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Human fascioliasis infection: gender differences within school-age children from endemic areas of the Nile Delta, Egypt

Filippo Curtale[a,*], Yehia Abdel Wahab Hassanein[b], Paolo Barduagni[a], Mohamed Mostafa Yousef[b], Aly El Wakeel[c], Zuhair Hallaj[d], Santiago Mas-Coma[e]

[a] *Directorate General for Development Cooperation (DGCS), Ministry of Foreign Affaires, Rome, Italy*
[b] *Endemic Diseases Control Department, Ministry of Health and Population, Cairo, Egypt*
[c] *Behera Regional Health Directorate, Ministry of Health and Population, Damanhour, Egypt*
[d] *Department of Communicable Diseases, Eastern Mediterranean Regional Office, World Health Organization, Cairo, Egypt*
[e] *Department of Parasitology, Faculty of Pharmacy, University of Valencia, Valencia, Spain*

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Summary Several studies have reported a higher prevalence of infection for human fascioliasis among girls than among boys. To investigate this aspect further a sufficiently large data set was assembled comprising of 21 477 subjects with 932 positive cases. Subjects were primary school children covered by a control programme implemented by the Egyptian Ministry of Health and Population in the Nile Delta from 1988 to 2002. Stool analyses were performed by the Kato—Katz thick smear technique for a quantitative diagnosis on the intensity of infection. Both prevalence and intensity of infection, indirectly measured as mean number of eggs per gram of faeces, were significantly higher among girls than boys. The higher level of infection in girls was consistent across different years and in different survey areas. Co-infection with *Schistosoma mansoni* was present and associated with fascioliasis, but schistosomiasis was significantly more prevalent among boys. In Egypt rural girls are often involved in household and farm work and are exposed more than boys to infected foci. The lower school attendance for girls in rural areas appears to be an important factor increasing risk of infection. The precise mode of transmission and behavioural risk factors for human infection need to be investigated further to identify those related to gender.
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* Corresponding author. Present address: Agenzia di Sanità Pubblica del Lazio, Via di Santa Costanza 53, 00198 Rome, Italy. Tel.: +39 06 83060375; fax: +39 06 83060405.
E-mail address: curtale@asplazio.it (F. Curtale).

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1. Introduction

Human infection with *Fasciola* spp. can often induce severe pathology (Chen and Mott, 1990). In the past, human fascioliasis has been considered a rare disease, concerning just sporadic cases (Haswell-Elkins and Elkins, 1996), but in recent years the number of human cases affected by *Fasciola* spp. has increased drastically (Mas-Coma et al., 1999). There is evidence that this parasite is able to adapt to different definitive hosts, including humans, initiating the spread of disease into new transmission foci (Mas-Coma et al., 2005).

The Nile Delta, where the first human cases were detected in 1928, is considered to be one of the most endemic areas in the world for human fascioliasis (Curtale et al., 1998; El Shazly et al., 1991; Farag et al., 1979). In 1995, WHO estimated an overall prevalence of 3% in Egypt, with at least 830 000 people infected and 27.7 million people being at risk of infection (WHO, 1995a). Although the actual figure may be lower, due to the control intervention implemented by the Egyptian Ministry of Health and Population since 1998 (Curtale et al., 2005), human fascioliasis is still considered a serious public health problem in Egypt.

As for other helminth infections, the most affected population group appears to be school children (Esteban et al., 1998). A field study recently conducted in Behera, the largest and most populated Governorate of the Nile Delta, has confirmed a peak prevalence and intensity of human fascioliasis infection among children, between 9 and 11 years of age (Curtale et al., 2003a).

In terms of infection prevalence and intensity, gender differences have also been reported in different endemic areas. In Egypt, higher prevalence and intensity of infection were found among girls compared with boys (Farag et al., 1979). In Andean countries, prevalence did not differ between the sexes, but females excreted more eggs than males (Esteban et al., 1999). A recent study in Egypt detected a significant difference in prevalence, but not for intensity of infection (Esteban et al., 2003). Most of the studies conducted until now have failed to detect significant differences in intensity of infections, which is considered to be a more reliable indicator of infection risk and, as for other intestinal helminth infections, to be a useful predictor of later morbidity (Montresor et al., 1998).

In Egypt, a low number of positive cases are usually detected in a survey population, which may account for failing to detect significant differences by gender for intensity of infection. To investigate this further it is necessary to utilize sufficiently large data sets. In this paper we analyse data collected during a screening of fascioliasis in the primary schools of endemic districts in Behera (Curtale et al., 2005), where, from 1998 until 2002, just over 20 000 children were screened and 932 cases of human fascioliasis were identified and treated. This sample size was considered sufficient to test the hypothesis that girls are more at risk of being infected with *Fasciola* spp. than boys.

2. Materials and methods

2.1. Study area and subjects

The faecal sample collection took place from 1998 to 2002 in the primary schools of six endemic districts in Behera Governorate, identified during former assessments. The schools surveyed were those covered by a national selective chemotherapy control programme described elsewhere (Curtale et al., 2005) and were different every year.

Faecal samples were collected from class five children, for the pre-screening activities (years 1998 and 2001), and from all primary school children for the screening activities (years 2000 and 2002). The pre-screening consisted in the identification of endemic villages/foci, through the screening by a single Kato—Katz stool examination of 100 class five school children (10—12 years of age), attending a primary school randomly selected in each village of the endemic districts. Then, in villages where a school had reported four or more positive cases, all children attending every primary school (6—12 years of age) in that village were screened. In towns and large settlements with more than 100 000 inhabitants, such as Delengat town, a pre-screening was conducted for all the schools in the urban area, treating each school in that area as a different village.

All children excreting ova of *Fasciola* spp. or any other intestinal helminth, either during pre-screening or screening, were treated with appropriate anthelminthics. A single dose of triclabendazole (10 mg/kg body weight) was used for treatment of fascioliasis (WHO, 1998), and the recommended WHO treatment guidelines were followed for all other parasites detected (WHO, 1995b).

2.2. Faecal analysis

The Kato—Katz thick-smear technique (WHO, 1994) was utilized for diagnosis of human fascioliasis, which is considered more appropriate than sedimentation techniques for large-scale screenings and surveys (Ebrahim et al., 1997). The number of eggs per slide is considered a reliable indicator of worm load and was used as an indirect method to assess the intensity of infection (Shehab et al., 1999). One slide was prepared and read for each individual faecal sample, utilizing a template of 41.7 mg. The number of eggs per slide was converted to eggs per gram of faeces (epg) applying a multiplication factor of 24. No attempt was made to differentiate between *F. hepatica* and *F. gigantica*, both present in Egypt. In this paper, they will be referred to as *Fasciola* spp.

2.3. Data management

Screening data were entered using EpiInfo software (CDC, Atlanta, GA, USA), edited, and then analysed using SSPS, release 10.0, software program (SPSS Inc., Chicago, IL, USA). To minimize the effect of confounding factors, and to assess consistency of the results over time and in different areas, data were analysed by year. Differences in prevalence of infection by gender were statistically tested using the χ^2 test and odds ratios. Prevalence data on infection with *Schistosoma mansoni*, the most prevalent helminth in the area, including association with *Fasciola* spp. infection and gender differences, were also calculated on the same sample to analyse any possible role of co-infection in gender bias.

Differences on intensity of infection were calculated across all samples, including negative slides, and presented

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