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Original Article

The Prevalence of Intestinal Parasitic Infections in Labor Children in Karaj, Alborz Province, Iran

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Abstract

Background: Child labor (CL) is the exploitation of children through any work or activity that interferes with their ability to attend school or is harmful to their mental, physical, social, or moral well-being. Unfortunately, child laborers are a shadow population for which specific information on the prevalence of intestinal parasites is not available; we aimed to estimate the prevalence of intestinal parasites among child laborers in Karaj-Alborz, Iran.

Methods: The present study was conducted with a cross-sectional design between 2020 and 2022 in Karaj-Alborz, Central Iran. Two hundred and three stool samples were collected from working children in Karaj and its suburbs. The samples were examined for the presence of intestinal parasites at Alborz University of Medical Sciences using parasitological techniques (e.g., t smear, Formalin-Ether concentration, modified trichrome staining, and Ziehl-Neelsen staining).

Results: The prevalence of intestinal parasites in CLs was estimated at 76% (156/203), of which 76.4% (155/156) were associated with protozoa and 1/203 (0.5%) with helminths. The highest prevalence was related to the protozoan *Blastocystis hominis* (89 cases (43.8%)), and among the pathogens, 11 cases (5.4%) of *Giardia duodenalis* were isolated.

Conclusion: The significant and alarming prevalence of intestinal parasites in CLs requires preventive, supportive, and therapeutic measures for this vulnerable population. Further attention should focus on the health status of child laborers in future studies.

Introduction

The child labor issue has long been a social challenge in human societies (1). More precisely, the term "child labor" is often defined as work that deprives children of their childhood, their potential, and their

dignity, and is harmful to their physical and mental development (2, 3). Child laborers often do not have access to adequate educational and health facilities, and some are deprived of these facilities altogether (4). Un-



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fortunately, the extent of child labor is still significant, with estimates that in some regions, such as sub-Saharan Africa, one in five children is involved, although precise statistics are not available and can vary from country to country (5, 6). In addition to emotional damage, the lack of access to safe drinking water and nutritious food sources has led to problems such as malnutrition, physical-mental retardation, so that they are prone to many infections (7). There are numerous unreported infections among child laborers because this segment of the population is not covered by comprehensive centers (8). Screening and reporting of infections among child laborers have been neglected to date. Types of child labor jobs reported are mostly related to the exploitation of children in agriculture/ animal husbandry in rural communities, retail and services, exploitation in industrial/ manufacturing jobs in urban communities, various types of manual labor are seen in exchange for money (9).

As mentioned earlier, unsafe drinking water and food are risk factors for infections, especially parasitic infections for these children (10, 11). So, it is natural that they are prone to intestinal parasitic infections (IPIs). Intestinal parasites, both protozoan and/or helminthic (such as soil-transmitted helminths), are prevalent worldwide (12). Giardiasis, amoebiasis, cryptosporidiosis, blastocystis infection, ascariasis, toxocariasis, etc. are parasitic infections that are transmitted to the host (in this case humans) through the oral route (12-14). It is clear that malnourished child laborers are more susceptible to various infections (15). In this regard, parasitic infections are more frequent or more severe in malnourished individuals than in healthy individuals (16). As well, opportunistic intestinal parasitic pathogens for example microsporidia spp, *Isospora belli*, *Cryptosporidium* spp., *Cyclospora* spp., and *Strongyloides* appeared to having an impaired immune system individual like CLs (17, 18). These infections can be life-threatening in

immunocompromised patients, malnourished ones, preschool and school age children (17, 19, 20).

Unfortunately, there are limited studies and data available on this population in Iran and/or the world including a study from Tehran and others from Peru and Ethiopia (21-23). However, comprehensive local data specific to child laborers in Karaj remain scarce. Given the high rate of child labor and the lack of data on parasitic infections in these children in Karaj metropolis, the present study aimed to present the status of child laborers' infection with digestive parasites and their nutritional status.

Materials and Methods

Ethical Approval

The ethical approval for this study was issued under the supervision of the Research Ethics Committee of Alborz University of Medical Sciences (NO: AB-ZUM.REC.1396.82), and all steps of the study were carried out under the administration of that committee. As an ethical consideration for the study, all children infected with gastrointestinal (parasitic) infections were referred to the health center to receive antiparasitic treatments.

The study area and Sampling

This cross-sectional study was performed among 2020-2022, in Karaj city as a capital of Alborz province. The metropolis of Karaj is one of the most populous provinces (Alborz) in Iran - with a population of nearly four million - and has a high ethnic diversity, including immigrant foreign nationals. Alborz Province is located in the north-central region of Iran (Fig. 1), adjacent to the Alborz Mountain Range, which is located at longitude and latitude in 35.855938, and 50.961750, respectively. The average annual rainfall in this region is estimated at 251 mm, and this metropolis has

a population of over 1,615,000 people with high ethnic diversity.

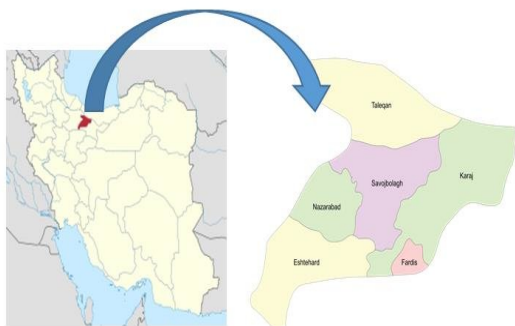


Fig. 1: The geographic location of Alborz Province, Iran

Initially, after identifying the working children under the protection of Kiana and Aq Tapeh support centers, informed consent to participate in the study and a questionnaire containing demographic characteristics of the children were obtained. Then, 203 stool samples were collected from all participants in labeled stool containers.

Some of the children studied had previous jobs that had recently been taken over by the two centers, however, many of them were still employed and it was found that the children were engaged in permanent or seasonal/part-time jobs, mainly peddling, construction workers, fruit picking, garbage collection, shoe shining or as assistants in other service jobs (mechanics, cleaning, etc.). These types of jobs were recorded through direct questioning in the questionnaire phase.

Laboratory investigation of fecal samples

All samples were transferred to the Parasitology Laboratory of the Faculty of Medicine, Alborz University of Medical Sciences (Alborz, Iran) as soon as possible. The samples were first examined for macroscopic features such as consistency, color, contamination, and etc. Specimens observe affirmative for intestinal parasites depend on their distinguishing features morphology. Fecal specimen of any participant was examined macroscopically (con-

sistency, color, etc.) and microscopically. In the first step, wet smears and Lugol's staining were performed to observe details. Then, Formalin-Ether concentration technique was used to isolate protozoan cysts and helminth eggs according to the Brummaier et al. protocol (24). As well, two permanent staining techniques modified Trichrome staining and modified Ziehl-Neelsen staining (ZNS) were employed; the first was for better visualization of both trophozoite and cysts forms of intestinal parasites and the second was for better identification/differentiation of protozoa such as *Cryptosporidium* spp., other Coccidia, and Microsporidia spp. Magnifications of 100x, 400x, and 1000x were used in microscopic examinations.

Statistical Analysis

All analyses were conducted in SPSS Statistics (V. 24) (IBM Corp., Armonk, NY, USA) as a statistical software by exploiting the Chi-square test; since a 95% confidence interval, a significance level of 0.5 was considered.

Results

According to the socio-demographic profile of all 203 participants, 67 (33%) of the CLs were male and 136 (67%) were female. In terms of nationality, 199 (98%) of the studied CLs were from Afghanistan, three (1.5%) of them were Uzbek, and one (0.5%) was Iranian. The age range of participants was 5 to 18 years, and they were classified into three categories (5-9, 10-14, and 15-18 years old) in the present study. Unsurprisingly, the level of education of the children did not correspond to their age and was generally estimated to be low, with 8 children (3.9%) not having any education, 157 children (77.3%) with primary/elementary education, and only 38 children (18.8%) with secondary/high school education. The highest frequency of contamination was associated with people who did not have permanent jobs, for example, seasonal jobs

(60.5%), casual construction workers (29.6%), and part time farm workers (9.9%) (Table 1).

Table 1: Demographic characteristics of child laborers participating in the study (n=203)

Characteristics	N (%)
Age group (yr)	
5-9	36 (17.7)
10-14	112 (55.2)
15-19	55 (27.1)
Gender	
Male	67 (33)
Female	136 (67)
Nationality	
Iranian	1 (0.5)
Uzbek	3 (1.5)
Afghan	199 (98)
Family number	
3-7	146 (71.9)
8-13	57 (28.1)
Occupational status	
Part time / (seasonal jobs)	120 (59.1)
Fruit picking	13 (6.4)
Construction workers	18 (8.9)
Other part time/seasonal jobs	89 (43.8)
Ancillary	59 (29.0)
Plantation workers	24 (11.9)
Educational status	
Primary/ elementary school	157 (77.3)
Secondary/high school	38 (18.8)
Uneducated	8 (3.9)

In macroscopic examination consistency of stool specimens included in formed 150 (73.9%), loose 12 (5.9%), soft 39 (19.2%), watery 2 (1%)

Prevalence of intestinal parasites in CLs using parasitology methods

Collected samples were investigated by the heretofore intimated methods for the intestinal parasites' detection. Our findings established the all-over dissemination and prevalence of intestinal parasites amidst CLs (Table 2) with 156 cases (76.9%) infected with intestinal parasites, of which 76.4% (155/203) were infected with protozoa and 0.5% (1/203) with

helminths. The highest prevalence of pathogenic protozoa was related to *G. duodenalis* with 11 cases (4.5%) and the helminths related to *H. nana* with 1 case (0.5%) (Table 2). A single case of *Acanthamoeba* isolated from a stool sample appears to be a contamination because *Acanthamoeba* is a free-living protozoan that mostly inhabits aquatic environments, and its isolation in feces is very rare.

Table 2: Prevalence and species of intestinal parasites in labor children, Karaj City (n= 203)

intestinal parasites	Species	N (positive) (%)
Protozoa		
	<i>Entamoeba histolytica/dispar</i>	8 (3.9)
	<i>Endolimax nana</i>	62 (30.5)
	<i>Entamoeba coli</i>	49 (24.1)
	<i>Blastocystis hominis</i>	89 (43.8)
	<i>Giardia duodenalis</i>	11 (5.4)
	<i>Iodamoeba buetschlii</i>	31 (15.3)
	<i>Retortamonas intestinalis</i>	4 (2)
	<i>Trichomonas hominis</i>	1 (0.5)
	<i>Dientamoeba fragilis</i>	1 (0.5)
	<i>Acanthamoeba</i>	1 (0.5)
	<i>Entamoeba hartmanni</i>	1 (0.5)
	<i>Enteromonas hominis</i>	1 (0.5)
	<i>Chilomastix mesnili</i>	4 (2)
Helminths		
	<i>Hymenolepis nana</i>	1 (0.5)

Demographic variables/risk factors and the prevalence of intestinal parasites association

The prevalence rate of intestinal parasites was assessed with age ($P=0.229$), the level of educational ($P=0.209$), and the employment

sector ($P=0.193$) variables being statistically insignificant. Interestingly, the prevalence rate was significantly assessed by the gender of the participants ($P=0.022$). The status of the variables is briefly presented in Table 3.

Table 3: Characteristics of Child labors variables and their statistical association with intestinal parasites

Risk factor	IPs N (%)	P value
Age (yr)		0.229
5-9	30 (19.2)	
10-14	85 (60.5)	
15-19	42 (26.9)	
Gender		0.022
Male	45 (28.8)	
Female	111 (71.1)	
Occupational status		0.193
Part time/ (seasonal jobs)	95 (60.5)	
Ancillary	17 (10.7)	
Plantation workers	16 (10.1)	
Educational status		0.209
Primary/ elementary school	122 (77.7)	
Secondary/high school	27 (17.2)	
Uneducated	8 (5.1)	

Discussion

Intestinal parasitic infections are a world-wide health concern with millions of cases reported annually (25). Incidence and mortality rates vary in different geographical areas depending on their climate, dietary habits, level of hygiene/education, and economy. As expected, the prevalence of IPs is higher in tropical and underdeveloped regions, where human populations lack uniform access to sanitary drinking water and adequate micronutrient nutrition. The coexistence of IP infections with poor nutritional status can complicate the host's condition. Studies have shown that poor nutritional status in terms of vitamins, proteins, and micronutrient intake can predispose a person to a variety of infections caused by infectious agents such as parasites. On the other hand, many intestinal parasites cause malnutrition problems for their hosts by disrupting absorption and feeding from the host (mostly hookworms) especially in child hosts. This malnutrition is often associated with developmental problems, mental and physical retardation, and other co-infections (16, 26).

According to the common child labor term, these children's work is unfortunately not voluntary, and they are under psychological, emotional, financial, and nutritional pressure (27). As a shadow population, child laborers lack access to health, education, safe food and water sources, and due to the nature of their outdoor jobs, they are exposed to a variety of IPs. Our results surprisingly indicated that the majority of participants were infected with IPs (156/203; 76.9%). As shown in a recent comprehensive study by Grima and Genet, the pooled prevalence in children under 5 years of age was 28.27%, and contaminated raw vegetables and fruits consumption was a significant risk factor associated with the prevalence of IPs in those children (28). The children studied in our study also lacked adequate access to vegetables and fruits.

Although limited, some studies have investigated IPs among working or street children. For instance, a study had reported prevalence in Tehran, Iran, while other studies in Lima (Peru) and Jimma (Ethiopia) have also explored this issue (22, 23). These were added to the introduction to highlight gaps in regional data.

In the present study, the rate of protozoal infections was incomparably higher, and of these, most cases were infected with organisms that are clinically insignificant and considered self-limiting in immunocompetent patients (29). However, it should be noted that CLs do not have ideal immunity levels due to nutritional conditions; therefore, these self-limiting organisms should not be neglected in this vulnerable population (30). *Blastocystis* species were among the most common intestinal opportunists with the highest prevalence, followed by *Endolimax nana* and *Entamoeba coli*; *Blastocystis* spp., although it does not cause serious problems in immunocompetent people can be dangerous in immunocompromised individuals (31, 32). Nevertheless, a pathogenic organism such as *G. duodenalis* was worryingly isolated and reported from the studied eleven cases, which had caused tangible clinical symptoms in CLs. As we know, child laborers do not have adequate food security in terms of nutritional status, and research has revealed the positive association between IPs and undernutrition (33). In addition to having a direct negative impact on physical and mental health, malnutrition causes an impairment in the host immune system and also makes a person vulnerable to parasitic infections (34, 35). In this regard, according to the demographic questionnaire data, unfortunately, all participants had poor nutritional status. The next major concern was the children's poor hygiene and awareness of personal hygiene. According to the demographic profile (Table 1), the majority of children came from large

families with poor economic status. Hence, the children were literally deprived of education, and it seemed that the conditions for defecation and hand washing were not at all adequate, and they did not have access to safe drinking water, which explain the high prevalence of IPs in CLs. Unfortunately, there are no comparable statistics on parasitic infections of CLs of any kind; therefore, parasitic infections of these children are examined with other children with different conditions. In this regard, intestinal parasites of children attending daycare centers were estimated at 14% according to the study of Abdi et al., which had a very low infection rate compared to CLs; in their study, *G. duodenalis* was similarly isolated and reported from 11.7% of the children studied (36).

In another study, Heidari and Rokni estimated IPs prevalence in daycare-attending children in the Damghan region and found that 68.1% of children were infected with at least one parasite, either pathogenic or non-pathogenic. In this study, the prevalence of *E. vermicularis* (33.8%) and *G. duodenalis* (26.2%) was significantly higher than in the present study, which could be due to the applied method to parasites isolation such as the scotch tapes/ Graham methods (37).

Ahmad-Rajbi et al. in a cross-sectional study evaluated the prevalence of IPs in Bam city daycares children by using three consecutive times sampling and formalin-ether/scotch tapes methods. Their results showed that 47% of the children were infected with at least one IP (38). Interestingly, a statistically significant relationship was observed between parents-related variables (education, occupation, etc.), the number of children in the family, and the IPs prevalence. Although the prevalence was higher in the 10-14 age group, it was not statistically significant, and other factors such as gender and covert variables such as health status and type and place of work may have an impact on the IPs prevalence.

Another similar study (21), showed a 44% (77/175) prevalence of parasites among work-

ing children in Tehran. The frequency of the protozoan *B. hominis* was the most common parasite (32.6%), followed by *G. duodenalis* (9.1%), and (8%) samples had *Entamoeba Coli*. Similar to our results, the prevalence rate of helminth parasites was lower, with the frequency of helminth infection being 3/175 (1.7%), including 2/175 (1.1%) *Hymenolepis nana* and 1/175 (0.57%) *Ascaris lumbricoides*. Given the relatively high prevalence of parasites in the children studied, health education seems necessary (21). The public health aspect of intestinal parasitic infections in vulnerable groups of children, especially in developing populations, should not be overlooked. In this regard, the prevalence of intestinal parasites in 258 working children in Lima, Peru, was estimated as 66.3%. Of these, *E. coli* and *G. duodenalis* were the most common (41.9% vs. 17.1%, respectively) (23).

According to a study in Ethiopia (Jimma town), 312 street children were studied, and the prevalence of IPI was 66.7%. Several variables were statistically significantly associated with the prevalence, including uncut fingernails, eating street food, swimming in unprotected water, not wearing shoes at the time of data collection, and lack of knowledge about the routes of transmission of IPIs (22).

Finally, IPs can cause chronic inflammation and initiate malignancy in the intestinal (colorectal) area, therefore, monitoring colorectal cancers using updated techniques in people with chronic parasitic infections can be beneficial in increasing the patient's lifespan (39).

Limitations and Future Directions

This study had several limitations. First, the diagnosis of protozoan infections relied solely on microscopic methods, and molecular techniques such as PCR were not used, which could improve the accuracy of species identification. Second, the sampling method was non-random and limited to two centers in Karaj, which may reduce the generalizability of the findings to all working children in Iran. Future studies should employ larger and more

diverse populations using advanced diagnostic tools and consider longitudinal designs to evaluate the long-term health impacts of intestinal parasitic infections among vulnerable child populations

Conclusion

Child labor as a social, economic and especially health problem should be given more attention. The prevalence of intestinal parasites in working children was assessed as high and most of their infections were acquired through the oral route and with poor nutritional status. The need for support in terms of hygiene improvement, ameliorate health facilities, routine organization checkup and cure arrangements, access to safe drinking water and food, education and health awareness for this vulnerable group is deeply felt. Support from NGOs and governments to reduce their health risks must continue until this problem is completely eradicated. It is recommended that future studies pay more attention to screening for infections in this vulnerable group.

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Conflict of Interests

The authors declare no conflict of interest.

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