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Research Article

Effect of Multiple Rounds of Mass Drug Administration under Lymphatic Filariasis Elimination Program on Prevalence of Soil-Transmitted Helminthiasis in One of the Co-endemic Districts of India

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Abstract

Both soil-transmitted helminthiasis and lymphatic filariasis are co-endemic in some districts of India. The study was aimed at comparing the prevalence of soil-transmitted helminthiasis (STH) infection before and after mass drug administration (MDA) given for lymphatic filariasis at Alappuzha.

We examined stool samples of 219 children aged between 9 and 10 years from nine schools at Alappuzha, Kerala, in June 2015. The current STH situation was compared with that in the year 1999 (before the institution of MDA) in the same age group in the same district. WHO-recommended Kato-Katz technique was used for STH prevalence estimation. Information regarding socio-demographic variables, sanitation, personal hygiene practices was also recorded. Chi-square test was used to study association of risk factors with STH infection.

A total of 79 (36.07%) children were found to be positive for STH infection. Out of all samples positive for ***Ascaris lumbricoides***, 4 (5%) were found co-infected with ***Trichuris trichiura*** and none with hookworm. Factors like absence of household latrine, lack of hand washing before meals and practice of consuming unwashed fruits were found to be significantly associated with occurrence of STH infection.

Over the years, consecutive rounds of MDA for LF have led to a decline in intestinal worm burden but with little effect on the overall prevalence of STH. Thus, STH control activities working synergistically with the Filarial Elimination Strategy can yield better results in the co-endemic areas with optimum resource utilization.

Keywords: Soil-transmitted helminthiasis, Prevalence, ***Ascaris lumbricoides***, Hookworm, ***Trichuris trichiura***, Mass drug administration

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Introduction

Soil-transmitted helminths (STH) are among the most prevalent intestinal parasites worldwide. Approximately 4.5 billion individuals are at a risk and more than 1.5 billion people or 24% of the world's population, are infected with STH infections worldwide.[1,2] The global diseases burden caused by common STHs is estimated to be about 39 million DALY.[3]

STH is a widely prevalent problem especially in developing world[1] with countries like India accounting for about 27% of the world's STH burden and having over 241 million children in need of deworming.[3,4] ***Ascaris lumbricoides*** (roundworm, AL), Hookworm(HW), ***Trichuris trichiura*** (whipworm, TT) infections are common in India with variation in their individual prevalence rates.

Jain et al. conducted a systematic review of the studies which found out the prevalence of STH infection in different age-groups in India between 2008 to 2015.[5] This study revealed ranges of overall prevalence of STH, AL, HW and TT were 7.56 to 78.27%, 0.4 to 71.87%, 0.14 to 42% and 0.3 to 29.57%, respectively. 16.7% studies targeted only children (age-group 0–12 years; STH prevalence range was 27.58% to 34.56%), 50% studies targeted both children and adolescents (age-groups 0–12 years and >12–17 years; STH prevalence range was 7.56% to 78.27%) and 33.3% studies targeted all the three categories, viz., children, adolescents and adults (age-groups 0–12 years, >12–17 years and >17 years; STH prevalence range was 31.2% to 75.78%). Lwanga and Lemesaw have suggested STH prevalence among school children age-group 9–10 years for planning and monitoring STH control activities in the community.[6] The STH prevalence was estimated in the above mentioned age group at Alappuzha.

Under the Elimination of Lymphatic Filariasis (ELF) Strategy, annual MDA is carried out with a single dose of anti-filarial drug DEC (diethyl carbamazine) along with tablet Albendazole since 2005.[7] Albendazole is also the WHO-recommended anthelminthic drug to be given for preventive chemotherapy in the community.[1] The strategy under ELF is to carry out annual MDA in the entire population of filarial-endemic areas (excluding children below two years, pregnant women and seriously ill persons) for at least 5 years to interrupt transmission of the disease.[7]

In a review, Hall et al. had concluded that if the population of worms in a community of hosts is perturbed by giving mass treatment with an anthelminthic, reinfection can occur immediately and the number of worms will rebound to a similar number as before, a state called equilibrium within a few months after treatment and reach pre-treatment level in as early as 5–6 months. The worm burden takes considerably longer to reach the pre-existing load. This implies that the prevalence may show only a small difference between rounds of treatment, but the mean worm burden may be on a constant decline.[8]

There are a limited number of studies from India estimating the burden of STH infections and assessing the risk factors associated with problem. Also, there is scarce amount of scientific data on assessment of the effect of consecutive annual MDA rounds under LF program on the prevalence and intensity of STH.

In other countries, MDA for control of one disease has yielded collateral benefits to other diseases also. For example, MDA for controlling trachoma infection had synergistically controlled yaws infection in Solomon Islands. In view of the above, the present study was planned in Alappuzha, an area endemic for filariasis where MDA activity has been carried out for five consecutive years (last round before study was conducted in April 2013). The present study was aimed at assessing the prevalence and intensity of STH infection and its association with risk factors at Alappuzha over the period when MDA was carried out. Also, an attempt was made to compare STH prevalence and intensity between 1999 (before the commencement of MDA activity)[4] and 2015 (after five rounds of MDA).

Materials and Methods

Study area

Alappuzha, is localized in coastal region of the Western Ghats (location co-ordinates: 9.54°N 76.40°E). Owing to its proximity to the sea, the climate of Alappuzha is humid and hot during the summer, although it remains fairly cool and pleasant during the months of October and November.

Study population

WHO has recommended a sample size of 200–250 individuals for each ecologically homogeneous area in order to evaluate the prevalence and intensity of STH infection.[5,8] Based on WHO recommendations, the current survey was conducted among 219 school children of age-group 9–10 years, studying in fourth and fifth standard from nine selected government schools located in Alappuzha area. The schools were randomly selected out of the total enlisted schools in the study area. Out of the nine randomly selected schools, two were exclusively girls schools, one was exclusively boys school and six were co-ed schools.

Study design and setting

The study was carried out during June, 2015. Necessary permissions were obtained from state/district education departments, heads of schools and parents. All stakeholders including headmasters/principals of schools, teachers and school children were briefed regarding the purpose of the

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study. Basic Information regarding causes, consequences and control of STH infections and importance of maintaining proper sanitation and personal hygiene were provided to children.

Height and weight of each participant was recorded. Information regarding socio-demographic status, personal hygiene, history of passage of worms, use of household latrines, practice of hand washing before meals and after defecation and source of water supply were collected with the help of a pretested questionnaire. Participants were also examined for presence of unclean nails and pallor. All participants were given a stool collection vial and were demonstrated the method of stool sample collection and transportation. They were instructed to bring the fresh morning stool sample on the next day for examination. The vials were collected from students in each school next day and transported to the laboratory at NCDC, Cherthala, Kerala, on the same day for further processing and examination for the presence of helminthic eggs.

Parasitological examination

The stool samples were examined using the WHO-supplied Kato-Katz technique. Kits used in this technique had a template that delivered 41.7 mg of stool sample on to the slide. In laboratory, fecal samples were examined for the eggs of ***Ascaris lumbricoides*** (roundworm, AL), hookworms (HW) and ***Trichuris trichiura*** (whipworm, TT). The number of eggs per slide (EPS) thus obtained after microscopic examination of each slide were multiplied by a common factor of 24 to obtain eggs per gram (EPG) of stool.[9]

Categorization of intensity of infection

As per WHO recommendations, calculated eggs per gram of stool have been utilized for the categorization of intensity of STH infection into three categories, viz., mild, moderate and heavy. For AL infection, EPG counts of ranges 1–4999, 5000–49,999 and ≥50,000 represent mild, moderate and heavy infections respectively. For HW infection, EPG counts of ranges 1–1999, 2000–3999 and ≥4000 represents mild, moderate and heavy infections respectively. For TT infection, EPG counts of ranges 1–999, 1000–9999 and ≥10000 represent mild, moderate and heavy infections respectively.

Quality control

In order to ensure the consistency and accuracy of microscopic readings, quality control measures were instituted. All microscopists were trained about Kato-Katz technique and morphological differentiation of stained helminthic eggs. All STH-positive slides and 10% of STH-negative slides were re-examined by another expert independently.

Statistical examination

Data were entered and analyzed using Microsoft Excel and Epi-Info statistical software (Version 3.5.1). Chi-square test was used to study the association of various risk factors with the prevalence of STH infection. P value of <0.05 was considered statistically significant.

Results

Out of the total 219 stool samples examined in nine schools, 79 samples (36%) were found to be positive for any helminthic egg. AL was found in all positive samples, TT was found in only 4 (5%) samples whereas hookworm was not reported in any of the tested samples. Majority 75 (95%) of STH-infected children were only infected with AL (monoparasitism) whereas only 4 (5%) children were having two (AL+TT) types of helminthic infection (polyparasitism).

Table 1.Comparison of Prevalence of STH Infection before and after MDA in Alappuzha, Kerala

Study	Prevalence of STH (n)	Prevalence of AL (n, %)	Prevalence of TT (n, %)	Prevalence of HW (n, %)
Bora et al. (1999)	31.6% (389)	15.17% (59)	21.59% (84)	3.86% (15)
Present study (2015)	36.07% (219)	36.07% (79)	1.83 % (4)	0 % (0)

*n=no.ofsamplesexamined, STH=Soil-transmittedhelminthiasis, AL=*Ascaris lumbricoides*, HW=Hookworms, TT=*Trichuris trichiura*.

On the basis of EPG, ***Ascaris lumbricoides*** infection in the current survey was of moderate intensity (EPG count=9708) whereas the infection with ***Trichuris trichiura*** was of mild intensity (EPG count=312) (Table 2).

Table 2.Comparison of Intensity of STH Infection before and after MDA in Allepey, Kerala

Study	Overall STH infection		AL infection		TT infection		HW infection	
	Cumulative EPG	Mean EPG	Cumulative EPG	Mean EPG	Cumulative EPG	Mean EPG	Cumulative EPG	Mean EPG
Bora et al. (1999)	122664	997.3	98568	1670.6	21360	254.3	2736	182.4
Present study (2015)	10020	126.8	9708	122.9	312	78	0	0

STH=Soil-transmitted helminthiasis, AL=*Ascaris lumbricoides*, HW=Hookworms, TT=*Trichuris trichiura*, EPG=Eggs per gram of stool

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About three-fourths of the participants were females. Majority of participants were having tap water as main source of drinking water at their homes (n=126, 57.53%). Almost all participants had latrines at their home. Majority (89.95%) of students said that they practiced hand washing after defecation. However, about half of the students were not using footwear consistently and did not wash hands before meal. Also, about half of the participants ate soil/ play with soil and eat food fallen on ground (Table 3).

Table 3.Risk Factors Associated with STH Infection among School Children

S.No.	Risk Factor/Demography	Infected (n) (%)	Non-infected(n) (%)	Total	χ2	P value
Gender						
1	Male	20 (34.48)	38 (65.52)	58	0.08	.0.77
	Female	59 (36.64)	102 (63.36)	161		
Age-Group						
2	≤10 yrs.	31 (39.74)	47 (60.26)	78	0.7	0.4
	>10 yrs.	48 (30.04)	93 (69.96)	141		
Untrimmed nails						
3	Present	55 (33.74)	108 (66.26)	163	1.5	0.22
	Absent	24 (42.85)	32 (57.15)	56		
Clean Cloths						
4	Present	75 (36.23)	132 (63.77)	207	0.04	0.83
	Absent	4 (33.33)	8 (66.67)	12		
Source of drinking water						
5	Tap water	47 (37.30)	79 (62.7)	126	0.28	0.87
	Tanker	28 (35)	52 (65)	80		
	Others	4 (30.77)	9 (69.23)	13		
Household latrine						
6	Present	77 (35.48)	140 (64.52)	217	3.57	0.049
	Absent	2 (100)	0 (0)	2		
Treatment for worms						
7	Yes	18 (31.57)	39 (68.43)	57	0.67	0.41
	No	61 (37.65)	101 (62.35)	162		
Consistent use of footwear at home						
8	Yes	31 (31)	69 (69)	100	2.05	0.15
	No	48 (40.33)	71 (59.67)	119		
Washing hands before meal						
9	Yes	21 (22.34)	73 (77.66)	94	13.46	0.0002
	No	58 (46.4)	67 (53.6)	125		
Practice of eating food fallen on ground/ unwashed vegetables/fruits						
10	Yes	55 (44)	70 (56)	125	7.93	0.004
	No	24 (25.53)	70 (74.47)	94		
Eat soil/ play with soil						
11	Yes	47 (40.86)	68 (59.14)	115	2.41	0.12
	No	32 (30.77)	72 (69.23)	104		
Washing hands after defecation						
12	Yes	69 (35.02)	128 (64.98)	197	0.93	0.33
	No	10 (45.45)	12 (54.55)	22		

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On examination, majority of the participants had clean/trimmed nails and pallor was positive in about three-fourths of the children. Factors like lack of household latrine, not washing hands before meals and practice of eating unwashed vegetables/fruits or food fallen on ground were found significantly associated with occurrence of STH infection having P values 0.049, 0.0002 and 0.004 respectively. Pallor was also more common in children with STH infection (P=0.007) (Table 3).

Discussion

STH infections have important implications on the overall health of the community due to their easy transmissibility through contaminated food, water and soil. The overall prevalence of STH infections in India ranged between 7.56% and 78.27% in different studies and these infections have mostly been polytypic in nature.[5] It is a known fact that climatic and soil conditions influence STH infections and that STH mapping needs to be done on basis of agro-climatic zones.[10] However, such prevalence mapping has not been available in India up till now making it difficult to compare results of previous studies owing to variations in geographical locations, testing methodologies used and study groups studied.

Our study area Alappuzha has been categorized as a filarial-endemic region. Five rounds of MDA have been carried out in this area under the Elimination of Lymphatic Filariasis Strategy. The last MDA round was carried out in April, 2013 in which Albendazole (400 mg) together with DEC was administered to the targeted population.[7] The previous STH survey in Alappuzha was carried out before the commencement of MDA by Bora et al. in 1999[4] and the present study was conducted in the same study area during June, 2015. The overall STH prevalence of 36.07% found in the present study is comparable to that of 1999 survey. However, in comparison to the 1999 survey, prevalence of ***Ascaris lumbricoides*** has doubled where as that of ***Trichuris trichiura*** was significantly reduced and hookworm was absent in the present survey. The major impact of consecutive rounds of MDA was seen on the intensity of infection which was found to be less than 10% of the previous estimates in 1999 (Table 2).

It is expected that after several rounds of MDA (including Albendazole), there will be a reduction in intensity of infection whereas the overall prevalence may remain almost the same and may take a long time to reduce owing to re-infection. A similar study in Indonesia also observed that after five rounds of MDA, prevalence rates of ***Ascaris lumbricoides*** only reduced marginally from 34% to 27%, whereas that of hookworm reduced significantly from 28% to 4% and that of ***Trichuris trichiura*** from 11% to 2%. Also, the same study noticed that after about three years of discontinuation of MDA, STH infection rates reached the pre-MDA levels, whereas the intensity of infection still remained reduced.[11] Another study in Tamil Nadu, India, estimated that prevalence of hookworm (92.9%) and whipworm (74.9%) was significantly reduced after seven rounds of MDA. However, the same study also observed that the prevalence of round worm was reduced by 80% and the overall STH prevalence declined from 60.4% to 12.5% with a percentage reduction of 79 after seven rounds of MDA.[12] Other studies in Congo and Indonesia have also shown that even after two rounds of MDA, hookworm infection rates in the community reduced dramatically with lesser impressive effects on ***Ascaris lumbricoides*** and ***Trichuris trichiura***.[13,14] The fact that hookworm was not found in the present survey and ***Trichuris trichiura*** was significantly reduced is explained by the impact of repeated MDA rounds as demonstrated by these studies. In our study, we found many folds declined in the mean EPG values overall STH, AL and TT infection after consecutive episodes of MDA. However, we did not find any case of hookworm infection though it was reported by previous study (Bora et al.) (Tables 2 and 3).

A review study has also observed that after mass drug administration the prevalence rate almost returns to pre-intervention level after about nine to twelve months particularly for ***Ascaris lumbricoides***.[15] It may explain the high prevalence of ***Ascaris lumbricoides*** observed in our study.

In our study, all stool samples found positive had presence of eggs of ***Ascaris lumbricoides*** (AL) in their stool sample. A review of past 18 studies in India has also shown a predominance of AL infection in the positive samples.[5]

In the current study, practicing unhygienic habits among study participants like eating food fallen on ground/eating unwashed fruits and not washing hands before meals had significantly contributed to high STH prevalence rate. Other studies about the risk factors of STH infection among school children have also concluded that not washing hands before meals[16,17] and eating food fallen on ground[18,19] are significant risk factors for acquiring STH infection. This further emphasizes the importance of sanitation and good personnel hygiene practices in addition to mass chemotherapy in control of STH infections.

We also found that pallor was more common in children suffering from STH infection. Studies among school children have demonstrated significant association of STH infections with lower hemoglobin levels.[20,21]

Conclusion

The findings of the current study show that consecutive rounds of MDA lead to a significant decline in mean worm burden with only a little impact on the overall prevalence of STH. Since five rounds of MDA have been completed,

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further STH control activities in such areas should be in collaboration with the Elimination of Lymphatic Filariasis Strategy based on findings of the Transmission Assessment Survey (TAS).

Our study also showed that habits like lack of hand washing and eating unwashed fruits/vegetables are important risk factors for STH infection in children. Hence, for overall physical and cognitive development of children, it is necessary to target the STH problem with other multipronged approaches apart from periodic de-worming. This may include imparting health education to children on importance and technique of hand washing especially before meals, improvement of overall sanitation and hygiene by providing access to toilet and availability of soap to children both at homes and in schools in endemic districts.[19]

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Conflict of Interest: None

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