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Original Research Article

Assessing the burden of intestinal parasitic infestations among children in rural areas of Tamil Nadu, India: implications for public health policy

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ABSTRACT

Background: This study was conducted to estimate the prevalence of intestinal parasitic infestation among children in selected rural area Kunnathur, Arani Taluk, Thiruvannalmalai, Tamil Nadu, India and the implications for public health policy.
Methods: The present cross-sectional study was carried out to determine the prevalence of intestinal parasitic infestation among children. A total of 60 stool samples were collected and examined for parasitic infections through visual and microscopic observation. Samples were screened using saline and iodine wet mounts, a saturated saline concentration technique and light microscopy was used to analysis the data.
Results: Out of 60 stool sample (female 30), (male 30) a total of 46 (76.7%) positive for parasite infections. The gender-wise prevalence among the children showed that, 21 boys (70%) and 25 girls (83.4%) were recorded positive with minimum one parasitic infestation. The positive cases of individual parasites were *Ascaris lumbricoides, Giardia lamblia, Ancylostoma duodenale, Entamoeba histolytica* and *Entamoeba vermicularis* and mixed infections were also detected in the present investigation. The distribution of parasites was maximum among 7-9 years age group with 77.8%, followed by 4-6 years age group with 73.4% was found in this study. While males were mostly infected with *A. lumbricoids*, females were mostly infected with *Ancylostoma duodenale*.
Conclusions: The result of the present study revealed importance of creating awareness among rural areas about children's personal hygiene, environmental hygiene particularly in communities with poor water, sanitation, eating contaminated food, open defecation, walking with barefoot, effectiveness of deworming treatment intervals from 6 to 4 months in order to reduce the risk of parasitic infection.

Keywords: Children, Infection, Infestation, Parasite, Prevalence, Rural areas, Tamil Nadu

INTRODUCTION

Human beings are infected by three types of intestinal parasites, namely tape worm, round worm (or nematodes) and protozoa which live in the small and large intestines of humans. Few of these parasites within the intestines and others remains outside or invade into other organs. Some are small they can be seen only with the help of microscope, while some grow many feet long. Tape worm and round worm develop in the human body and lay their eggs, the egg then comes out of the body through feces contamination. Intestinal parasites exist throughout the world, according to World Health Organization (WHO) 3.5 billion people worldwide are infected with some type of intestinal parasites and as a result of this about 450 million of them suffer among this children are mostly infected with their parasites.[1,2] WHO report has documented a high mortality from amoebic dysentery among worldwide.[3] Younger children are imposed to heavy infection to intestinal parasites because of their

frequent habit of playing with faecal contaminated soil, encourages the transmission of the parasitic diseases.[4,5] Human intestinal parasites populate the gastro-intestinal tracts of humans. It has become a major health problem in many developing countries. The distribution and occurrence of the intestinal parasitic species mainly depend on social, geographical, economical and migrates, poverty, low literacy rate parasitic infection are the most important and common health problem. Intestinal parasitic worm infestation is one of the major childhood health problems in developing countries.[6,7]

Pets and other animals can be potential source of parasites that can affect children. Toxoplasmosis is spread by ingesting soil or litter-box contents with infectious cat faeces. Children can also be born with this infection if their mother was infected during pregnancy. In different region of Madagascar, a number of research studies have been conducted on the prevalence of intestinal parasitic infestations (IPI) among children using microscopy-based techniques for the identification of IPI. Across-sectional study done in remote villages within the Ifanadiana district of Madagascar in 2016 revealed an overall IPIs prevalence of 92.5% for intestinal parasites.[8,9] The first steps to control and prevent intestinal parasitic infections comprise conducting epidemiological studies, identifying pathogenic agents, and determining the number of affected people in different populations, especially school-aged children who are most vulnerable to infection yet also vital to the future of their country. These findings can be used to determine the appropriate health measures and plans needed to treat patients and prevent further contamination among children.[10,11] High prevalence is attributed to poor sanitation, poverty and lack of health education.[12-15]

The parasites are associated with diverse clinical manifestation such as malnutrition, iron deficiency anaemia, mal absorption syndrome, intestinal obstruction, mental and physical growth retardation, there parasites may infect people of all ages but children are often infected.[16] Lack of hygienic practices like open field defecation faecal contamination of water and improper hand washing aggregate infestation, children's remain outdoors playing in the soil are the major causes of parasitic infections.[17-19] Epidemiological surveys on the intestinal parasitic infections among school children are important in the developing countries since they reflect the sanitary condition of schools and generate data that are essentials to formulate strategies for the control of intestinal parasites infestations among school children.[20] Soil transmitted helminths (STH) then suck as *Ascaris lumbricoides* (round worm), *Trichuris trichiura* (whip worm) and *Ancylostoma spp.* (hook worm) *Arer nematodes* that infect more than a billion people worldwide, with low- income countries accounting for over 80% of the diseases burden, long them effects associated with the condition include diminished physical fitness growth retardation etc.[21-23]

Intestinal parasites show an adverse effect on growth of children and influence upon their nutritional status and morbidity.[24] About 39 million disabilities- adjusted life years (daily) are attributed to intestinal parasitic infections and these infections thus represents a significant socio-economic burden. In India, institution such as schools, day care, hospitals and health care clinics, yet are not in ideal position to fully detect the specific condition that promote the prevalence and spread of parasitic diseases with in urban or rural population, there are determined by particular geographical and ecologic factors and also by the contribution from the effects of population explosions.[25] Intestinal worm infestation is gender independent difference in prevalence among boys and girls may be related to personal hygienic.[26] Insufficient waste disposal, poor drainage system occupation like farming trading, water sources like stream bore well ponds etc., may also influence the parasitic infestation.[27-29] High prevalence of parasitic infections among pre-school children in due to incomplete coverage of the de-worming programme especially in areas remote from health care centres. The programme must be strengthened and tightly controlled in areas of difficult across.[30-33]

METHODS

Data collection

The present cross-sectional research study was conducted in the period of November-2021 to April-2022 among the children under age group of 1-9 in the area of selected rural area Kunnathur village, Arni Taluk, Thiruvannamali district of Tamil Nadu, India. The parents were informed and they were asked to provide fresh stool sample of the study child, prior to the study only children, whose parents were voluntary for their participation, were involved in the study as the study population were mainly illiterate oral consenting of the parents or guardians of the children, children found positive for intestinal parasites were treated with appropriate drugs by physician.

Children/parents were given a brief description about the importance of examination of stool and the impact of intestinal parasites upon health. The plastic container were labelled with children name and roll number, date and time of collection were distributed to the parents, during the distribution of containers, questionnaires accompanying the queries about name, age, address, sex, family size, clinical history, symptoms any and use of any drugs/medicines, hygienic practice, usage of drinking water, type food intake were filled by interviewing them with the help of caretaker, teachers and parents.

Sample collection

Inclusion criteria of sample collection consisted of children aged between 1-9 years living in selected rural area of Tamil Nadu, stool sample were collected from the children after procuring informed and written permission

from the school and parental authorities. Other data (data regarding what food was consumed by the children, whether vegetarian or non-vegetarian; type of accommodation, during quality of water (tap/can water etc.,) was acquired by verbal interview with their parents. The criteria for exclusion had been children who were unable to provide samples because of lack of cooperation and being absent were excluded as stool examination is essential for a proper diagnosis and participants with incomplete questionnaire responses, mistakenly labelled or missing samples were removed in order to maintain data quality and accuracy. The parents were also notified, in writing, of whether their child tested positive or negative for ova or cysts of specific parasite species. Individual testing positive for presence of intestinal pathogenic parasites were offered treatment, which included appropriate anti parasitic drugs

Children's demographic data was collected, de-identified and stored in a coded manner to ensure confidentiality. Stool samples were collected in standard, sterile fecal collection vessels. Children and parents were advised to pass stool in a sterile paper to avoid contamination and collect it in the container with the spatula both provided to them. Single specimen was collected from individual they advised not to contaminate the stool with water and urine and the sample collected was immediately brought to the laboratory with iodine solution. Microscopic and macroscopic examination was done in the laboratory.

Macroscopic examination

Direct macroscopic examination of feces was performed to detect the stool consistency (i.e. formed, soft, loose or watery) presence of blood and mucus (any other abnormalities were observed) adult worm segments of tapeworm, larvae, was recorded and also additional diagnostic indicators like stool colour and odour were examined to identify any specific infestation.

Microscopic examination

As soon as the specimen was collected direct microscopic method was used to detect the presence of ova, larvae, trophozoite and cyst parasites. 1gram of sample feces and 4ml of 10% formaldehyde- saline was mixed well for 30 seconds and sieved, the sieved suspension was collected in a centrifuge tube. About 4 ml of ethyl acetate was added and mixed well and then this was centrifuged at 3000 rpm for 1 minute and the sediment was used for observing the intestinal parasites and slide preparation.

Statistical analysis

The simple statistical method was used to analysis the data. Further analysis had been carried out by employing the Chi-square (χ^2) test to establish if there is any statistically significant variance between the occurrence of parasites found within the gender and age group of the children.

RESULTS

Out of 60 stool sample examined among children of selected rural area Kunnathur village, Arni Taluk, Thiruvannamali district Tamil Nadu, India. A total of 46 (76.7%) were recorded positive with at least one parasitic infestation (Table 1, Figure 1). Fecal samples from 60 children (female 30), (male 30) were screened using saline and iodine wet mounts, a saturated saline concentration technique and light microscopy. As the lifestyle and habits of the students varied with age, they were segregated into age groups children below the age of 5 years had their health and hygiene needs met by either parents or guardians, whereas the older age groups were self-caring. Our data revealed a positive overall presence of parasites in children of 76.7%. The gender-wise prevalence among the children showed that, 21 boy (70%) and 25 girls (83.4%) children tested positive for at least one parasitic infestation (Table 2).

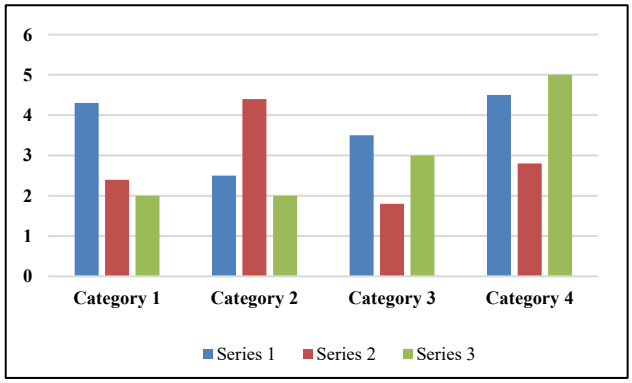

Figure 1: Prevalence of intestinal worm infestation among children by sex in the study area.

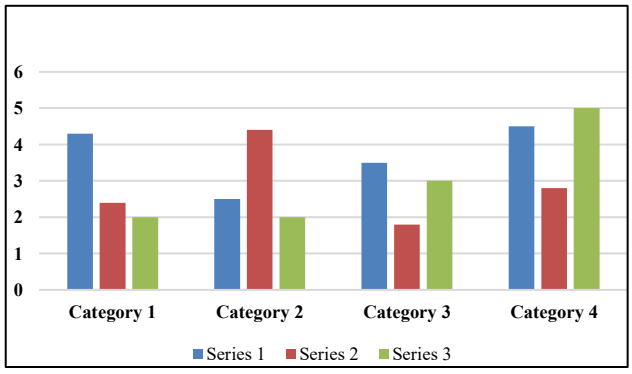

Figure 2: Prevalence of intestinal worm infestation among different age grouped children

Table 1: Prevalence of intestinal worm infestation among children by sex in the study area.

Gender	Positive	Normal	Total
Boys	21	9	30
Girls	25	5	30
Total	46	14	60

*Chi square test was significant.

Table 2: Prevalence of intestinal worm infestation among children by sex in the study area.

Gender	Total	Positive (N)	Positive %
Boys	30	21	70
Girls	30	25	83.4
Total	60	46	76.7

*Chi square test was significant.

Table 3: Prevalence of intestinal worm infestation among different age grouped children.

Age group (years)	Total	Positive (N)	Positive %
1-3	12	10	83.3
4-6	30	22	73.4
7-9	18	14	77.8
Total	60	46	76.7

The result of the study confirmed the fact that intestinal parasites are still prevalent among children of the study area. The number of children with the sample analyzed indicates high incidence and prevalence of intestinal parasitic infection. The occurrence of intestinal parasites was still ranked high among the major health problem affecting children from rural communities due to their low economic status and social isolation. The positive cases of individual parasites were *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Entamoeba histolytica* was most prevalent intestinal parasite of the study this could be explained by the reason that most of children examined lack of good health education with poor family back ground.

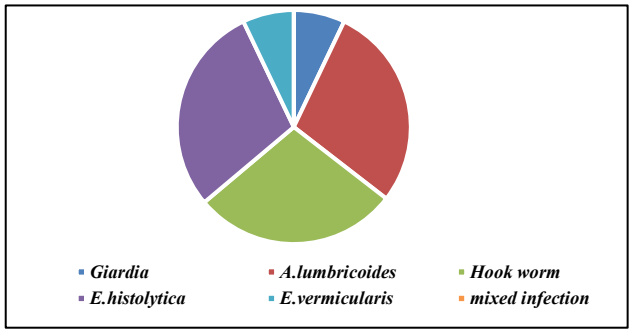

Figure 3: Intestinal parasite that were identified in children.

The distribution of parasites was heavier among the 7-9 (77.8%) age group than the other age group of the study. Of the total 60 sample 46 sample were found to be infected with intestinal parasites the higher number of parasitic infections were seen in girls 25 (83.4%) than the boys 21 (70%) (Figure 3 and Table 4). Of total 46 positive cases the highest number of parasitic infections was seen between 7-9 years, age group 77.8% followed by 4-6 years age group with 73.4% was found in the study (Table 3). A total of 46 parasites were identified and few were unidentified, of 46 positives. The microscopic view of intestinal parasites identified among children of this study is shown in Figures 4 and 5.

Table 4: Intestinal parasites that were identified in children.

Age group	Number of intestinal parasites (%)					
	***Giardia* (%)**	***A. lumbricoides* (%)**	***A. duodenale* (%)**	***E. histolytica* (%)**	***E. vermicularis* (%)**	**Mixed infection (%)**
1-3 years	33.4	16.7	25	25	0	0
4-6 years	66.7	50	41	50	66.7	66.7
7-9 years	33.4	33.4	33.4	25	33.4	33.4
Total	133.5	100.1	99.4	100	100.1	100.1

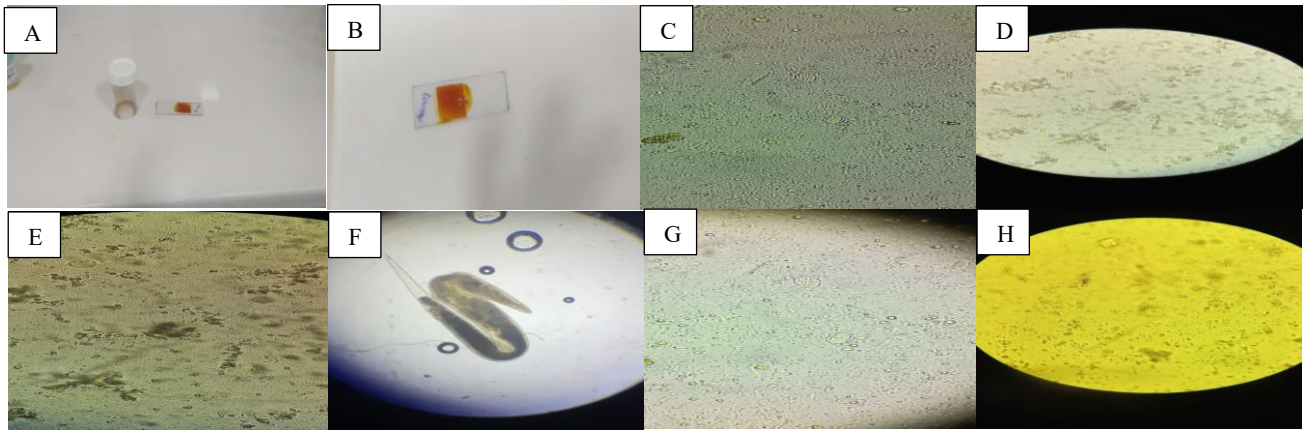

Figure 4: Stool sample and intestinal parasites identified in children (microscopic view): C) *Giardia lamblia*; D) *E. histolytica;* E) *A. duodenale;* F) *A. lumbricoide;* G) *E. vermicularis;* H) Mixed infections.

DISCUSSION

The prevalence of intestinal parasites in the present study revealed the percentage prevalence of G. *lamblia* and E.*histolityca, A. lumbricoides* observed. In contrast, our finding suggests that the occurrences of helminthic infestations in school children in rural India were significantly less than those in urban areas. Further investigation into diet, lifestyle and geographic location will enhance our understanding of infection type, and prevalence and assist in future morbidity rates worldwide. Male children were infected than the females by the intestinal parasites.[19] The highest prevalence of parasitic infection associates by no latrine availability, no fingernail hygiene, open defecation, no formal mental education, rural residence, no habit of wearing shoes, no regular hand washing.[11,12,15] Several possible determinants associated with IPIs were investigated and a significant association was found between IPIs and children aged between 4 and 5 and low educational level of mothers (primary and secondary respectively).[8] Recent reports have indicated a higher level of protozoan infection in comparison with infection with helminths in different populations. In a study of primary school child in Semnan province, neither hookworm, whipworm, taenia, strongyloid nor ascaris were found in the faecal samples.[10]

The result of this study revealed that personal hygiene such has clean hands and sandals wearing play important role in transmission of parasitic intestinal infestation infections among the PSAC. This is similar to the finding of other studies. Age is an important factor for internal parasitic infection and pre-school and school going children have been imported to be at high risk.[34] The prevalence reported in the study is partly due to fact that the sub-urban communities that account for high poverty rate, poor socioeconomic development that facilitate the transmission of helminth parasite.[5,35] Availability of water bodies near to house and contact with water bodies were having significant association with the prevalence of IPIs.[35] In poor rural communities, there is high tendency for children to walk barefoot and to interact with contaminated soil, water and objects, thus increasingly exposing them to different forms of infections including parasitic intestinal infection. There is need to increase people's awareness on the importance of proper personal and environmental hygiene particularly in communities with poor water quality, lack of sanitation and hygiene. Clinical manifestations were reported in 19.4% (193/996) of examined children. Majority of signs were nonspecific abdominal discomfort. Signs such as nausea, vomiting, diarrhoea, loss of appetite and weight loss.[33]

This study also affirms the eating unwashed fruits and uncooked vegetables were positively associated parasitic intestinal infestation infection, which is similar to what was reported in other studies. This could imply lack of knowledge about transmission and prevention of parasitic intestinal infestation. This finding would reflect that those communities who experience unclean environments due to pen defecation are more likely to transmit parasites through soil, water, fomites, food or other means.[11] In this study, open defecation, unsanitary disposal of faeces of young children and inadequate knowledge about transmission and prevention of parasitic intestinal infestation were factors associated with parasitic intestinal infestation infections among PSAC. Prevalence of intestinal parasites was found slightly higher among boys but the difference was not statistically significant, similar findings have been reported by various studies conducted in Nepal.[36,37] The occurrence of parasitic infections at high rates is indicators faecal population of soil &domestic water supply around homes due to poor sanitation and improper sewage disposal in those areas.[17,38] Regarding the behavioural and environmental factors, there were highly significant differences between infected and non-infected children regarding those factors with a considerable proportion of children having an unsanitary environment, little fingers hygiene, poor hand washing practice and risky health behaviour.[28,29,39,40]

This may contribute to forgetting deworming program schedule unless they are regularly reminded using information, education and communication (IEC) materials. Diarrhea disease is one of the greatest causes of childhood mortality and is responsible for over 2.2 million deaths of children under the age of five years in developing countries. The recently initiated national school-based deworming programme might have on impact on the STH infection rate among preschool children in the long run.[7] High prevalence if IPIs among children indicates little personal hygiene and poor environmental sanitation. Much more needed for the application of proper prevention and control strategy[13]. The research also reported that most of the primary pupils, irrespective of their gender due normally defecate in the nearby bush surrounding the school premises which might result in the development of helminth eggs being washed into the school compound by the rainfall and runoff water. Most of the children with parasitic infection has a history of contact with water bodies and it was strongly associated with the infection.[32] This finding could further be explained by the fact that most of the children go to the school barefooted which might altogether facilitate high prevalence of hookworm infections. These measures may help to prevent or reduce the prevalence and the risk of IPIs in the study region.

While assessing the findings, this is necessary to keep attention to the limitations of this study regarding the prevalence of parasite infection among children in Tamil Nadu. To begin with it is difficult to differentiate among failure of treatment along with infection reactivation because this study did not evaluate parasitic drug resistance through genetic testing or laboratory techniques. In addition, this study contains self-reported data about personal hygienic habits may be influenced by

social attraction and remembrance. Although education for parents was implemented as an alternative measure of awareness, this could not accurately reflect real knowledge, mindsets and actions towards the prevention of parasitic infections. Furthermore, a thorough examination of infrastructure quality, patterns of consumption and microbial water contamination was not carried out, therefore restricted the evaluation of sanitary conditions and water infrastructure. In addition, due to the cross-sectional approach used in this research, climate effects such as variations in the seasons in rainfall and temperature were not accurately documented. In the end this study limits the capacity to determine casual relationship between known risk variables and the prevalence of infection with parasites.

CONCLUSION

The prevalence of soil transmitted helminths infection among children in rural area of Kunnathur, Arni, Thiruvannamali district, Tamil Nadu, India. Hookworm, infection intensity, was the highest followed by *A. lumbricoides* and the mean egg intensity was higher among older children than younger ones. Not washing hands with soap after defecation, eating vegetables and fruits without proper cooking and or washing them, improper disposal of faeces of young children and irregular deworming of preschool-age PSAC are some of the factors associated with STH infection. Deworming programs should focus on reaching communities in lowland areas, in addition to exploring the feasibility and cost effectiveness of shortening deworming treatment intervals from 6-monthly to 4-monthly, in order to reduce the risk of STH infections among PSAC. While males were more infected with *A. lumbricoides*, females were found to be more infected with hookworm in this study. In conclusion, one of the greatest challenges for healthcare professionals is the prevention and treatment of protozoal and helminthic parasitic infections. From our study we conclude that the prevalence of different pathogenic species of amoeba such as *Entamoeba histolytica* (4.2 versus 0%), and *G. lamblia* (17.9 versus 14%), (p value was equal to 1) were significantly higher among rural children compared children from urban areas. Our study, although a small one, in the field of surveillance of parasitic infestations, whether it be rural or urban, may assist others in the prevention and control of intestinal parasitic disease in children worldwide.

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