33 (50%) (-3 - -2.01) z-score, 58 (47.2%) (-2 - -1.01 z-score, 45 (47.4%) (- 1.00 - 0.00) z-score, 27 (51.9%) (0.01 - 1.00) z-score, 8
(47.1%) (1.01 – 2.00) z-score and 0 (0.00) (> 2.00) z-score. Difference statistically was not significant. (P > 0.05)

### 3.4.3.2 Weight for age

Prevalence rates of infected children by intestinal parasites according to age for weight by z-score in the study were 18 (51.4%) (< -3) z-score, 46 (47.4%) (- 3.00 - - 2.01) z-score, 75 (49.7%) (- 2.00 – 1.01) z-score, 44 (51.8%) ( - 1.00 – 0.0) z-score, 1 (7.1%) (0.01 – 1.00) z-score, 2 (33.3%) (1.01 – 2.00) z-score and 0 (0.00) (> 2.00 z-score. The difference was not statistically significant (P > 0.05).

### 4.4.3.3 Weight for height:

According to weight for height the prevalence rates of infected children by intestinal parasites were 4 (40%) (< -3) z-score, 25 (51%) (-3.00 – 2.00) z-score, 85(54.5%) (-2.00 - -1.01) z-score, 54 (40.6%) ( - 1.00 – 0.00) z-score, 13 (43.3%) (0.01 – 1.00) z-score and 5 (41.7%) (1.01 – 2.00) z-score. The difference statistically was not significant (P > 0.05).
Table (1): Distribution of children according to age group by living area

<table>
<thead>
<tr>
<th>Age group</th>
<th>urban No (%)</th>
<th>Rural No (%)</th>
<th>Displaced No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1 yr</td>
<td>24 (18.5)</td>
<td>19 (14.6)</td>
<td>30 (23.1)</td>
</tr>
<tr>
<td>&gt; 1 – 2 yrs</td>
<td>35 (26.9)</td>
<td>25 (19.2)</td>
<td>29 (22.3)</td>
</tr>
<tr>
<td>&gt; 2 – 3 yrs</td>
<td>23 (17.7)</td>
<td>27 (20.8)</td>
<td>32 (24.6)</td>
</tr>
<tr>
<td>&gt; 3 – 4 yrs</td>
<td>25 (19.2)</td>
<td>35 (26.9)</td>
<td>26 (20)</td>
</tr>
<tr>
<td>&gt; 4 yrs</td>
<td>23 (17.7)</td>
<td>24 (18.5)</td>
<td>13 (10)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130 (100%)</strong></td>
<td><strong>130 100%</strong></td>
<td><strong>130 (100%)</strong></td>
</tr>
</tbody>
</table>
Table (2): Prevalence rates of intestinal parasites among children by living area

<table>
<thead>
<tr>
<th>Study area</th>
<th>Parasitized</th>
<th>Non parasitized</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No   (%)</td>
<td>No   (%)</td>
</tr>
<tr>
<td>Urban</td>
<td>51 (39.2)</td>
<td>79 (60.8)</td>
</tr>
<tr>
<td>Rural</td>
<td>58 (44.6)</td>
<td>72 (55.4)</td>
</tr>
<tr>
<td>Displaced camp</td>
<td>77 (59.2)</td>
<td>53 (40.8)</td>
</tr>
<tr>
<td>Total</td>
<td>186 (47.7)</td>
<td>204 (52.3)</td>
</tr>
</tbody>
</table>
### Table (3): Distribution of infected children by types of parasites and living area

<table>
<thead>
<tr>
<th>Area Types of parasites</th>
<th>Urban</th>
<th>Rural</th>
<th>Displaced camp</th>
<th>Total in the study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>G. lamblia</td>
<td>34</td>
<td>26.2</td>
<td>45</td>
<td>51</td>
</tr>
<tr>
<td>H. nana</td>
<td>11</td>
<td>8.5</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>E. coli</td>
<td>8</td>
<td>6.2</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>E. vermicularis</td>
<td>5</td>
<td>3.8</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>E. histolytica</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>S. mansoni</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

- Percentage calculated in regard to sample size in all groups = 390
- Percentage calculated in regard to total of parasited instance = (186) – hence a child may have more than one parasites.
Table 4: Distribution of infected children by intestinal parasites according to age group by living area

<table>
<thead>
<tr>
<th>Age group</th>
<th>Urban</th>
<th>Rural</th>
<th>Displaced area</th>
<th>Total of the study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td>Parasitized</td>
<td>Non-parasitized</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Up to 1 yr</td>
<td>6</td>
<td>11.8</td>
<td>18</td>
<td>22.8</td>
</tr>
<tr>
<td>&gt; 1-2 yrs</td>
<td>12</td>
<td>23.5</td>
<td>23</td>
<td>29.1</td>
</tr>
<tr>
<td>&gt; 2-3 yrs</td>
<td>9</td>
<td>17.6</td>
<td>14</td>
<td>17.7</td>
</tr>
<tr>
<td>&gt; 3-4 yrs</td>
<td>12</td>
<td>23.5</td>
<td>13</td>
<td>16.5</td>
</tr>
<tr>
<td>&lt; 5 years</td>
<td>12</td>
<td>23.5</td>
<td>13</td>
<td>13.9</td>
</tr>
<tr>
<td>Total by area</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
</tr>
</tbody>
</table>

Total of the study | 51  | 27.4 | 79  | 38.7 | 58  | 31.2 | 72  | 35.3 | 77  | 41.4 | 53  | 26  | 186 | 100  | 204 | 100  |
Table 5: Distribution of infected children by intestinal parasites according to gender by living area

<table>
<thead>
<tr>
<th>Study area</th>
<th>Urban Parasitized</th>
<th>Urban Non-parasitized</th>
<th>Rural Parasitized</th>
<th>Rural Non-parasitized</th>
<th>Displaced area Parasitized</th>
<th>Displaced area Non-parasitized</th>
<th>Total of the study</th>
<th>Total non-parasitized by age group</th>
<th>Total parasitized by age group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Male</td>
<td>36</td>
<td>70.6</td>
<td>38</td>
<td>48.1</td>
<td>30</td>
<td>51.7</td>
<td>41</td>
<td>56.9</td>
<td>35</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>29.4</td>
<td>41</td>
<td>51.9</td>
<td>28</td>
<td>48.3</td>
<td>31</td>
<td>43.1</td>
<td>42</td>
</tr>
<tr>
<td>Total by area</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
</tr>
<tr>
<td>Total of the study</td>
<td>51</td>
<td>27.4</td>
<td>79</td>
<td>38.7</td>
<td>58</td>
<td>31.2</td>
<td>72</td>
<td>35.3</td>
<td>77</td>
</tr>
</tbody>
</table>

* n : parasitized = 186
** n : nonparasitized = 204
Table 6: Distribution of infected children by intestinal parasites according to father's education by living area

<table>
<thead>
<tr>
<th>Study area Status</th>
<th>Fathers’ education level</th>
<th>Urban Parasitized</th>
<th>Urban Non-parasitized</th>
<th>Rural Parasitized</th>
<th>Rural Non-parasitized</th>
<th>Displaced area Parasitized</th>
<th>Displaced area Non-parasitized</th>
<th>Total parasitized by age group</th>
<th>Total non parasitized by age group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Illiterate</td>
<td>5</td>
<td>50</td>
<td>1</td>
<td>20</td>
<td>33</td>
<td>66</td>
<td>17</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>Quasar school</td>
<td>1</td>
<td>50</td>
<td>3</td>
<td>60</td>
<td>1</td>
<td>100</td>
<td>0</td>
<td>0.00</td>
<td>5</td>
</tr>
<tr>
<td>Primary school</td>
<td>18</td>
<td>40.9</td>
<td>33</td>
<td>53.2</td>
<td>29</td>
<td>46.8</td>
<td>31</td>
<td>55.4</td>
<td>25</td>
</tr>
<tr>
<td>Secondary school</td>
<td>19</td>
<td>40.4</td>
<td>15</td>
<td>36.3</td>
<td>11</td>
<td>50</td>
<td>11</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>Graduated or post-graduated</td>
<td>8</td>
<td>29.6</td>
<td>6</td>
<td>35.3</td>
<td>1</td>
<td>100</td>
<td>0</td>
<td>0.00</td>
<td>15</td>
</tr>
<tr>
<td>Total by study area</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
</tr>
<tr>
<td>Study area Status</td>
<td>Study area</td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td>Urban Parasitized</td>
<td>Non-parasitized</td>
<td>Rural Parasitized</td>
<td>Non-parasitized</td>
<td>Displaced Parasitized</td>
<td>Non-parasitized</td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Unemployed</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>2</td>
<td>100</td>
<td>4</td>
<td>66.7</td>
<td>2</td>
<td>33.3</td>
</tr>
<tr>
<td>Unskilled labour</td>
<td></td>
<td>32</td>
<td>44.2</td>
<td>40</td>
<td>55.6</td>
<td>36</td>
<td>42.9</td>
<td>48</td>
<td>57.1</td>
</tr>
<tr>
<td>Skilled labour</td>
<td></td>
<td>9</td>
<td>42.9</td>
<td>12</td>
<td>57.1</td>
<td>8</td>
<td>53.3</td>
<td>7</td>
<td>46.7</td>
</tr>
<tr>
<td>Civil job</td>
<td></td>
<td>10</td>
<td>28.6</td>
<td>25</td>
<td>71.4</td>
<td>10</td>
<td>41.7</td>
<td>14</td>
<td>58.3</td>
</tr>
<tr>
<td>Total by study area</td>
<td></td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
</tr>
</tbody>
</table>

Table 7: Distribution of infected children by intestinal parasites according to father’s occupation by living area.
# Table 8: Distribution of infected children by intestinal parasites according to mother’s education by living area

<table>
<thead>
<tr>
<th>Mothers’ education level</th>
<th>Urban Parasitized</th>
<th>Urban Non-parasitized</th>
<th>Rural Parasitized</th>
<th>Rural Non-parasitized</th>
<th>Displaced area Parasitized</th>
<th>Displaced area Non-parasitized</th>
<th>Total of the study Parasitized</th>
<th>Total of the study Non-parasitized</th>
<th>Total of the study by age group</th>
<th>Total non parasitized by age group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Quraan school</td>
<td>2</td>
<td>66.7</td>
<td>1</td>
<td>33.3</td>
<td>1</td>
<td>100</td>
<td>0</td>
<td>0.0</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Primary school</td>
<td>16</td>
<td>34</td>
<td>31</td>
<td>66</td>
<td>32</td>
<td>49.2</td>
<td>33</td>
<td>50.8</td>
<td>25</td>
<td>59.5</td>
</tr>
<tr>
<td>Secondary school</td>
<td>22</td>
<td>40</td>
<td>33</td>
<td>60</td>
<td>12</td>
<td>30</td>
<td>28</td>
<td>70</td>
<td>1</td>
<td>33.3</td>
</tr>
<tr>
<td>Graduated or post-graduated</td>
<td>4</td>
<td>33.3</td>
<td>8</td>
<td>66.7</td>
<td>5</td>
<td>50</td>
<td>5</td>
<td>50</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total by study area</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
<td>59.2</td>
</tr>
</tbody>
</table>
Table 9: Distribution of infected children by intestinal parasites according to mothers’ occupation by living area by living area

<table>
<thead>
<tr>
<th>Study area</th>
<th>Status of infection</th>
<th>Parasitized N</th>
<th>%</th>
<th>Non-parasitized N</th>
<th>%</th>
<th>Parasitized N</th>
<th>%</th>
<th>Non-parasitized N</th>
<th>%</th>
<th>Total parasitized by age group</th>
<th>%</th>
<th>Total non parasitized by age group</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Unskilled labourer</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>100</td>
<td>1</td>
<td>50</td>
<td>1</td>
<td>50</td>
<td>17</td>
<td>65.4</td>
<td>9</td>
<td>34.6</td>
</tr>
<tr>
<td>Rural</td>
<td>Unskilled labourer</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>50</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Displaced area</td>
<td>Civil job</td>
<td>4</td>
<td>28.6</td>
<td>10</td>
<td>71.4</td>
<td>3</td>
<td>42.9</td>
<td>4</td>
<td>57.1</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>House-wives</td>
<td>47</td>
<td>40.9</td>
<td>68</td>
<td>59.1</td>
<td>54</td>
<td>44.6</td>
<td>67</td>
<td>55.4</td>
<td>59</td>
<td>58.4</td>
<td>42</td>
<td>41.6</td>
</tr>
<tr>
<td>Total by study area</td>
<td></td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
<td>59.2</td>
<td>53</td>
<td>40.8</td>
</tr>
<tr>
<td>Family income</td>
<td>Urban Parasitized</td>
<td>Urban Non-parasitized</td>
<td>Rural Parasitized</td>
<td>Rural Non-parasitized</td>
<td>Displaced area Parasitized</td>
<td>Displaced area Non-parasitized</td>
<td>Total of the study</td>
<td>*Total parasitized by age group</td>
<td>**Total non parasitized by age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>-------------------------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Low</td>
<td>12</td>
<td>54.5</td>
<td>10</td>
<td>45.5</td>
<td>15</td>
<td>46.9</td>
<td>17</td>
<td>53.1</td>
<td>51</td>
<td>54.8</td>
<td>42</td>
<td>45.2</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>20</td>
<td>34.5</td>
<td>38</td>
<td>65.5</td>
<td>18</td>
<td>40</td>
<td>27</td>
<td>60</td>
<td>23</td>
<td>67.6</td>
<td>11</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>9</td>
<td>34.6</td>
<td>17</td>
<td>65.5</td>
<td>19</td>
<td>45.2</td>
<td>23</td>
<td>54.8</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Very high</td>
<td>10</td>
<td>41.7</td>
<td>14</td>
<td>58.3</td>
<td>6</td>
<td>54.5</td>
<td>5</td>
<td>45.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total by area</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
<td>59.2</td>
<td>53</td>
<td>40.8</td>
<td>186</td>
</tr>
<tr>
<td>Total of the study</td>
<td>51</td>
<td>27.4</td>
<td>79</td>
<td>38.7</td>
<td>58</td>
<td>31.2</td>
<td>72</td>
<td>35.3</td>
<td>77</td>
<td>41.4</td>
<td>53</td>
<td>26</td>
<td>186</td>
</tr>
</tbody>
</table>
Table 11: Distribution of infected children by intestinal parasites according to sewage system at home by living area

<table>
<thead>
<tr>
<th>Study area</th>
<th>Parasitized</th>
<th>Non-parasitized</th>
<th>Urban</th>
<th>Non-parasitized</th>
<th>Rural</th>
<th>Non-parasitized</th>
<th>Displaced area</th>
<th>Non-parasitized</th>
<th>Total of the study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td></td>
<td></td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td>Total non parasitized by age group</td>
</tr>
<tr>
<td>Status of infection</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Siphon</td>
<td>2</td>
<td>50</td>
<td>2</td>
<td>50</td>
<td>3</td>
<td>60</td>
<td>2</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Private pit latrine</td>
<td>48</td>
<td>39</td>
<td>75</td>
<td>61</td>
<td>49</td>
<td>41.9</td>
<td>68</td>
<td>58.1</td>
<td>3</td>
</tr>
<tr>
<td>Common pit latrine</td>
<td>1</td>
<td>33.3</td>
<td>2</td>
<td>66.7</td>
<td>2</td>
<td>100</td>
<td>0</td>
<td>0.00</td>
<td>74</td>
</tr>
<tr>
<td>Open space</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Total of the study</td>
<td>51</td>
<td>39.2</td>
<td>79</td>
<td>60.8</td>
<td>58</td>
<td>44.6</td>
<td>72</td>
<td>55.4</td>
<td>77</td>
</tr>
</tbody>
</table>

104
<table>
<thead>
<tr>
<th>Status of infection</th>
<th>Urban</th>
<th>Rural</th>
<th>Displaced area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parasitized</td>
<td>Non-parasitized</td>
<td>Parasitized</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Pallor</td>
<td>24</td>
<td>40</td>
<td>36</td>
</tr>
<tr>
<td>Jaundice</td>
<td>1</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Keratitis</td>
<td>-</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Wheezes</td>
<td>3</td>
<td>42.9</td>
<td>4</td>
</tr>
<tr>
<td>Abd. distension on ex.</td>
<td>2</td>
<td>66.7</td>
<td>1</td>
</tr>
<tr>
<td>Hepatomegaly</td>
<td>1</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Splenomegaly</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LL. oedema</td>
<td>2</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Wasting in the arm &amp; buttock</td>
<td>1</td>
<td>100</td>
<td>0.00</td>
</tr>
<tr>
<td>Signs of vit deficiency</td>
<td>1</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total of the study</strong></td>
<td><strong>35</strong></td>
<td><strong>42.2</strong></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>
Table 12: Distribution of infected children by intestinal parasites according to presenting symptoms by living area:

<table>
<thead>
<tr>
<th>Study area</th>
<th>N</th>
<th>Urban</th>
<th>N</th>
<th>Rural</th>
<th>N</th>
<th>Displaced camp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>17</td>
<td>51.5</td>
<td>14</td>
<td>46.7</td>
<td>45</td>
<td>60.8</td>
</tr>
<tr>
<td>Cough</td>
<td>23</td>
<td>35.9</td>
<td>27</td>
<td>50.9</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Anorexia</td>
<td>15</td>
<td>45.5</td>
<td>9</td>
<td>39.1</td>
<td>30</td>
<td>58.8</td>
</tr>
<tr>
<td>Abd. Pain</td>
<td>13</td>
<td>40.6</td>
<td>13</td>
<td>43.3</td>
<td>19</td>
<td>50</td>
</tr>
<tr>
<td>Abd. Distension</td>
<td>13</td>
<td>52</td>
<td>6</td>
<td>54.5</td>
<td>18</td>
<td>51.4</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>10</td>
<td>34.5</td>
<td>8</td>
<td>36.4</td>
<td>32</td>
<td>65.3</td>
</tr>
<tr>
<td>Purities</td>
<td>8</td>
<td>44.4</td>
<td>8</td>
<td>50</td>
<td>7</td>
<td>46.7</td>
</tr>
<tr>
<td>Itching</td>
<td>1</td>
<td>14.3</td>
<td>9</td>
<td>81.8</td>
<td>77</td>
<td>46.7</td>
</tr>
<tr>
<td>Loss of wt</td>
<td>12</td>
<td>41.4</td>
<td>9</td>
<td>45</td>
<td>6</td>
<td>46.2</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
<td>26.9</td>
<td>15</td>
<td>53.6</td>
<td>15</td>
<td>78.9</td>
</tr>
</tbody>
</table>

Total 119 40.2 118 48.4 303 58.9
Figure (1): Distribution of children by gender
n = 390

- Male: 48.2%
- Female: 51.8%
Figure (2): Distribution of children according to age group by living area

n = 130
Figure (3): Distribution of prevalence rates of intestinal parasites among children by living area N=186
Figure (3.1): Prevalence rates of intestinal parasites among children in urban area n= 130

60.8% non parasitized

39.2% parasitized
Figure (3.2): Prevalence rates of intestinal parasites among children in rural area $n = 130$

- 44.6% parasitized
- 55.4% non-parasitized
Figure (3.3) Prevalence rate of intestinal parasite among children in displaced camp
n=130

59.20% Parasite
40.80% Non parasite

Male □ Female □
Figure (5): Mode of infections in the infected children in urban, rural and displaced camp n = (130)
Figure (4): Distribution of types of parasites among children in urban, rural and displaced n = 130

Types of parasites:
- G. Lamblia
- E. coli
- E. histolytica

Urban
Rural
Displaced camp
Fig (6): Distribution of prevalence rate of children infected by intestinal parasites according to age group by living area
urban n=51 rural =58 displaced =77
Figure (7): Prevalence of infected children by intestinal parasites according to gender and living area \( n = 130 \)
Figure (8): Distribution of children infected by intestinal parasites and father's education by living area.
Figure (9): Distribution of children infected by intestinal parasites and father's occupation by living area
Figure (10): Distribution of children infected by intestinal parasites and mother’s education by living area
Figure (11): Prevalence rate of infected children by intestinal parasites according to mother occupation
Figure (12): Distribution of infected children by parasitic infection and family income
Figure (13): Distribution of infected children by intestinal parasites and family size by living area

- Small family
- Average family
- Large family
Figure (14): Distribution of children infection by intestinal parasites according to personal habits.

- Washing hand before & after meal
- Wash vegetable
- Rom meat eating
- Boiling milk
- History of pica
- Control fillies

Urban | Rural | Displaced camp

Percentage
Figure (15): Distribution of children infected by intestinal parasites according source of drinking water at home by living area.
Figure (16): Distribution of children infected by intestinal parasites according to sewage system at home by living area

Chapter Four
4- Discussion

4.1   Stool Findings:

This is a community based study conducted in three areas (urban, rural and displaced camp area) in Jabel Aweleia Governorate, to determine the prevalence of intestinal parasitic infection among under five children. It revealed that the overall prevalence rate was 186 (47.7%): 51 (39.2%) in urban area, 58 (44.6%) in rural area and 77 (59.2%) in displaced camp area. This high prevalence rate was in agreement with study done among under-five children in the police camps in Khartoum State, where the prevalence rate was (44%) (32), also in agreement with study done in Arkaweet and Soba Alaradi area Khartoum State with prevalence rate (37.5%) and (35.7%) respectively(37).

The findings of our study is in agreement with other studies done in other countries such in Ethiopia, Iraq and Nepal with prevalence rates (48.1%, 46.27%, 44%) respectively(17,25,11). This similarity could be due to similar socio-economic characteristics and climatic condition.

This study shows a lower prevalence from other studies done in Khartoum State in Elengaz area and southern Sudan, the prevalence were (64.4%) and (66%) respectively (35,33). Other studies done in nearby
countries which have higher prevalence rates than our study: in Ethiopia (83.8%) Yemen (61.2%) \cite{18,28}.

The present study showed higher prevalence rates than others studies in Saudi Arabia (29.4%) and (18.4%), Brazil (22.3%), we concluded that the prevalence rates were lower, probably a consequence of the good sanitary condition, adequate latrine type and high level parental education \cite{9,27,29}.

4.1.1 Types of parasites:

In the present study the commonest parasites were G. lamblia (33.3%), H. nana (9.5%) and non pathogenic E. coli (8.5%). These findings were similar to the findings of studies done in Khartoum State in the police camp G. Lamblia (21%) and H. nana (10.4%), in Arkaweet and Soba Alarady G. Lamblia (18.7%), H. nana (8.4%) and non pathogenic E. coli (15.9%), and in Elengaz area commonest parasites were G. lamblia (33.4%) and H. nana (26\%)\textsuperscript{32,35,37}.

In other countries high prevalence of G. lamblia and H. nana was found in such as Iraq (35.39%) Koran district and (27.2%) Azadi district for G. lamblia and [(28.32\%) Koran district and (19.72\%) Azadi district)] for H. nana and in Yemen; G. lamblia (25.5\%) and (36.3\%), H. nana (4.6\%) and (2.2\%) in urban and rural area respectively \textsuperscript{25, 28}. In Saudi
Arabia, Ethiopia, Australia, Nepal and United States, the prevalence rates of G. lamblia were (14.5%), (7.7%), (32.1%) (13.7%) and (7.2%) \(^{(29, 17, 6, 11, 12)}\) respectively.

The infection with G. lamblia depends on the route of spread either by contamination of food through food handlers (carries), contamination of drinking water by giardial cysts or through faeco-oral route from person to person. In this study there are many factors were observed contributing to high spread of G. lamblia. Contamination of food by flies, lack of personal hygiene, eating of raw meat, defecation in open spaces or unhealthy communal pit latrines without washing hands, no proper use system of control flies and some times contamination of water supply or source of drinking water.

H. nana was the second often G. lamblia in the study. It is prevalence was (9.5%), in agreement with reported among under five children in the study of the police camps (10.4%) and with study done in Arkaweet and Soba Alarady (8.4%) and among refugees in Juba (11\%) \(^{(32, 37, 34)}\). H. nana was lower than that reported among school children in Elengaz (26\%) \(^{(37)}\).

This prevalence rate was lower than that among children of other countries: Sahara Republic (17.1\%), Tigray, Ethiopia (17\%), and
Australia (20.5%) \cite{19,17,6}. While it was higher than that prevalence less than (1%) \cite{28,27}.

Non pathogenic E. coli was the third most prevalent parasite, (8.5%), and this was in agreement with study done in Arkaweet and Soba Alarady (8.3%). It is lower than that reported in southern Sudan (37.8%) and higher than that was reported in police camp (2.7%) \cite{37,33,32}. In other countries non pathogenic E. coli was US (4.2%), Malaysia (3.3%), Saudi Arabia (6.2%), and Iraq [(48.5%) and (26.27%)] \cite{12,8,27,25}.

E. vermicularis prevalence rate was (3.8%) and it underestimated in this study mainly because it is diagnosed macroscopically by finding the adult worm in the stool. The accurate diagnosis made by use of the selltape swap and tape in the diagnosis which was not used in this study although there were 49(12.6%) complaining of pruritus ani in the study. The prevalence rates of E. vermicularis were higher in the studies done before, they were (7.4%), (6.2%) in the police camp and Elengaz, respectively \cite{32,35}.

In other countries E. vermicularis, prevalence rates were Saudi Arabia (1.4%), Ethiopia (1%) and Yemen (13.5% and 8.4%) \cite{29,17,28}. 

130
E. histolytica was found in 3 (0.8%) probably most common in adult and was in agreement with study done in police camp (0.7%) and not in agreement with study done in southern Sudan (28.4%) (32,33).

Schistosoma mansoni was found in 1 (0.3%) from the rural area. This very low prevalence rate may be due to absence of canals, this in agreement with study done in police camp where there was no schistosomiasis, little pit with study done in southern Sudan (2.2%) and also with study done in Arkaweet and Soba Alarady (0.0%) and (1.4%) respectively (32,33,37).

Taeniasis, Strongloides and Trichuris trichiura were not found in this study but was found in previous studies in police camp and southern Sudan (32,33).

4.2 Mode of Infection:

In the present study, the most common mode of parasitic infection among children was by one parasites (82.8%) in all areas, by two parasites two parasites (14.5%) and three parasites (2.7%). It was observed that the infection by one parasite was compatible with study done in police camp (88.5%) by one parasite and (11.5%) by two parasites but was not in agreement with study done in Arkaweet and Soba Alarady (30.2%) and (30%) one parasite, (5.7%) and (9.2%) by two
parasites, respectively, also was not compatible with study done in Juba, where one parasite was isolated in (42%), two parasites (21%), three parasites (2%) and four parasites (1%) (32,37,34).

In other countries, Sierra Leone (53.1%) one parasite, (40%) two parasites and (6.9%), three or more parasites and in Nepal (14.3%) mixed infection (15,11).

4.3 Prevalence according to socio-demographic characteristics:

The prevalence rates according to the age showed an expected normal distribution curve with peak of infection at age of four years (28%). These findings were in agreement with the study done in police camp 57 (49.1%) for age group (25-48) month (32).

Prevalence rate according to gender showed 101 (54.3%) for male and 85 (47.7%) for female. It was in agreement with study done in Khartoum State, Arkawet (urban) (39.4%) male and (32.2%) female (37). This study was contrasting with study done in Juba which female (70%) more than males (60%) and also Saudi Arabia where male and female were equal (34,29).

In our study males were infected than females because they played outside more exposed to soil transmitted parasites than female, while in
Juba female refugees working more than male, while in Saudi Arabia there was good sanitation and equal for both.

In the present study, the prevalence according to family size were 84 (43.3%) small family, 81 (53.6%) average family and 21 (46.7%) large family. This in agreement with study done in Arkaweet and Soba Alarady (23.2%) and (76.8%) respectively (37).

This high prevalence in this study is likely due to of overcrowd and person to person transmission through source of drinking water like Elzeer which sometimes may be uncovered or sharing (Elroc) for drinking water which can easy be contaminated and at sometimes no refugees in displaced camp.

The present study showed the prevalence rates among children drinking from Elzeer was 137 (73.7%) and in agreement with study done in Arkaweet and Soba Alarady (rural 93%) (37).

The prevalence rate of intestinal parasitic infections among children according to the use of private pit latrine 100 (53.8%) and communal pit latrine 77 (41.4%) possibly due to breeding flies and poor sanitation and this in agreement with study done in Arkaweet and Soba Alarady (> 85%) (37).

4.4 Prevalence Rate According to Clinical Finding:
In this study the prevalence of intestinal parasites among children approximately equal with limited range of 27 (43.5%) for loss of weight and 76 (55.5%) for fever, Abd. pain 45 (45%) was the main symptoms intestinal parasites in agreement with study done in Elengaz and Yemen (35,28) and high than all symptoms related to intestinal parasites or study done in police camp (35,28,32).

The most common signs were pallor 118 (30.33%) and the prevalence rates of infected children among them was 61 (51.7%), followed by abd. distension on examination 28 (66.7%), this high prevalence rate of clinical signs among infected children by malabsorption and loss of appetite (anorexia) associated parasitic infection and most likely G. lamblia (33.3%). The malabsorption of micronutrient, folic acid, iron and other vitamins which can result from parasitic infection also can lead to pallor. This in agreement with studies done in Arkaweet and Soba Alarady and Yemen (37,28).

In this study it was observed the prevalence rate of parasitic infection according to age for weight, age for height and weight for height by z-score for (< - 3) were 18 (51.4%), 15 (44.1%), 4 (40%) respectively.
This prevalence was suspected because one third of children in study from displaced camp. The prevalence rates were agreement with study done in Arkaweet and Soba Alarady and Yemen and disagreement with study done in police camp which showed no relationship between parasitic infection and under nutrition (37, 28, 32).
♦ Conclusions:

Our study revealed that the prevalence rate of intestinal parasites was found to be higher in the displaced camp area, about three fifth children followed by rural area, about less than half of children and the less one was the urban area, about two fifth were found to be infected by intestinal parasites.

The most commonly infected age group in all areas was > 2 yrs and < 4 yrs, male were infected more females in all areas.

G. lamblia and H. nana were common in all areas and encountered, about one third and one tenth allover the study respectively except non pathogenic E. coli was more commoner than H. nana in rural area. There was no direct relationship between socio-economic and the prevalence of intestinal parasites or environmental factors. However this relationship could be multifactorial, related to poor hygiene, inadequate sewage system, unavailability clean water and irregular refuse disposal.
Pallor was observed in about one third of children in the study and about half of them were infected.

Underweight and malnutrition children were about three fifth of infected children in the study.

♦ Recommendation

(1) Strenuous efforts should be carried out to control and prevent spread and transmission of parasitic infestations within the community in general and among families from displaced camp and rural area through the following recommendation:

Health education at community level about personal hygiene by explaining how to protect food and drinks from flies and dust, storage and handling water by filtration for drinking water, also we should change the incorrect knowledge, attitude and practice (KAP) of the community about personal habits.

(2) Early detection and treatment of all cases infected with intestinal parasites through PHC programs.

(3) Improving the system of proper excrete disposal, food preparation especially in the displaced camp. There should be proper
sewage system done by government with standard measurement of health protection

(4) Prevention of malnutrition and vitamin deficiency among children by good balanced meals and prophylactic doses of vitamins especially vit. A, also vaccination.

REFERENCES


(6) Meloni BP, Thompson RCA, Hopkins RM, Reynoldson JA, Gracey M. The prevalence of giardia and other intestinal parasites in children, and


(28) Zein JH. Prevalence of intestinal parasitic infection in urban and rural areas in Yemen. MD Thesis. University of Khartoum; Sudan: 1997.

(29) Al-Balaa SR, Al-Sakeit M, Al-Rashed RS, Al-Hedaithy MA, Al-Nazrou AM. Prevalence of pathogenic intestinal parasites among preschool


Babiker MA. Assessment of the use of different diagnostic techniques for the detection of intestinal parasites in food handlers in Khartoum State. MD Thesis. University of Juba; Sudan: 2002.


Eisen D, Band JD, Talavera F, John JF. Cryptosporidiosis. 


pozos D. Cryptosporidios. http://www/austin.cc.edu/microbio/2704c/Crypto.htm


Ascaris lumbricoides (human roundworm). 
http://www.ce.berkeley.edu/nelson/ce210a/Ascaris/ascaris.htm.


Weiss EL, Louden M, Talavera F, Hirshon JM. 


Necardor americanus and Ancylostoma duodenale. 


Material safety data sheet infectious substance: Trichuris trichiura.

Trichuris trichiura.

Symptoms of whipworm.


Weiss EL, Louden M, Talavera F, Plaster ML. Trichuris trichiura.

Pinworm infection index.

Bocka J, Peak DA, Talavera F, Taylor JP. Pinworm.

Parenting and child health. worm. Worms affecting people in Australia.

Enterobius vermicularis.


Hymenolepsis. [http://www.urm.edu/ency/article/001378.htm](http://www.urm.edu/ency/article/001378.htm).


(105) Kucik CJ, Martin GL, Sortor BV. Common intestinal parasites. Am Fam Phys 2004; p. 34.

(106) Human intestinal parasites worms.
University of Khartoum Postgraduate medical studies
Department of pediatric & Child Health Intestinal Parasitic & Helminthes Infestation

QUESTIONNAIRE
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Serial No.</td>
<td></td>
</tr>
<tr>
<td>(2) Study area No.</td>
<td></td>
</tr>
<tr>
<td>(3) Date</td>
<td></td>
</tr>
<tr>
<td>(4) Child</td>
<td></td>
</tr>
<tr>
<td>i. Name</td>
<td></td>
</tr>
<tr>
<td>ii. Age in year &amp; months</td>
<td></td>
</tr>
<tr>
<td>iii. Sex</td>
<td>1 - Male 2 - Female</td>
</tr>
<tr>
<td>iv. Residence</td>
<td>1- Angola 2- Elterea 3- Elgabal</td>
</tr>
<tr>
<td>v. Original home:</td>
<td>1- Khartoum 2 central Sudan 3- south 4- west 5- East 6- North</td>
</tr>
<tr>
<td>vii.</td>
<td>1- Displaced 2- Non displaced</td>
</tr>
<tr>
<td>(5) Father education</td>
<td>1- Illiterate 2- Quraan school 3- Primary school 4- Secondary school 5- Graduate or Postgraduate</td>
</tr>
<tr>
<td>(6) Father Occupation</td>
<td>1- Unemployed 2- Unskilled laborer 3- Skilled laborer 4- Civil or military Job</td>
</tr>
<tr>
<td>(7) Mother Education</td>
<td>1- Illiterate 2- Quraan school 3- Primary school 4- Secondary school 5- Graduate or Postgraduate</td>
</tr>
<tr>
<td>(8) Mother Occupation</td>
<td>1- Unemployed 2- Unskilled laborer 3- Skilled laborer 4- Civil Job 5- House Wife</td>
</tr>
<tr>
<td>(9) Family Income</td>
<td>1- &gt; 10,000 SD 2- 10,000- 30,000 3- 30,000- 50,000 4- &lt; 50,000</td>
</tr>
<tr>
<td>(10) Family Size</td>
<td>1- (3- 5) 2- (6- 8) 3- (9- 11)</td>
</tr>
<tr>
<td>(11) No. of Rooms</td>
<td></td>
</tr>
<tr>
<td>(12) Habits- 1- Yes 2&quot; No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I. Hand Washing before Meals</td>
</tr>
</tbody>
</table>
ii. Hand Washing After Meals

iii. Washing of Vegetable

iv. Row Eating

vi. History of pica

vii. Fillies Control

(13) Water Supply at the Area

1-Piped in Doors

2- Piped out Doors

3-. Deep Wells Cfr

4-. Canals

5-. Nile

(14) Source of Drinking Water

1-. Tap

2-. Refrigeret

3-Zeer

4. Others

(15) Contacts with Animals 1- Yes 2-No

If yes what type of animals 1-Pet 2-Domestic

(16) Sewage System:

1- . Siphon

2- Private Pit Latrine

3- Communal Pit Latrine

4- Open Space

5- Others

(17) Refuse Disposal

1- Frequent

2- Unfrequent?

3- None
(18) House refuse is
1- Sent to refuse disposal area
2- Buried
3- Burnt

(19) Symptoms
1- Yes 2- No
i. Fever
ii. Cough
iii. Anorexia
iv. Abdominal Pain
v. Abdominal Distension
vi. Diarrhea
vii. Purities Ani
viii. Itching
ix. Loss of Weight
x. Others

(20) Physical Examination:
1- Yes 2- No

i. Pallor
ii. Jaundice
iii. Keratitis
iv. Wheezing
v. Abdominal distension
vi. Hepatomegaly
vii. Spleen
viii. Kidneys
ix. L.L oedema
x. Wasting 1- Arm 2- Buttock 3- Thigh
xi. Signs of Vitamins Deficiency
xii. Weight ............. kg  Z-score ....................
xiii. Height or Length ............. Cm  Z-
Investigation:

(21) Macroscopic Examination of fecal specimens  1- yes   2- No
i.  Ascaris
ii.  Pin worm
iii. Toenia

(22) Direct Microscopic Examination of fecal specimens  1- yes  2- No
i.  G. cyst
ii.  G.flagellate
iii.  E. dispar
iv.  E. histolylica
v.  E. coli
vi.  lumbricoides
vii.  Hookworm
viii.  T. trichiuria
ix.  Schistosoma Sp.
x.  Taenia Sp.
xi.  Strongtoides
xii.  H.nana

(23) Examination by formal ether concentration technique
i.  G.lamblia
ii.  E. dispar
iii.  E. histolylica
iv.  E. coli
v.  A. lumbricoides
vi.  Hookworm
vii.  T. trichiuria
viii. Schistosoma Sp.
ix.  Taenia Sp.
x. Strongtoides
xi. H. nana
(24) Examination by zinc sulphate floatation concentration technique
   i. G. lamblia
   ii. E. dispar
   iii. E. histolytica
   iv. E. coli
   v. A. lumbricoides
   Vi. Hookworm
   vii. T. trichiuris
   viii. Schistosoma Sp.
   ix. Taenia Sp.
   x. Strongtoides
   xi. H. nana