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Trends of intestinal parasites prevalence in the Gaza Strip, 1998–2007: the use of government health records

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Aim: To evaluate the amount of intestinal parasite infections over a 10-year period in the Gaza Strip.

Materials and methods: Data from the Epidemiology Department, Ministry of Health were collected and analyzed statistically. The prevalence of intestinal parasites was monitored and studied for the period 1998–2007.

Results: The present study shows results including the records of 471,688 patients (all ages) who had every provided 1 stool specimen to the laboratories of primary health care centers in one of the 5 governorates of the Gaza Strip. It was found that 116,261 specimens were positive for intestinal parasites, representing an overall prevalence of 24.6%. Entamoeba histolytica and Giardia lamblia were the most frequently detected intestinal parasites; there is a clear variation in the prevalence of intestinal parasites due to season.

Conclusion: Intestinal parasites still constitute a health problem and there were fluctuations in the prevalence from 1998 to 2007. It is recommended that there is a need for health authorities to review health records periodically and examination of stool specimens by one method should be reviewed.

Key words: Parasites, trend, prevalence, health records, Gaza

1. Introduction

Gaza Strip residents have suffered from intestinal parasitic diseases for decades. Studies have commonly reported the existence of nematodes (*Ascaris lumbricoides*, *Enterobius vermicularis*, *Strongyloides stercoralis*, and *Trichuris trichiura*), cestodes (*Hymenolepis nana)*, and protozoa (*Entamoeba histolytica/dispar*, *Giardia lamblia,* and *Cryptosporidium parvum*) (1–4).

The Gaza Strip is divided into 5 governorates: Gaza, North, Mid-Zone, Khan Younis, and Rafah. The total surface area of the Gaza Strip is 360 km^2, where approximately 1.5 million Palestinian people live and work (5). It is a very crowded area, with a population density estimated at 3698 persons per km^2 (6).

To evaluate and compare diseases and other health conditions in populations, epidemiologists use several measures of disease frequency, the most important of which are prevalence and incidence (7). Knowing the amount and time of disease occurrence helps in the detection of outbreaks and assessment of seasonal and secular trends. In addition, the location of disease occurrence is also important to detect clusters and allows for comparison of infection/disease rates among various geographical areas, such as countries, states, counties, census tracts, institutions, or water service districts (8).

The objectives of the present study were to use health records to evaluate the amount of intestinal parasite infections over a 10-year period in the Gaza Strip, to determine the most common intestinal parasites prevalent during the study period, and to identify and explore any trends of infection with intestinal parasites during the study period.

2. Materials and methods

2.1 Data collection for intestinal parasites from health records

Data on intestinal parasite infections in the 5 regions of Gaza were collected from the records of the Epidemiology Department, Palestinian Ministry of Health. For each parasite, the distribution of infected cases recorded monthly was monitored and studied in the period 1998–2007. The data were processed and classified based on season, governorate, year, and type of each intestinal parasite.

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2.2 Quality and management of the data

The flow of data starts from the primary health care center laboratories responsible for the investigation of infectious diseases, including intestinal parasites, among individuals who attend these primary health care centers. These data were transferred to the headquarters of primary health care in Al-Rimal Clinic in Gaza City. Then they were transferred to the epidemiology department in the Ministry of Health for storage and analysis. Then they were forwarded directly to the Palestinian Health Information Center to be used in the annual report about health status in Palestine.

Data collection and flow regarding the diagnosis of intestinal parasites from the 33 laboratories of the primary health care centers distributed in the 5 regions of the Gaza Strip to the Ministry of Health decision makers are summarized in Figure 1.

Those who were working or collecting these data were professionals, either laboratory technicians who inspected the stool samples using direct smear microscopy saline and iodine or IT specialists who collected reports and carried out analysis.

2.3 Focus group

The focus group was performed by 6 experts and professional medical technologists from both the governmental and private sectors, where they discussed in a forum the risk factors for the intestinal parasitic infection in the Gaza Strip. One question was asked to them: what are the risk factors for intestinal parasitic infection in the Gaza Strip? The following risk factors were summarized during the meeting; breeding of animals, unwashed vegetables, hand hygiene, contaminated water, contact with contaminated soil, parents' education, contaminated food, insects as mechanical carrier, opens sewers, lack of sterilization of bottles for babies, open yards in schools, life style and economic status, and breeding of birds.

2.4 Ethical considerations

The present study had ethical approval from the Department of Epidemiology, Ministry of Health, dated 25 April 2005 and renewed in 2011.

2.5 Statistical analysis

The Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 18, and Windows Excel were used for the statistical analysis. Cross tabulation, frequency, and advanced statistics were used, and one-way analysis of variance (ANOVA) was used to test the hypothesis in which several means were equal. ANOVA was used to compare the means of intestinal parasites detected according to the type and diarrheal diseases in each governorate. In order to know which mean differs significantly, Tukey's honestly significant difference test was performed. In addition, a one-sample t-test was used to test whether the mean of a single variable differed from a specific constant. The t-test was used to compare the mean of each parasite type. A P-value of less than 0.05 was considered statistically significant (9).

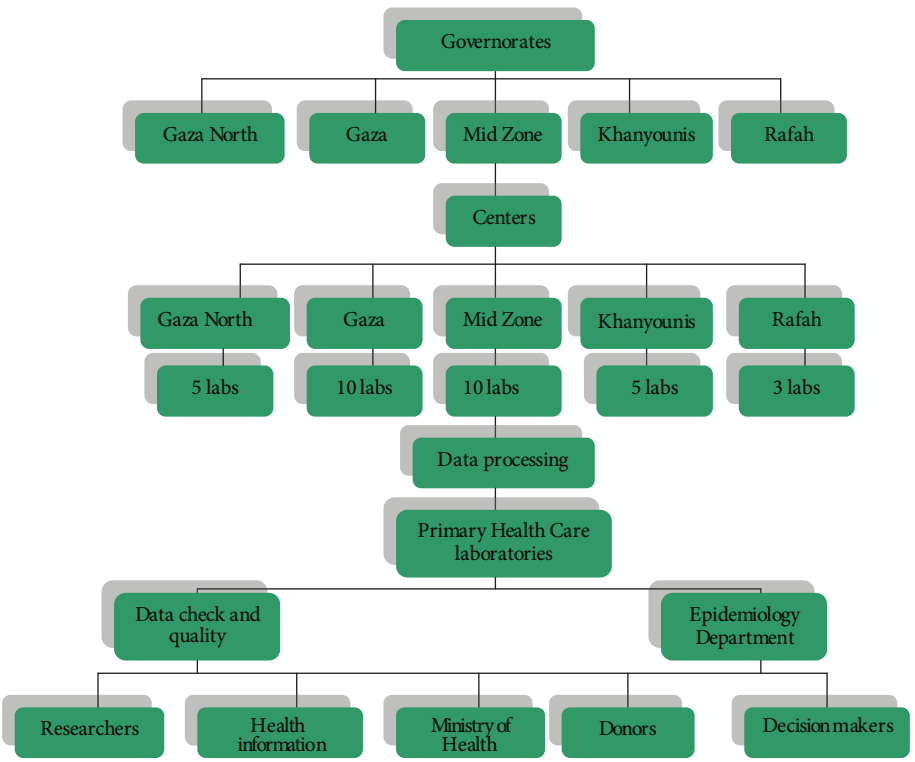

Figure 1. Flow chart of data for the diagnosis of intestinal parasites in the Gaza Strip.

3. Results

3.1 Results of trends of intestinal parasites in the period 1998–2007

The present study included the records of 471,688 patients (all ages) who had each provided 1 stool specimen to the laboratories of primary health care centers in 1 of the 5 governorates of the Gaza Strip. It was found that 116,261 specimens were positive for intestinal parasites, representing an overall prevalence of 24.6%.

Table 1 shows the trends in the prevalence of intestinal parasites in the period 1998–2007 in the 5 governorates where the highest prevalence was in both Gaza and Mid-Zone. Differences between regions regarding prevalence of intestinal parasites were tested through ANOVA ($F = 0.975$, $P > 0.05$) (Table 1).

Table 2 shows that the year 1998 represented the lowest prevalence for intestinal parasites in Gaza North, while the year 2006 showed the highest prevalence. In Gaza, Mid-Zone, and Rafah the highest prevalence was observed in the year 1999, 38.3%, 31.5%, and 31.5% respectively.

3.2 Prevalence of intestinal parasites due to parasite type from 2000 to 2007

For *E. histolytica/dispar* stable and similar prevalence was noted from 2001 to 2007, with the year 2000 showing the lowest prevalence. Moreover, *E. histolytica/dispar* had double prevalence compared to that for *G. lamblia* (Figure 2). Like *E. histolytica/dispar*, *G. lamblia* showed stable and similar prevalence from 2001 to 2007 except for the year 2000, which had the lowest prevalence (Figure 3). Data for 1998–1999 were not available.

Table 1. Results of trends of intestinal parasites in the period from 1998 to 2007 in the 5 governorates.

Region	* The range for prevalence	Overall prevalence
Gaza North	12.7 to 30.9	25.70
Gaza	22.9 to 33.9	28.02
Mid-Zone	24.5 to 33.1	28.10
Khan Younis	19.9 to 38.3	26.4
Rafah	20.2 to 31.5	24.69

*The range for prevalence = indicates the prevalence from 1998 to 2007 for each area.

Table 2. The distribution of parasitic infection from 1998 to 2007 in the 5 governorates.

Year	Gaza North			Gaza			Mid-Zone			Khan Younis			Rafah		
	Total patients	Total (+)	(%)	Total patients	Total (+)	(%)	Total patients	Total (+)	(%)	Total patients	Total (+)	(%)	Total patients	Total (+)	(%)
1998	12,125	1551	12.8	15,751	3645	23.1	10,203	2476	24.27	2616	1851	70.7	10,203	2476	24.2
1999	10,198	2737	26.8	5254	2014	38.3	8650	2725	31.5	5254	2014	38.3	8650	2725	31.5
2000	11,700	3344	28.6	6003	1744	29.1	7178	2138	29.8	6003	1744	29.1	7178	2138	29.8
2001	12,103	2834	23.4	7090	1660	23.4	7089	1588	22.4	7090	1660	23.4	7089	1588	22.4
2002	9950	2412	24.2	4959	1509	30.4	7382	1494	20.2	4959	1509	30.4	7382	1494	20.2
2003	11942	3233	27.1	4962	1214	24.5	7845	1583	20.2	4962	1214	24.5	7845	1583	20.2
2004	10041	2949	29.4	5545	1104	19.9	8005	1789	22.3	5545	1104	19.9	8005	1789	22.3
2005	9518	2740	28.8	6236	1415	22.7	8099	1877	23.2	6236	1415	22.7	8099	1877	23.2
2006	8547	2637	30.9	5621	1377	24.5	7041	1999	28.4	5621	1377	24.5	7041	1999	28.4
2007	8414	2105	25.0	4497	1106	24.6	5575	1370	24.6	4497	1106	24.6	5575	1370	24.6
Total	10,4538	24,130	23.1	52,783	14,994	28.4	77,067	19,039	24.7	52,783	14,994	28.4	77,067	19,039	24.7

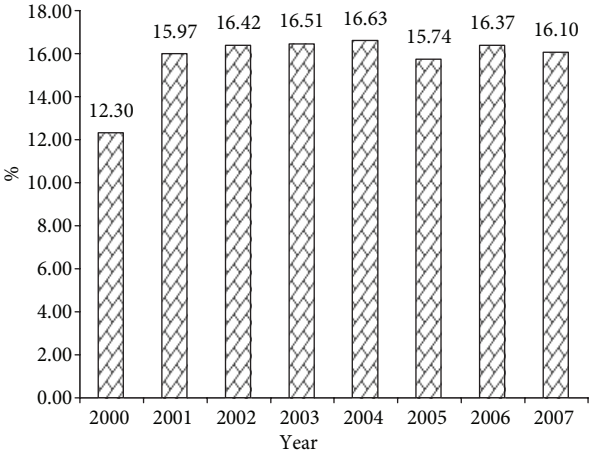

Figure 2. Prevalence (%) of *E. histolytica/dispar* in years 2000–2007.

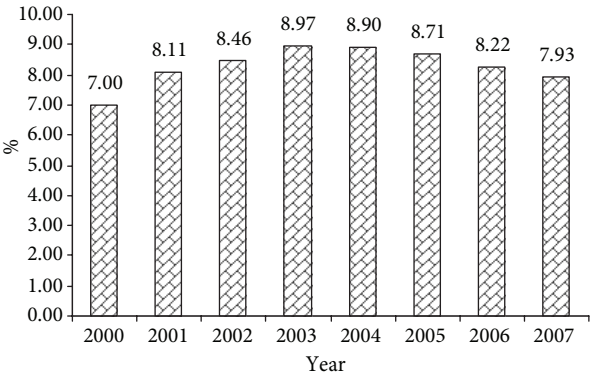

Figure 3. Prevalence (%) of *G. lamblia* in years 2000–2007.

Table 3 shows that there was a high significant difference in the prevalence of *E. histolytica/dispar* by season (P = 0.0001), where the summer season had the highest prevalence. For *G. lamblia* the highest prevalence was observed in the spring (P = 0.0001).

3.3 Annual prevalence of intestinal parasites, 1998 to 2007

Data are summarized in Figure 4 showing that the highest values were observed in 1999 and 2000, while the lowest prevalence was in 1998. According to ANOVA, there was a significant difference between the types of intestinal parasites (F = 669.234, P < 0.001).

Figures 4 and 5 illustrate by following the trend if there was any increasing, decreasing, or fluctuation through the years, and where there was a difference between types through the years with statistical significance (P = 0.001). Low prevalence of some detected parasites was noted in health records like *T. trichiura*, *S. stercoralis*, *E. vermicularis*, *H. nana*, and *T. saginata*.

4. Discussion

4.1 Parasitic infection in the Gaza Strip

To monitor and observe the changes in the prevalence of intestinal parasites in the Gaza Strip, the records of Ministry of Health from 1998 to 2007 were analyzed. These parasites still constitute a public health problem in Gaza and the need for decreasing the prevalence is an urgent matter. Intestinal parasites in the Gaza Strip have been reported by many authors during the last decade, where the general prevalence ranged from 24% to 53% in different locations (10–12). It was found that there was no difference in the prevalence of intestinal parasites due to regions. The Gaza Strip is a small, overcrowded area and life inside and outside of the refugee camps may become similar due to refugees' attempts to improve their lifestyle at a time when circumstances for all people are difficult.

The health records studied showed the following intestinal parasites: *E. histolytica/dispar*, *G. lamblia*, *A. lumbricoides*, *T. trichiura*, *S. stercoralis*, *E. vermicularis*, *H. nana*, and *T. saginata*.

Table 3. The distribution of *Entamoeba histolytica/dispar* and *Giardia lamblia* by season for years 2000–2007 .

Parasite	Season							
E. histolytica/dispar	Summer		Autumn		Winter		Spring	
	N	%	N	%	N	%	N	%
Total positive (%)	19,250 (17.4)		13,023 (14.7)		11,106 (15.9)		18,118 (16.4)	
	χ^2 = 261.9 P = 0.0001							
G. lamblia								
Total positive (%)	9561 (8.7)		6937 (7.9)		6035 (8.7)		9984 (9.0)	
	χ^2 =86.77 P = 0.0001							

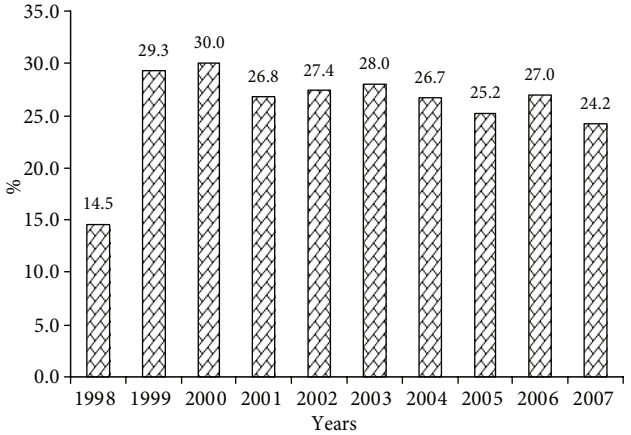

Figure 4. Prevalence of intestinal parasites due to years in the 5 regions in the whole of Gaza Strip.

4.2 Intestinal parasites prevalence trend

A. lumbricoides showed a considerable decline in its prevalence in the period from 1998 to 2007. Continuous flooding of the sewers in Gaza is a problematic issue due to excessive pressure on the sewers system in the area, where this makes people under risk of coming in contact with Ascaris. A. lumbricoides still persists in the local community in spite of the fact that the open sewers in most of the Gaza Strip were closed in the last 10 years, especially in the refugee camps. This could be explained by widespread contamination of the environment with feces.

The persistence of *A. lumbricoides* in a community and its contribution to the regulation of its population in that community depend on the number of eggs that are produced, the number that embryonate in the environment that attain infectivity, and the number of these that are accessible to susceptible hosts (13).

In a study in Lebanon, Hamze et al. (14) indicated that there was an increase in the prevalence of *A. lumbricoides* and *G. lamblia* in the period of 1997–2001 with less marked changes in the prevalence of other parasites. Another study (15) included 22,970 stool specimens collected from patients attending the Central Medical laboratory in the city of Nablus, Palestine, in the period of 1981–1986; 7412 (32.3%) were positive. *E. histolytica* (22.9%), *G. lamblia* (7.3%), and *A. lumbricoides* (5.7%) were the most prevalent intestinal parasites found. The irregular attendance of people at the primary health care centers due to the Intifada (uprising) and the absence of a computerized system for the primary health care centers, which depend on written reports for the diagnosis of intestinal parasites, could contribute to year on year variations. *E. vermicularis* was diagnosed by stool examination, not the best choice of method. Adhesive tape or similar preparations are not in use in hospitals and private laboratories in Gaza. In addition, most physicians depend on the complaints of the patients, like itching, to prescribe the suitable drug.

4.3 Risk factors for infection with intestinal parasites

a) Sewer systems and correlation to intestinal parasitic diseases

Open sewers (narrow channels) in the streets in front of houses have been the dominant type of sewer system in the Gaza Strip over much of the last 40 years. During the time of the Palestinian Authority most of these sewers have now been closed. As a result of overcrowding in the Gaza Strip (density 3698 persons/km^2), however, there is pressure on this aspect of the infrastructure in the sewers, which were designed to serve a limited population density only. In addition, flooding of sewers is a frequent event in Gaza, especially in winter, where the sandy soil readily absorbs sewage.

Lack of wastewater management has a direct impact on problems related to public health, marine and coastal pollution, and deterioration of nature and biodiversity, as well as the landscape in the Gaza Strip as reported by the Ministry of Environmental Affairs (16).

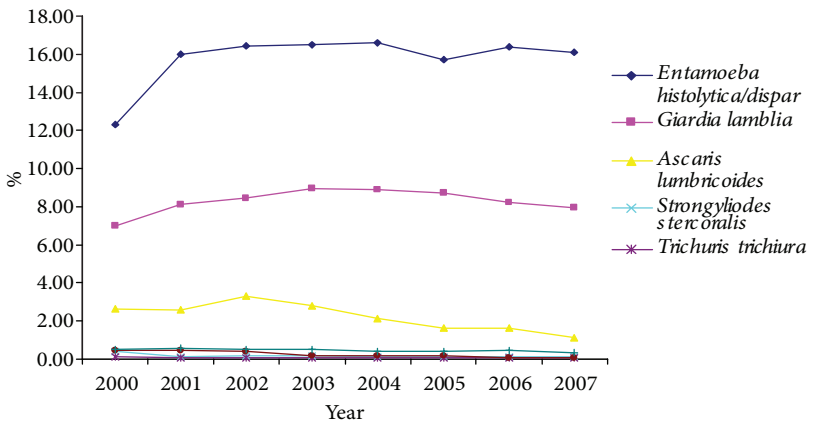

Figure 5. Prevalence of intestinal parasites trend from years 2000 to 2007.

The introduction of piped sewerage in the Al-Shati Refugee Camp has not resulted in a reduction in either the prevalence or intensity of *Ascaris* infection, nor has it lessened the levels of environmental contamination by *Ascaris* ova (17). Intermittent water supply and sewage floods seem to contribute largely to self-reported diarrheal diseases among people in Gaza (18).

b) Garbage in streets and near garbage containers

The garbage in the Gaza Strip is a very serious public health problem. It is present everywhere, near big containers, around houses, and in the public yards in spite of the efforts of the municipality. Conditions, which encourage the transmission of intestinal parasites, may be resulting in an increased prevalence of houseflies (19). Furthermore, the practice of dumping solid waste in the street should be minimized, as it is common to see children playing in and around disposal sites in the Gaza Strip, which can certainly cause serious health problems (20).

c) Hygiene, health practices, and behavior

The health records examined during the present study do not indicate the sex or age of the individuals. A thin fecal smear is the major technique used in the diagnosis of intestinal parasites in governmental and private laboratories in the Gaza Strip; some of the other studies in the Gaza Strip were not using health records, in which this approach has well established limitations. Most people attending primary health care centers were complaining about symptoms such as diarrhea and abdominal colic, where infection with parasites could be relevant. No information on polyparasitism was found in the health records; this means that the examination of a fecal smear stopped as soon as a single parasite was found. Most studies on parasitic diseases were carried out in school-age children, who have low standards of hygiene and negative behavior towards health and washing hands before eating and/or after defecating. There is a need for continuing health education in the community.

The first study in Gaza reporting the effect of health education on decreasing intestinal parasitic infections was done by Kanoa (4), where he found a significant association between the health education and intestinal parasites among school-age children from 3 locations in the Gaza Strip. Therefore, child behavior in this respect needs follow up and improvement.

d) Drinking water and contamination with sewage

Drinking water coming into the houses through the public network is possibly contaminated. As the network of drinking water is close to the sewage network, seepage is expected. Water contamination constitutes a high risk for the transmission of intestinal parasites and other infectious agents. Contamination of ground water with sewage is a serious problem worldwide, and is especially prominent in developing countries, and many chemical and microbial contaminants are potential threats to human health (21,22). Sharif (23) reported that the highest levels of contamination were encountered in well water located in the western regions of the wastewater treatment facility (WWTF) located in the Northern Gaza Strip. Sharif concluded that seepage or overflow of inefficiently treated wastewater from the WWTF is thought to be the point source of bacteriological and physicochemical contamination detected in the analyzed well water. Thus, the drinking water may be susceptible to contamination with the infectious stages of parasites and other agents.

e) Sewers and the Gaza beach

All sewers systems along the Gaza shore were designed to end at the Gaza beach to expel the sewage after biological treatment by the 3 sewage plants. Because residents heavily use the Gaza Strip shore for fishing and recreation, these sewage pipes constitute a risk factor for the transmission of intestinal parasites and other pathogens. Their close proximity to the beach gives no protection to the people. Recreational water generally contains mixtures of pathogenic and nonpathogenic microbes derived from sewage effluents, industrial processes, farming activities, wildlife, and indigenous microorganisms. This mixture can present a hazard to bathers when an infective dose of pathogen colonizes a suitable growth site in the body and leads to disease (24). In a study conducted on the Gaza beach, it was reported that there was a high prevalence of *Salmonella* (15.4%) isolated from sand samples at different locations on the Gaza shore (25), but with no mention of the infectious stages of intestinal parasites.

f) Vegetables and fruits and intestinal parasites

Vegetables and fruits are transported usually in the internal community by donkeys, especially in popular areas of the Gaza Strip, to be sold in local markets. Therefore, intestinal parasitic infection is very easy to be transmitted from the possible contamination in these vegetables and fruits. In our society, it is easy for people to taste fruits when buying, without washing or being aware of possible contamination on these fruits. Fresh fruits and vegetables in market stalls are likely to be kept moist and fresh with water of unknown quality, which may well be contaminated with potential pathogens. It is obvious from Table 3 that the highest prevalence of *E. histolytica/dispar* occurred in the summer season (17.4%); this could be attributed to the high temperature during summer, which can reach 33 °C. Our results were supported by the results reported by Amin (26), associated with high relative humidity. All these factors in addition to personal hygiene and improper practices such as eating unwashed vegetables (Al-Hindi and Khalaf) (unpublished data), a common habit in the Gaza Strip, constitute risk factors for infection.

g) Weather, temperature, seasons, and the prevalence of intestinal parasites

The Gaza Strip is located on the Mediterranean Sea, where temperature ranges between 14.4 °C in January to 27 °C in August, while the general rainfall rate is 442 mm per year as reported by the Palestinian Meteorological Authority (27).

Seasonal occurrence of intestinal parasites in the West Bank has been studied in the period of January 1981 to August 1997. Lower prevalence rates of intestinal parasites generally occurred during winter and early spring. Seasonal variation in a particular area may influence the occurrence of helminth infections and determining such fluctuations may help to maximize the beneficial effects of mass treatment (28). In that study, *A. lumbricoides* infections were found to correlate significantly only with the number of wet days in a month ($P < 0.001$).

A significant seasonal variation of *Giardia* notification was observed, peaking in late summer and early autumn. The pattern of *Giardia* infection remained relatively similar over the years, but variations in rates persist between the areas. Although infection rates decreased in most years, they have increased in 5 areas (representing 30% of the national population). No specific reasons for these changes have been identified. Random variation in yearly rate could be a possibility (29).

In the present study, it seems that the intestinal parasites were high mostly in summer, perhaps associated with increases in temperature, humidity, and the consumption of vegetables.

h) Poverty, population density, houses, and family size

According to the World Health Organization (WHO) (30), the prevalence of poverty among Palestinian households in Gaza was 56% in 2008. In addition, family size is considered high when it ranges between 3 and 15 people/family. Moreover, Farah (31) indicated that approximately 40% of households have a density of 3 persons or more per room. In addition, she mentioned that, in most shelters, 1 room is utilized more than other rooms, and in some shelters there might be 4 or 6 people in the same room. Moreover, she indicated that poverty prevents most families from improving, relocating, or expanding their habitats.

The crowding index is an important measurement to assess the social and economic situation of the residents, and has been calculated in Abu-Murad's study in the Al-Nusirat Refugee Camp (32). The mean crowding index (2.7 individuals per room) was found to be significantly higher than the optimal mean of 1 individual per room, and this reflects the problem of refugees.

A small number of infected individuals may contribute greatly to transmission due to the uneven distribution of parasites in a population.

The high mean of intestinal parasites in Gaza governorates may be explained by the fact that Gaza is a crowded area and the continuous closure of the Gaza Strip during the Israeli occupation during the uprising, when no allowance was made for refuse to be removed from Gaza. Moreover, on a more positive note, in the Mid-Zone there are a number of active nongovernmental organizations involved in relief and developmental projects, under the responsibility of the United Nations for Relief and Work Agency (UNRWA) in the refugee camps (Mid-Zone is mainly a cluster of 4 refugee camps). Also in the 4 refugee camps in the Mid-Zone, sanitation and the environmental situation is the responsibility of UNRWA. Some projects have made improvements to the infrastructure like streets and increasing the garbage containers.

In the present study, from the health records, giardiasis and amoebiasis were the most common protozoa.

4.4 Health records

Medical records can provide a rapid and valuable source of information on the importance of infectious diseases. Those examined here also a reveal a number of problems, such as the lack of information on age, sex, residence, and general symptoms. To the best of the authors' knowledge, one of the hospitals in the Gaza Strip has applied a computerized system in patient admission in all wards. In a conflict zone like Gaza, the likelihood of reliable records being made consistently is fairly small. The flow of information from the laboratories in each region should be accurate and continuous.

The methods employed in the laboratories in the Gaza Strip are similarly limited, particularly for *Strongyloides*. In fact, a single stool sample with thin smear investigation is limited for all of these parasites, and so this may need to be reviewed by health authorities.

It is concluded that intestinal parasites still constitute a health problem and there were fluctuations in the prevalence from 1998 to 2007.

Recommendations:

1. There is a need for health authorities to review health records periodically.
2. Examination of stool specimens by one method should be reviewed.
3. Recording age, sex, and symptoms in the records of the Ministry of Health is very important.

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