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Prevalence of intestinal parasitic infection and its associated factors among children in Puducherry, South India: a community-based study

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Abstract There is paucity of studies at community level on prevalence of intestinal parasitic infection among under 18 years age group. This cross-sectional community-based research aimed to determine the prevalence of intestinal worm infections and its associated risk factors among 1 to 18 years age group in Puducherry, India. Sociodemographic, behavioral and other associated factors were collected using a structured questionnaire. One stool sample was collected from each participant and examined using direct (saline/iodine wet mount) and concentration (floatation/sedimentation) microscopic techniques**.** Log binomial regression analysis was used to find the factors independently associated with intestinal parasitic infection. Of 187 participants who provided the stool sample, 25 (13.4%) had at least one of the parasitic infections and among them 12 (6.4%) had Soil Transmitted Helminth infection (STH) and 13 (6.9%) had intestinal protozoan parasites. Parasitic infection is marginally higher among 1 to 7 years age group (14.4%) compared to 8 to 18 years age group (12.1%). After adjusting for confounding, urban residence (APR = 3.3, 95% CI 1.4–8.0) and open-air defecation (APR = 3.3, 95% CI 1.4–7.5) were significantly associated with intestinal parasitic infections. One out of eight children had any of the parasitic infection and nearly 50% of parasitic infections were caused by STH. Those children residing in urban areas and practice of open-air defecation had higher prevalence of parasitic infection.

Keywords Prevalence of intestinal parasitic infections · Soil transmitted helminths · Ascaris lumbricoides · South India

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Introduction

Intestinal parasitic infections are major public health problem especially in developing countries (Mehraj et al. 2008). Approximately two billion people worldwide are affected by this infection, of which developing countries are said to have the highest burden (Ramana 2012). Intestinal parasitic infections are widely distributed in tropical as well as subtropical regions (Kumar et al. 2014). The greatest number of cases occurs in sub-Saharan Africa, China, and East Asia. Some of the intestinal parasitic infections are Ascariasis, Hookworm infection, Amoebiasis and Trichuriasis (World Health organisation 1987). It is important to assess the problem of the intestinal parasitic infections at community level in these countries, so that appropriate interventional measures may be adopted.

Soil-transmitted helminthiasis (STH) is the most common intestinal parasitic infection. Its associated factors may differ across developing countries. The increase in intestinal parasitic infections in these countries are because of consumption of uncooked meat, contaminated food and water, poor sanitation practices such as open-air defecation, lack of hygiene like improper hand washing habits and walking barefoot on contaminated soil, lack of access to clean water and sanitation (Haque 2007; Ramana 2012). Various other socioeconomic factors like poverty, illiteracy and environmental factors like hot and humid tropical climate play an important role in increased incidence of these infections (Bethony et al. 2006). It affects the poorest and most deprived community worldwide and it poses a major global cause for morbidity (World Health Organisation 2020).

Although this infection is prevalent in various range of age groups, studies have shown that children are at higher risk of acquiring the infection. Chronic infection in these groups may cause anemia and undernutrition (Tyoalumun et al. 2016). In order to reduce the burden, WHO recommended mass deworming to control morbidity by reaching 75–100% of at risk population (Ministry of Health anf Family Welfare 2015). Mass deworming has reduced the burden of these infections to a certain level, but not 100%. Periodic community- based surveys are important to assess the intensity of infection and foster the preventive strategies. There is paucity of studies at community level among under 18 years age group. Hence, we aimed to determine the prevalence of intestinal parasitic infection and the factors associated with it among age groups of 1 to 18 years in Puducherry, India.

Methods

Ethics

The study protocol was reviewed by scientific advisory committee and approved by Institute Ethics Committee of a tertiary medical college hospital in Puducherry, India.

Setting and design

A community based cross sectional analytical study was conducted during July to December 2019 among 1 to 18 years age group residing in urban and rural field practice areas of a tertiary care hospital, Puducherry. These participants and their families availing medical care from the Urban and Rural Health Centers attached to medical institution situated in their locality for free of cost. Albendazole is the drug of choice for deworming in the current setting and it has been given twice yearly in these areas for all children, adolescents and reproductive age group women for free of cost.

Sample size estimation and sampling technique

This study targeted all children aged one to 18 years residing to any of the eight areas of villages or wards in rural and urban Puducherry, covered by medical institution. Rural Health Center located in Ramanathapuram village, Villianur Taluk of Puducherry. This centre covers four villages in rural community namely Ramanathapuram, Thondamanatham, Thutipet and Pilliyarkuppam. In urban area there is an Urban Health Centre located in Kuruchikuppam, Puducherry. This centre covers four areas in urban community namely Kuruchikuppam, vaithikuppam, vazhaikulam and chinnayapuram.

1. Inclusion criteria:
   One to 18 years children residing in urban and rural service area of medical institution.
2. Exclusion criteria:
   (a) Children belonging to migrant population.
   (b) Not a permanent resident of the area (Those who doesn't have any residential documents like Aadhar/ration/immunization card.)

Considering the prevalence of helminthic infection as 36% in school children (Ragunathan et al. 2010) and absolute precision of 6, alpha error of 5%, the calculated sample size was 246. Adding 10% of non-response rate, the final sample size was found to be 270 using OpenEpi software version 3.0. Proportionate and systematic sampling was done to select the households of the participants from each area. One child was selected from each household by simple random technique. If a selected childass not able to give the sample even after two visits after the first visit, then it was considered as non-response.

Sample collection methods

The participants were approached at their residence for data collection. After the written informed consent, information regarding sociodemographic and behavioral factors were collected using a structured questionnaire. A clean, labeled, wide mouthed screw capped plastic container was given to them for stool sample collection and were asked to provide one sample on the next morning (large teaspoon amount of solid stool-roughly of thumb size or 10 ml of liquid stool) in the container given to them. The collected stool samples were transported to the Parasitology laboratory on the same day and examined using direct (saline/iodine wet mount) and concentration (floatation/sedimentation) microscopic techniques. The slides were covered with coverslips and examined under low power (10×) and the doubtful structures were confirmed with 40× magnification (Garcia and Microbiology 2016).

Quality assurance

The researcher has been trained in microscopy for the identification of parasites by a trained person. All the positive samples were confirmed by the laboratory supervisor. To ensure the quality, 10% of negative slides were

Table 1 Socio-demographic and behavioral characteristics of participants living in field practice area of a tertiary care centre, Puducherry, South India in 2019(N = 187)

Characteristics	Frequency n (%)
Residence	
Rural	98 (52)
Urban	89 (48)
Gender	
Male	94 (50.3)
Female	93 (49.7)
Age category (Years)	
01–07	104 (56)
08–18	83 (44)
Education	
Preschool	55 (29.4)
Primary (1–5)	88 (47.0)
Middle (6–8)	25 (13.3)
Higher secondary (10–12)	19 (10.1)
Education status of father	
Upto middle school (0–8)	43 (22.9)
High and higher secondary (9–12)	91 (48.6)
Graduate	53 (28.5)
Education status of mother	
Upto middle school (0–8)	33 (17.6)
High and higher secondary (9–12)	106 (56.6)
Graduate	48 (25.6)
Type of house	
Pucca	134 (71.7)
Kutcha or mixed	53 (28.3)
Availability of toilet in house	
Absent	18 (9.6)
Present	169 (90.4)
Source of water supply	
Tap or well	141 (75.4)
Filter	46 (24.6)
Practice of open air defecation	
Yes	52 (27.8)
No	135 (72.1)
Walking bare foot	
Always/sometimes	134 (71.66)
Never	53 (28.34)
Washing hands after defecation	
Always	168 (89.8)
Sometimes/never	19 (10.1)
Caretakers hand washing habit before cooking food	
Always	175 (93.58)
Sometimes	12 (6.42)
Albendazole drug history (within last 6 months)	
Yes	140 (74.87)
No	47 (25.13)

also cross checked by the supervisor who has completed her masters in microbiology.

Statistical analysis

The data was entered in EpiData version 3.1 (EpiData Association, Odense, Denmark), it was exported to SPSS (Statistical package for social sciences) software version 17.0 for analysis. Categorical variables like residence, education, practice of open defecation, walking barefoot, handwashing and previous history of albendazole were summarized as percentages. Participants with intestinal parasitic infection was summarized as proportions with 95% Confidence Intervals (CI). Association between sociodemographic, behavioral factors and parasitic infection was analyzed using Chi square test. Log binomial regression analysis was used to find the factors independently associated with intestinal parasitic infection. Factors which has a p value of 0.2 or less were included in multivariable analysis and adjusted prevalence ratios (APR) with 95% CI was calculated. A p value of < 0.05 was considered as statistically significant.

Results

Among 264 children, 187 participants had provided stool samples with the response rate of 70.8%. Of the 187 participants, 94 (50.3%) were males and 104 (56%) were in the age group of 1–7 years. More than half of the participants 98 (52%) were belonged to rural residence. Almost three fourth, 134 (71.7%) of the participants resided in pucca houses and 18 (9.6%) did not have access to toilet in their house. Almost one fourth of the participants 52(27.8%) practiced open air defecation and 134 (71.6%) had the habit of walking with bare foot. Deworming was done in 140 (74.9%) participants within last six months (Table 1).

Out of 187 participants, 25 (13.4%, 95% CI 9.0–18.8) had at least one of the intestinal parasites and within which 12 (6.4%, 95% CI 3.5–10.6) had exclusively STH infection. *Ascaris lumbricoides* and *Taenia* species were the major organisms and others include *Trichuris trichiura*, *H. nana, Blastocystis, Trichostrongylus, Entamoeba histolytica, Sarcocystis, Pentatrichomonaswere* (Fig. 1).

Table 2 shows that prevalence of intestinal parasitic infection was 3.3 times higher in participants belonged to urban residence when compared to rural. Similarly, the prevalence was three times higher in participants had the habit of open defecation than their counterparts. These associations were statistically significant with a p value of less than 0.05. Participants who had not been dewormed had 1.6 times higher prevalence of infection when

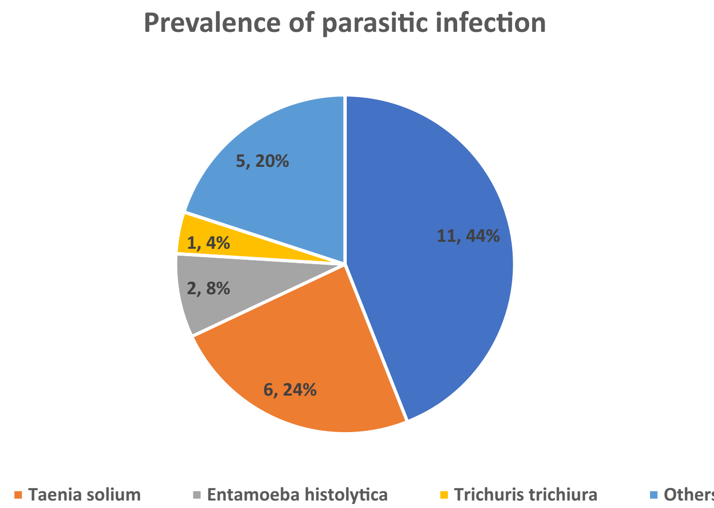

Fig. 1 Distribution of intestinal parasites among 1–18 years of children in Puducherry, South India 2019 (N = 25). *Others includes *H.nana, blastcystis, trichostrongylus, sarcocystis and penta trichomonas*

compared to participants who were dewormed which was not statistically significant.

Discussion

The current study from Puducherry, south India captured that the overall parasitic prevalence of 13.4% and it was higher in urban compared to rural settings and those who practice open air defecation. This study included wider age group of one to 18 years. This study evidenced that the prevalence of parasitic infection is marginally higher among 1 to 7 years age group (14.4%) compared to 8 to 18 years age group (12.1%).

Prevalence of intestinal parasitic infection in the current study was 13.4% and this was considerably less when compared to the study done in the same setting in the year 2016 (30.4%) (Langbang et al. 2019). But the above study also included adults and pregnant mothers. Recent Ethiopia study conducted among children in child centres found that 24.4% children were infected with at least a single species of intestinal parasite which is higher than this study (Abebaw et al. 2020). *Ascaris lumbricoides* was the most common parasite in this study (44%). This is similar to a study conducted in mountainous region of North India where the prevalence was found to be 46%. STH infection is considered to be the most common Intestinal parasitic worm infestation. Prevalence of STH infection in the current study was 6.4%. This is similar to a study done in Vellore and Thiruvanamalai regions of Tamil Nadu, south India among children of 6–14 years of age (Kattula et al. 2014). But an earlier study done in the Puducherry during the year 2006 among school children reported prevalence of about 35% (Ragunathan et al. 2010). The low level of prevalence in our study might be due to different age group and impact of the implementation of National Deworming program since 2015 February. Also, the recent push for sanitation and hygiene measures could have impacted the prevalence of parasitic infections (*Swachh Bharat Mission: Gramin, Ministry of Drinking Water and Sanitation* 2014).

Around one third (28%) of the participants had the habit of open-air defecation which is more compared to a study conducted in Kancheepuram district of Tamil Nadu in India which showed that only 19.2% of children had the habit of open air defecation (Gopalakrishnan et al. 2018). Nearly 90% of the households had toilet facility in our setting and still practicing open defecation. Since this has been reported as an important risk factor for the spread of infection, steps has to be undertaken by motivating the mothers to use the available toilet facility for their children thereby, we could cut down the chain of transmission and reinfection. Improvement in water, sanitation and hygiene measures and concurrent strengthening of deworming services in the study setting could have resulted in low prevalence in the target age group.

In the present study, the prevalence of Intestinal parasitic infection was 3.3 times higher in urban areas compared to rural. This finding is contrary to many other studies where rural was found to have more prevalence than urban (Parija et al. 2017; Tefera et al. 2017). In our study, two out of four urban areas belonged to urban slums. Crowding, walking barefoot, usage of common public toilet and improper sanitation would be probable reasons for such finding. Prevalence of the infection also was 3.3 times more in participants who practiced open air defecation. This is similar to a study conducted in Kancheepuram district where the people who practiced open air defecation had 2.5 times more prevalence of acquiring the infection (Gopalakrishnan et al. 2018).

Prevalence of Intestinal parasitic infection among children who did not consume albendazole was 1.2 times higher than children who had taken albendazole. These

Table 2 Log binomial regression analysis for finding the independent factors associated with intestinal parasitic infection among 1–18 years of age group in Puducherry, South India 2019 (n-187)

Characteristics	Total N	IPI present n (%)	Unadjusted PR (95% CI)	Adjusted PR (95% CI)	*P* value
Total	187	25 (13.4)			
Residence					
Rural	98	9 (9.2)	1	1	–
Urban	89	16 (18.0)	1.9 (0.9–4.2)	3.3 (1.4–8.0)	0.007*
Gender					
Male	94	12 (12.8)	1		
Female	93	13 (14.0)	1.1 (0.5–2.2)		
Age categories (Years)					
01–07	104	15 (14.4)	1.2 (0.6–2.5)	0.9 (0.4–1.9)	0.7
08–18	83	10 (12.1)	1	1	–
Education					
Play &Primary	143	21 (14.7)	1.6 (0.6–4.5)		
Above primary	44	4 (9.1)	1		
Type of house					
Pucca	134	19 (14.2)	1.3 (0.5–3.0)		
Kutcha / mixed	53	6 (11.3)	1		
Source of water supply					
Tap or well	141	17 (12.1)	1		
Filter	46	8 (17.4)	1.4 (0.7–3.1)		
Practice of open-air defecation					
Yes	52	11 (21.2)	2.0 (1.0–4.2)	3.3 (1.4–7.5)	–
No	135	14 (10.4)	1	1	0.005*
Washing hands after defecation					
Always	168	23 (13.7)	1.3 (0.3–5.1)		0.7
Sometimes/never	19	2 (10.5)			–
Caretakers hand washing habit before cooking food					
Always	175	24 (13.7)	1.6 (0.2–11.1)		
Sometimes	12	1 (8.3)	1		
Albendazole drug history					
Yes	140	18 (12.9)	1	1	–
No	47	7 (14.9)	1.2 (0.5–2.6)	1.6 (0.7–3.8)	0.3
Walking in barefoot					
Yes	134	16 (11.9)	1	1	0.7
No	53	9 (17.0)	1.4 (0.7–3.0)	1.1 (0.5–2.5)	
Child handwash after play					
Yes	119	21 (17.7)	3.0 (1.1–8.3)	2.1 (0.8–5.9)	0.1
No	68	4 (5.9)	1	1	

*Statistically significant *p* value

children would act as a carrier for parasitic infection and tend to spread the infection in the community. This finding was similar to a study conducted in South India where children consuming deworming tablets were found protective against acquiring STH infection.

Strength and limitations

After the implementation of National deworming program, there have been very limited studies done to gather data regarding the prevalence of this infection and most of the studies are conducted in facility-based setting and this community-based would give us an idea about the burden of parasitic infection in the community. All the collected samples were screened by single person and confirmed by experts were few of the strengths. Usage of only microscopic techniques with one stool sample was the limitation.

Conclusions

One out of eight screened children were positive for Intestinal parasitic infection and soil transmitted helminths contributed nearly half of the infection. Urban area and open-air defecation are the important predictors of infection. Long term control measures have to be implemented to reduce the prevalence of infection. Good sanitation, living conditions and proper treatment to be given to at risk populations to reduce the burden and transmission.

Author contribution SJ contributed in literature search, designing, data acquisition analysis and writing. GK contributed in study design, data analysis, interpretation and critically reviewed the manuscript. NR helped in designing and revised the manuscript. RU contributed in design, analysis and citically reviewing the manuscript. PK ad VM helped in data acquisition and revision of the manuscript.

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Declarations

Conflict of interest The authors did not have any conflict of interest with respect to research conduct, authorship or publication of this work.

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