Distribution of Human Fascioliasis by Age and Gender among Rural Population in the Nile Delta, Egypt

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Summary

The number of cases of human fascioliasis reported in Egypt, has increased drastically during the past years. Most of the newly infected cases were children and adolescents. In the year 2000, the Egyptian Ministry of Health and Population implemented a cross-sectional survey in four endemic foci of Behera Governorate, in the Nile Delta. The aim of the study was to define prevalence and intensity of human fascioliasis, by age and gender, in order to plan appropriate control measures in endemic areas. The field assessments involved 1331 subjects and utilized the Kato–Katz thick-smear technique, on a double preparation, for quantitative diagnosis of intestinal helminths. A total of 72 positive cases were detected, the majority of them (n = 51, 71 per cent) in subjects below 19 years of age. The highest prevalence and intensity of infection was reported in the 9–11 years age group. Women were more affected than men, but not at a significant level. Primary schoolchildren appeared to be more at risk of contracting the infection and should be considered the main target for control measures. Further studies are needed to identify new ways of infections and possible risk factors responsible for the higher transmission among schoolchildren and women.

Introduction

Human infection by Fasciola spp. has a well-known high pathogenic impact in humans, but is traditionally considered a secondary zoonotic disease, concerning just sporadic cases.1,2 In recent years the number of reports of humans infected by Fasciola spp. has increased constantly and several geographical areas are now considered endemic for the disease in humans.3,4 Very little is known about the distribution and intensity of the human infection by age and gender. Although all age groups can be affected,5 there are several reports suggesting that children below 15 years of age are the most affected, at least in high prevalence areas.6 Conflicting reports also exist suggesting gender might affect prevalence. While in Spain5 and Bolivia6 prevalence by sex appeared to be very similar, in Chile7 and Egypt8 a higher prevalence was observed in women.

In the Nile Delta the first human cases detected date back to 1928 and, until 1960 few sporadic cases were reported. In the 1970s an endemic focus was identified in Behera Governorate8, and since 1980 the number of cases rose drastically and human infection was reported in most Governorates of the Delta.9–12 Following the general concern on the increased number of cases reported every year, a number of surveys have been conducted in the area to define the extent of the problem and identify endemic areas.13 Population-based data are now available for many governorates of the country.
However, additional information is needed on the age and sex distribution of the infection in the area. Such information is of great importance to define the population at risk in an effort to control the spread of the disease in Egypt and may be useful for other countries facing a similar problem.

The aim of the present study was to define age and gender distribution of the infection among the rural population in the Nile Delta, gathering the information needed by the Ministry of Health and Population (MoHP) to plan appropriate and effective control measures in the area.

**Materials and Methods**

**Study area**

During 2000 (June–September), the Egyptian MoHP conducted a cross-sectional field assessment in four endemic foci from three different districts of Behera Governorate (Kafr El Dawar, Hosh Eissa, and Delengat), in the western part of the Nile Delta. The four villages were all newly identified foci, different from the traditionally known endemic foci of human fascioliasis in the Governorate. Although the widespread presence of infection among animals was already known in these villages, human infections were detected in large number only after 1996 and none of these villages was covered by control or research activities before this study.

**Sampling**

Taking into account the age distribution of the population in Egypt, the total sample was stratified into eight age groups (1–3, 4–5, 6–8, 9–11, 12–14, 15–18, 19–35, >35), represented by an equal number of study subjects. On the basis of the available literature, giving an expected population proportion (P) equal to 20 per cent or less with a 95 per cent confidence interval, the minimum sample size was calculated as 125 subjects for each age-group for a total of 1000 individuals. The same sample was considered sufficient to analyse differences by gender. Faecal samples were collected in the four endemic foci from all the people living in the households selected through a random procedure. All subjects testing positive for helminths’ ova were treated immediately through a random procedure. All subjects testing positive as measured by Pearson’s chi-squared test (χ² = 19.84; p = 0.005). Data on intensity of infection were consistent with the results on prevalence, with the most affected subjects in the age-group 9–11 years (Fig. 1); the difference was highly significant as measured by Pearson’s chi-squared test (χ² = 20.0; p < 0.001).

**Faecal analysis**

The study utilized the Kato–Katz thick-smear technique for quantitative diagnosis of intestinal helminths. Two slides were prepared and read for each individual faecal sample, utilizing a template of 41 mg. Number of ova per field was converted to eggs per gram of faeces (e.p.g.) applying a multiplication factor of 24. An internal quality control was conducted on 10 per cent of the sample; all positive slides were read twice to minimize errors in egg counting. No attempt was made to differentiate between *Fasciola hepatica* and *Fasciola gigantica*, both present in Egypt. In the present paper, they will be referred to as *Fasciola spp.*

**Data management**

Epi-Info and SPSS, version 6.1, software were used for analysis of the data. Differences in prevalence were tested for each age group and for both sex groups, by chi-squared test. Intensity of infection was indirectly measured as mean of e.p.g. for groups of individuals, which is considered a reliable estimate of worm burden. Statistical tests were performed after individual egg counts were converted according to the log (n + 1) transformation. Results on intensity of infection were expressed and presented in arithmetic and geometric means.

**Results**

**Study subjects**

The total number of samples collected and examined was 1351. The age of the study subjects ranged from 1 to 80 years. Males represented 41 per cent of the sample (n = 553), and women 59 per cent (n = 778). Ova of *Fasciola spp.* were detected in 72 Kato–Katz preparations, giving a 5.4 per cent prevalence of human fascioliasis in the four villages where the faecal samples were collected.

**Prevalence and intensity of infection by age**

Most of the cases (n = 51, 71 per cent) were detected in subjects below 19 years of age. The youngest case was 2 years old and the age-group 1–3 years reported the lowest prevalence (1.6 per cent). The highest prevalence, 11.6 per cent was detected in the age-group 9–11 years (Fig. 1); the difference was highly significant (p < 0.001). Above 12 years of age, both prevalence and intensity of infection were constantly decreasing. Regrouping all subjects in four broad age categories (infants 1–5, schoolchildren 6–11, adolescents 12–18, and adults > 18), the peak prevalence and intensity was detected among schoolchildren. Data on prevalence and intensity of infection, for the four age categories, are summarized in Table 1.

**Prevalence and intensity of infection by gender**

Prevalence of infection was higher among female (6.2 per cent) than male (4.3 per cent) subjects;
however, the difference did not appear to be significant. No remarkable differences emerged in arithmetic and geometric mean of e.p.g. for infected individuals. Results for prevalence and intensity of infection by gender are summarized in Table 2.

**Discussion**

The overall prevalence of human fascioliasis reported in the present study (5.4 per cent) was consistent with results of former studies in other
endemic areas of the Delta, \(^8,^{10}\) but much lower than that reported in South America. \(^4\) Intensity of infection was equally low (arithmetic mean = 111, geometric mean = 71), compared with similar data from a South American population, \(^20\) which reported a level of intensity more than double. A comparison with former studies in Egypt is difficult, since only studies concerning egg counts in a very few patients have been published until now. \(^21,^{22}\)

The infection presented a clear age trend, affecting more children and adolescents than adults. Both prevalence and intensity increased constantly until 9–11 years, and then decreased after that (Figs 1 and 2). A similar distribution of the human infection was observed in former studies conducted in other hyper-endemic areas, \(^2,^{20}\) although the same studies failed to detect a significant difference in intensity. Children below 5 years of age were the least affected age group, as observed in Spain. \(^7\) Both, prevalence and intensity of infection remained low and stable, around 4.3 per cent and 57 e.p.g. after 18 years of age.

Looking at the distribution of the cases it is reasonable to assume that higher transmission among young people was responsible for the increased number of cases detected in recent years, while adults were still sporadically affected. This observation may be explained either with an increase in human immunity in adult age or a greater exposition to sources of infection in younger ages. An increased immune response in adult age is very unlikely in parasitic infection. It is more realistic to assume that children were more exposed to contact and infection. The infection may also follow different routes and ways of transmission, than those observed for the sporadic cases of human fascioliasis reported in the past, mainly through the ingestion of raw aquatic vegetables (watercress), or the occasional sucking of grass, on which larval parasites are encysted. \(^23\) Children usually consume very limited amounts of raw vegetables and most of them are reluctant to eat them at all. A higher prevalence and intensity of infection among schoolchildren is well known for soil-transmitted helminths, which follow a different way of transmission than liver flukes, or parasites transmitted by ingestion of contaminated food. \(^24\)

Recent experimental studies, \(^25\) were able to isolate floating metacercarie from \(Fasciola\) intermediate hosts. The floating metacercarie appeared to be more infective than the encysted ones and humans can become infected by drinking or swimming in contaminated water. Additional studies are needed to assess the viability of floating metacercarie in the Egyptian environment, as well as to assess the possibility that encysted metacercarie may be present on other vegetables, raw foods and kitchen utensils, which may come into contact with contaminated water in the highly endemic areas. Another important aspect to be investigated will be the role of children as an egg reservoir and the distribution of eggs in the environment. It has already been demonstrated that human subjects can act as a viable definitive host in the life cycle of the parasite and actively participate in its transmission. \(^7\) A similar

### Table 1

<table>
<thead>
<tr>
<th>Age-group</th>
<th>Age range (years)</th>
<th>Prevalence (95% CI)</th>
<th>Max e.p.g.</th>
<th>Arithmetic mean e.p.g. ± SE</th>
<th>Geometric mean e.p.g. ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td>1-5</td>
<td>2.7 (1.3–5.4)</td>
<td>312</td>
<td>103 ± 36</td>
<td>79</td>
</tr>
<tr>
<td>Schoolchildren</td>
<td>6-11</td>
<td>8.3 (5.7–11.9)</td>
<td>528</td>
<td>159 ± 35</td>
<td>90</td>
</tr>
<tr>
<td>Adolescents</td>
<td>12-18</td>
<td>6.9 (4.4–10.5)</td>
<td>576</td>
<td>110 ± 30</td>
<td>67</td>
</tr>
<tr>
<td>Adults</td>
<td>&gt;18</td>
<td>4.3 (2.8–6.5)</td>
<td>192</td>
<td>57 ± 8</td>
<td>51</td>
</tr>
<tr>
<td>All subjects</td>
<td>1–80</td>
<td>5.4 (4.3–6.7)</td>
<td>576</td>
<td>111 ± 16</td>
<td>71</td>
</tr>
</tbody>
</table>

* Positive cases only.

### Table 2

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>Prevalence (95% CI)</th>
<th>Max e.p.g.</th>
<th>Arithmetic mean e.p.g. ± SE</th>
<th>Geometric mean e.p.g. ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>553</td>
<td>4.3 (2.9–6.4)</td>
<td>576</td>
<td>128 ± 34</td>
<td>70.9</td>
</tr>
<tr>
<td>Females</td>
<td>778</td>
<td>6.2 (4.7–8.1)</td>
<td>528</td>
<td>102 ± 17</td>
<td>70.1</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td>—</td>
<td>—</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>All subjects</td>
<td>1331</td>
<td>5.4 (4.3–6.7)</td>
<td>576</td>
<td>111 ± 16</td>
<td>70.7</td>
</tr>
</tbody>
</table>

* Positive cases only; \(^6\) Pearson’s chi-squared test, \(^\alpha\) t-test.
transmission may also occur in Egypt and this possibility should be verified.

According to the study results, women appeared to be more at risk than men. Former field studies conducted in Egypt detected a prevalence of 10.3 per cent and 4.4 per cent in females and males, respectively. However, the present study failed to detect significant gender differences. This may be due to the limited number of positive cases (72) detected in the total sample. Thus a relationship with age cannot be excluded on the basis of the present results and needs further investigation.

Even the higher prevalence among women suggests a different way of transmission, than that usually observed, and the hypothesis that hygienic habits and the traditional work division in rural Egypt may play an important role in the transmission of human fascioliasis. These aspects need to be investigated further, through controlled behavioural studies, in order to identify an effective way of preventing infection, reducing risk, and to design educational messages, specifically addressed to women.

The aim of the study was to identify the distribution of human fascioliasis by age and gender and the results showed a clear distribution of the infection pattern, which made possible the identification of schoolchildren as the population group more at risk of contracting the infection. At the same time, the study was not designed to assess why some sectors of the population was more likely to contract the infection than others, and additional field investigations are needed to identify the reasons behind the differences detected in the distribution of infection.

While the identification of the possible causes for the greater number of infections among children remain a priority for research, immediate control measures against this parasite, targeted at schoolchildren, should be implemented, or integrated to ongoing programmes (National Schistosomiasis Control Programme), in endemic areas. Following WHO recommendations and the results of this study, the Egyptian MoHP has launched a programme of fascioliasis mass screening, and treatment of positive cases by Triclabendazole, for all the children attending the primary schools located in the endemic areas of Beheira Governorate.

References