# Abstract


## Background

Pinworm (*Enterobius vermicularis*) infection is considered to be one of the most common helminthic infections of humans. Low income urban populations are at higher risk of getting intestinal helminthic infections due to favourable conditions for transmission. Control of pinworm infection needs a combination of drug treatment of the case and all members of the family and improvement in hygienic conditions. Lack of knowledge about enterobiasis among parents might be an important risk factor for enterobiasis in children and health education has been shown to be of value in the control of enterobiasis.

## Objectives

This study had two general objectives. The first objective was to estimate the pinworm egg positivity rate and associated factors among children aged three to seven years in low income settlements in the Colombo Municipal Council (CMC) Area.

The second objective was to evaluate the effectiveness of mebendazole mass treatment and health education on reduction of reinfection rate among the same study population.

## Methodology

### Component 1

A population based cross-sectional analytical study was carried out to estimate the prevalence of egg positivity of pinworm and to determine the factors associated with egg positivity of pinworm during January to February 2014. Any child who had completed three years to seven years of age and who was living in the selected low income settlements in the Colombo Municipal Council area for at least the last one year was recruited. Any child who was not suitable for the collection of the cellophane adhesive anal sample was excluded. The total sample size was 1257. Participants were selected using a population proportionate cluster sampling method from 48 settlements in the CMC using a list of low income settlements prepared by a previous survey and the electoral list.

Data was collected using questionnaire, data entry sheets, cellophane anal swabs, anthropometric and GPS sensing equipment. The questionnaire included sections on socioeconomic factors such as education, income, housing and household amenities, parents' knowledge, attitude and practices in relation to transmission, prevention and control of pinworm infection and features observed in children which may either increase the risk of transmission of pinworm infection or be the features of infection. Cellophane anal swabs (CAS) produced by a Japanese company were used to collect the perianal samples. Body weight of the children was measured using electronic digital scales and the height was measured using portable stadiometers. GPS coordinates were documented using 'Garmin' handheld sensors.Allied health science graduates collected the data. After obtaining their written informed consent, parents were given a demonstration on taking CAS using a mannikin and were advised to take the swab early morning as soon as the child woke up. CAS was collected for two consecutive days. Technicians in the Department of Parasitology, Faculty of Medicine, Ragama, carried out the microscopic examination of CAS.

**Component 2**

A factorial cluster randomized control trial was carried out to assess the effectiveness of deworming against pinworm during January to May 2014. Two interventions were used. One intervention compared the re-infection rate with two doses of SPMC mebendazole 100mg administered two weeks apart to only positive cases and their households against two doses of SPMC mebendazole 100mg administered two weeks apart to all study participants and their households, irrespective of pinworm egg positivity. The other intervention was to compare the reinfection rate following routine health education as against special health education. The education intervention was developed through discussions with residents of settlements which were not selected for the trial. Data collectors distributed health education leaflets and gave verbal advice during each follow-up visit to the settlements. Parents were given a participant recruitment card and were advised to make the routine healthcare provider aware about the recruitment status.

About two to three weeks after collection of the first CAS, depending on the type of intervention arm, eligible participants were given mebendazole. Whenever a child was treated, all household members were also treated with mebendazole. The second CAS was collected a week after administration of the first dose of mebendazole. A second

dose of mebendazole was given two weeks after the first dose. The third CAS was collected a week after the second dose of mebendazole, and the fourth CAS was collected 12 weeks after the second dose of mebendazole.

Data was entered twice in EpiData and validated for discordant entries between the duplicate documents. Data was exported to SPSS software and cleaned. Univariate and logistic regression analyses were carried out. Significance was assessed at 5% significant level.

**Results**

In Component One, the sample collection rate was 94.3% (1185/1257). Of the 1185 children who provided baseline samples, 504 (42.5%, 95% CI: 39.7 to 45.4%) were positive on at least one of the samples taken on two days. Of these 504 samples, 258 (51.1%) were positive only on one day. Prevalence of egg positivity was similar among males (40.4%) and females (44.6%). In univariate analysis, pinworm egg positivity was associated with age of child (p=0.001), number of children in a house (p=0.001), number of household members (p <0.001), levels of education in the mother (p=0.001) or father (p=0.001), household amenities score (p=0.001), socio economic status (p<0.001), weight for age Z score (p=0.02) and BMI for age Z score (p=0.02). In logistic regression analysis, pinworm egg positivity was associated with socioeconomic status (OR = 0.98, 95% CI: 0.97 to 0.99), age of the child [from 3 years to 7 years] (OR = 1.02, 95% CI: 1.004 to 1.05), BMI for age Z score (OR= 0.97, 95%CI: 0.95 to 0.99) and increasing number of children aged 3 to 7 years in a household (OR= 1.05, 95%CI: 1.001 to 1.1).

In Component Two, the sample collection rate was 79.8 % for $CAS_2$, 75.2% for $CAS_3$ and 73.3% for $CAS_4$. Overall egg positivity reduced from 42.5% to 10% following the first dose of mebendazole, further reduced to 6.8% following the second dose of mebendazole and then increased to 29.3% at 12 weeks following the second dose of mebendazole. Reinfection rate at 12 weeks after the second dose of mebendazole (i.e. those who were $CAS_3$ negative but $CAS_4$ positive) was similar in all four intervention arms: special education and treatment of only positive cases (31.6%), special education and mass treatment (29.7%), routine education and treatment of positive cases (25%) and routine education and mass treatment (32%). Overall negative conversion rate after the first dose of mebendazole ($NCR_1$) was 87.2% (366/420) and after the second dose of

mebendazole ($NCR_2$) was 94.2% (373/393). There was no evidence for an association between type of intervention and either $NCR_1$ or $NCR_2$. In univariate analyses, reinfection rates were associated with baseline egg positivity (p=0.001), number of household members (p=0.03), socioeconomic status (p=0.02) and BMI for age Z score (p=0.004). In logistic regression, there was no evidence for association between type of intervention and reinfection (OR= 1.003, 95% CI: 0.97 to 1.03) when baseline pinworm egg positivity rate and BMI for age Z score are adjusted, Re-infection was associated with baseline pinworm egg positivity (OR= 1.22, 95%CI: 1.15 to 1.3) and BMI for age Z score (OR= 0.96, 95% CI: 0.94 to 0.99).

## Conclusions

The prevalence of pinworm egg positivity among the children in low income settlements in the Colombo Municipal Council area was 42.5% (95% CI: 39.7 to 45.4%). When the possible risk factors were considered together, there was evidence that increasing age of child, higher number of children in a household, lower socioeconomic status and lower BMI for age Z score were independently associated with increased risk of pinworm egg positivity. There was no evidence for a difference in the reinfection rate of pinworm between the four intervention arms namely special education and treatment of only positive cases, special education and mass treatment, routine education and treatment of positive cases and routine education and mass treatment. There was also no evidence for a difference in the negative conversion rate following the first and second doses of mebendazole among the four intervention arms. Pinworm reinfection rate was found to be associated with baseline egg positivity and BMI for age Z score.

## Recommendations

Prevention and control activities of pinworm should be strengthened in the low income settlements in the Colombo Municipal Council area. The association between the pinworm egg positivity and the BMI for age should be explored further. Parents should be educated on the modes of transmission of pinworm infection. Parents and healthcare workers should be sensitized on the need for a second dose of mebendazole two weeks following the initial dose.

**Key words :** *Enterobius,* Pinworm, low income settlements, deworming, mebendazole