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*Original article*

# Prevalence of gastrointestinal parasites in the Greek population: local people and refugees

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## SUMMARY

**A total of 455 faecal samples from the Greek population and refugees was examined and 18.02% were found to be infected with one or more species of parasites. The prevalence of infection with intestinal parasites of the Greek (264) population was 11.36% and that of foreigners (191) originating from Europe, Africa and Asia was 27.23%. Found were a) protozoan parasites*: Blastocystis hominis, Cryptosporidium parvum, Entamoeba coli* and *Giardia lamblia* (found in both groups examined) and b) metazoan parasites: *Enterobius vermicularis, Taenia* spp. and *Strongyloides stercoralis* (in both groups) and *Ancylostoma duodenale, Ascaris lumbricoides, Trichuris trichiura* and *Schistosoma mansoni* (only in foreigners). Among the parasites found in foreigners only the helminth species *A. duodenale* and *S. mansoni* are considered as imported parasites from tropical and subtropical regions to European countries. The use of the multiple logistic regression showed that the odds ratio comparing Greeks to refugees, adjusted for age and gender, was 3.8 for Africans, 3.0 for Europeans and 2.6 for Asians. No correlation was found between age, gender or symptoms (diarrhea or abdominal pain) with the presence of parasites. The overall prevalence of infection with parasites was high in both the Greek population and refugees and therefore a screening for parasite infection is recommended for the prevention of further spread of the infections.**

**Key words:** parasites, immigrants, Greece

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## INTRODUCTION

People, nowadays, very frequently travel from one country to another for various reasons, including tourism, immigration, asylum seeking, wars, sports etc. These movements, especially those from non-European countries (Africa, India etc), through European places might present a serious threat to public health due to the importation of new diseases (such as parasitic diseases) into another area, to some intermediate destination and on arrival home, or may contribute to the distribution of parasitic species which already exist in the country. Many immigrants come from countries where gastrointestinal parasites (protozoa or metazoa) are highly endemic[1]. Furthermore, the fact that local population might be immunological naove and susceptible makes the situation even more important, since a large portion of the population might be exposed to a serious health risk. Refugees, or immigrants in general, of different nationalities, arriving in Greece may carry parasitic species that are not normally found in Greece. This is attributed mainly to ecological factors, which exist in each country allowing the development and distribution of parasites. In general, refugees, displaced persons and immigrants are at high risk for emerging infections, since in most cases they have a history of poor utilization of pretravel medical care and vaccination, living conditions of low socioeconomic status and a high possibility to be carrying symptomless diseases. For that reason it is important to carry out screening of travellers upon arrival because of the spontaneous loss of parasites

over time in the absence of reinfection.

It is obvious that it is essential to know the degree of risk of importation of parasites from other, especially non-European, countries, such as tropical and subtropical regions, into Greece and to evaluate this danger according to the level of infection of Greek citizens. A systematic previous survey for the prevalence of intestinal parasites in Greek people, aged from 18 to 26 years, and in foreigners, aged from 17 to 31 years, was carried out in 1981[2]. The aim of this study was to investigate the prevalence of infection with gastrointestinal parasites of people, aged from 1.5 to 78 years, immigrating to (refugees and asylum seekers) or living in Greece.

## MATERIALS AND METHODS

A total of 455 faecal samples were collected between 2000 and 2002, 191 from foreigners entering the country for different reasons, i.e. looking for political asylum, refuge, work, etc and 264 from people living in Thessaloniki, Greece. Samples from the local population were collected through the procedure of routine examination for health certificates (health insurance) or investigating gastrointestinal diseases. Samples from foreigners were collected through the "green card" procedure, since all foreigners asking for asylum or work, within a short period of entrance into Greece, are required to have a complete physical examination, which includes a stool examination for parasites. The laboratory authorized to carry out this examination was the Laboratory of Parasitology and Parasitic Diseases of the School of Veterinary Medicine of Aristotle University of Thessaloniki. Foreigners included in the study originated from Europe and the Former Socialist countries (19 persons from Albania, Hungary, Netherlands, Russia and Yugoslavia), Asia (77 persons from Afghanistan, India, Iraq, Iran, Palestine and Turkey) and Africa (95 persons from Burundi, Congo, Ethiopia, Nigeria, Rwanda, Sierra Leone and Sudan). The age ranged from 1.5 to 78 years (Table 1).

Each faecal sample consisted of 10 – 20 g of fresh stool, kept into a plastic container, presented to the Laboratory and examined within one hour of delivery. It was accompanied by a questionnaire including information on each individual. Briefly, it contained information regarding the gender, age, country of origin (in cases of foreigners) and occupation of each sampled person. The health history was of particular interest, including the presence of any symptoms, mainly diarrhea and abdominal pains, chronic diseases and recent travel abroad, specially to tropical countries (Table 1).

**Table 1.** Origin, age groups and gender of people examined in the study

| Origin | Age group (male/female) | | | Total |
|---|---|---|---|---|
| | 0-24 years | 25-34 years | 35-78 years | |
| Greece | 19/36 | 23/46 | 53/87 | 95/169 |
| Europe | 4/3 | 10/5 | 2 /3 | 16/11 |
| Africa | 28 /2 | 50/11 | 2/0 | 80/13 |
| Asia | 17 /10 | 31/5 | 7/1 | 55/16 |

Microscopical examination of faeces was carried out to detect ova, larvae, cysts or trophozoites of parasites according to Teleman's method[3]. Also smears of the faeces were prepared and stained with Giemsa and the modified safranin–methylene blue stain[4] to detect and identify any form of protozoan parasites (i.e. *Cyclospora*).

Statistical analysis was performed using multiple logistic regression models (SPSS, 11 version).

## RESULTS

Of 455 faecal samples examined in total, 82 (18.02%) were infected with one or more parasitic species. More precisely, 30 (11.36%) subjects from Greece and 52 (27.23%) foreigners were infected (Table 2). Greeks were infected with 4 protozoan and 3 helminths species. The most prevalent species were the protozoan *B. hominis* (5.3%) and the helminth *E. vermicularis* (1.1%). Foreigners were infected with 4 protozoan (same as Greeks) and 7 helminths species. The most prevalent species were the protozoan *B. hominis* (16.8%) and the helminth *A. duodenale* (6.3%) (Table 3).

Subjects from Greece were found, according to the chi-square analysis, to be significantly less infected than foreigners ($p<0.05$). Within the ethnic groups, subjects

**Table 2.** The prevalence rates of parasitic infection of people from Greece and foreigners and results of logistic regression (odds ratios)

| Origin | Number of people examined | Prevalence (%) | Odds ratios |
|---|---|---|---|
| Greece | 264 | 30 (11.36) | - |
| Europe | 19 | 8 (4.2) | 3.0 |
| Africa | 95 | 29 (15.2) | 3.8 |
| Asia | 77 | 15 (7.9) | 2.6 |

**Table 3.** Prevalence of parasites (protozoa and metazoa) found in faecal samples from subjects coming from Greece and foreigners

| | | Infected persons No (%) | | | |
|---|---|---|---|---|---|
| | | Protozoa | | | |
| **Examined persons** | | ***Blastocystis hominis*** | ***Cryptosporidium parvum*** | ***Entamoeba coli*** | ***Giardia lamblia*** |
| Greeks | 264 | 14 (5.3) | 7 (2.7) | 1 (0.4) | 6 (2.3) |
| Foreigners | 191 | 32 (16.8) | 3 (1.6) | 8 (4.2) | 7 (3.7) |

| | | Infected persons No (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Metazoa | | | | | | |
| **Examined persons** | | ***Ancylostoma duodenale*** | ***Ascaris lumbricoides*** | ***Enterobius vermicularis*** | ***Taenia* spp** | ***Trichuris trichiura*** | ***Schistosoma mansoni*** | ***Strongyloides stercoralis*** |
| Greeks | 264 | 0 | 0 | 3 (1.1) | 1 (0.4) | 0 | 0 | 1 (0.4) |
| Foreigners | 191 | 12 (6.3) | 2 (1.0) | 1 (0.5) | 1 (0.5) | 7 (3.7) | 1 (0.5) | 1 (0.5) |

from Africa were significantly more infected than the rest ($p<0.05$), followed by subjects from Europe (including the Former Socialist countries) and Asia.

The application of the multiple logistic regression models identifies which of the variables are independently correlated and do not act as implication factors or confounders. The development of the model was carried out according to the following direction: the presence or otherwise of a parasitic infection which was correlated to the influencing variables of age, gender and ethnic origin was considered a dependent variable. The results of the multiple logistic regression (method ENTER) showed that neither age nor gender are correlated to parasite infection, but ethnic origin acts solely as an independently correlated variable. Compared to subjects from Greece, the European group was found to have an odds ratio (OR – fracture of danger proportion) 3.0, i.e. threefold prevalence after the adjustment for age and gender, while for the group from Asia, the figure is 2.6 and from Africa 3.8 (Table 2). Furthermore, the presence of diarrhea and abdominal pain were not found to be correlated to the presence of infection.

## DISCUSSION

Most of the human gastrointestinal parasites are cosmopolitan in their distribution, but some are endemic in tropical and subtropical regions. The pathogenic effects of the parasites depends mostly on the parasitic species and on the intensity of infection. Most parasite infection is common mainly in areas where there are low standards of hygiene and sanitation and in tropical regions. The use of human faeces as a fertilizer is common in some parts of the world and can result in eggs getting on to salad vegetables (i.e. *A. lumbricoides, T. trichiura* etc). Untreated sewage is sometimes discharged into rivers and lakes, which represents a clear health hazard[5]. Since there is normally little person-to-person transmission of intestinal parasites, especially for helminthes, the local conditions and the life cycle of the parasites play the most important role in allowing the development and survival of the infective stages. In the case of helminthes, their eggs or larvae continue embryonation and development in the soil (i.e. *A. lumbricoides*) or intermediate host (i.e. *Schistosoma, Taenia*) before they can become infective to people. Exception within nematodes are the eggs of *Enterobius vermicularis* which are immediately infective and direct contamination from anus to fingers to mouth is a common mode of infection[5]. The same occurs with protozoan parasites, which are usually directly infective.

In the present study we found 7 species of intestinal parasites in 11.36% of people coming from Greece and 11 species in 27.23% of people coming from abroad. The most prevalent species was the protozoan *B. hominis* for both Greeks (5.3%) and foreigners (16.8%) and the helminth *E. vermicularis* for Greeks (1.1%) and *A. duodenale* for foreigners (6.3%). The prevalence of infection with *E. vermicularis* in this survey could not be the representstive of the real infection, as it is well known that ova are rarely found in the faeces and are usually looked for by wiping the anal region with sticky tape and sticking this onto a microscope slide for examination. Within the 7 helmiths species found in the foreigners examined, only *A. duodenale* and *S. mansoni* are considered imported worms, since the rest already exist in the country. *A. duodenale* infection is limited mainly to tropical and subtropical regions, because the larvae cannot develop below 22 °C, and is most common in rural

areas with an annual rainfall of over 100cm per year. *S. mansoni* infection is limited to Africa, South America and the West Indies, because the aquatic snail hosts (intermediate hosts of *S. mansoni*) live in slowly flowing water such as the irrigation channels, streams and lakes of the above regions[6].

Our results are more or less the same as those reported in a previous survey in Greece[2]. More precisely, it was reported that 30.1% of Greek origin students presenting gastrointestinal symptoms were infected with one or more intestinal parasites, compared to 41.9% and 12.3% of asymptomatic students coming from tropical and non-tropical countries, respectively. The prevalence in Greek students (30.1%) was higher than the one we found in this study for the Greek group (11.36%), but we believe that no correlation could be made with our results, since Himonas *et al*.[2] examined 299 symptomatic students within a certain age group and we screened a much wider (1.5 to 78 years) age group of asymptomatic people. Nevertheless, the parasitic fauna was more or less the same. On the contrary, the mean prevalence for students from tropical and non-tropical countries (27.1%) reported by Himonas *et al*[2] comes very close to our results (27.23%) since the groups in both studies were asymptomatic and within the same approximate age group. In Sweden, in a similar study, a prevalence of 36% was reported for refugees with more or less the same parasitic species from different parts of the world[1].

When people start presenting symptoms of a disease, as soon as they return from a visit abroad, the history of travelling abroad might provide very helpful information for the practitioner to apply successful treatment. In other cases, when people have no symptoms, the spread of this pathogen to others is very possible. In our study the presence of gastrointestinal symptoms was not correlated to parasitism, as was concluded in other similar studies[1,7-9]. Therefore, the lack of association of symptoms and detection of parasitic infections does not support the screening for parasitic infections in symptomatic subjects only[1]. In a case control study of enteropathogens associated with childhood diarrhea it was demonstrated that *Cryptosporidium parvum* was significantly associated, but not *Giardia lamblia*[10].

In this study, samples were taken from people who had just arrived in Greece, because it is well known that in surveys conducted in refugees it is important to carry out the screening upon arrival due to the spontaneous loss of parasites over time in the absence of re-infection. In Sweden, when refugees were examined for parasites immediately on arrival in the country, the positivity rate was 36%[1], but in another similar study, when examined after a longer stay in Sweden, the prevalence was 17%[11]. This difference was mainly attributed to the loss of parasites over time because of the absence of reinfection and ageing of parasites[1]. Salas *et al*[8] failed to detect helminths in immigrants who had been in the USA for more than 3 years, while prevalences of intestinal parasites exceeding 50% are normally observed in their original country. Adults of *Ascaris lumbricoides*, for example, are not very long living and eggs cease to be passed in under 18 months[5]. Nevertheless, it is important to consider with particular attention all kind of self-limiting diseases in the normal population since they can become chronic or lethal to immunocompromised hosts[12]. In this way, worms that do not exist in Greece, like *Ancylostoma* spp. or *Schistoma* spp., could spread and have an imported focus of infection.

The prevalence of infection with intestinal parasites is usually higher in children than adults, since age-related behavioral and environmental factors clearly contribute to exposure. Prevalence and species diversity increase with age up to 5-15 years and then decreases into adulthood. It is known that the common childhood behaviors of eating soil and neglecting to wash hands after defecation increases the opportunities for parasite infection, especially for certain parasites, such as *A. lumbricoides*[13-16]. Additionally to age, another important factor allowing the establishment of parasitism is the Human Immunodeficiency Virus (HIV) serostatus. In most surveys, HIV positive patients, children or adults, had a significantly higher rate of infection with parasites than the healthy control groups, particularly regarding *Cryptosporidium parvum* and *Giardia lamblia*[17-19]. HIV serostatus information was not included in our study and therefore no comparison or conclusion can be drawn.

Finally, *C. cayetanensis*, one of the parasitic agents of diarrhea mainly in international travelers, immunocompromised patients and expatriate populations in certain developing countries[10,20], was not detected in any of the subjects examined in our study.

In conclusion, we can support that the parasitological screening of faeces of immigrants, mainly those coming from tropical and subtropical regions to any European country, remains very necessary for preventing further spread of the infection, especially with parasites which do not exist in the country.

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