PREVALENCE OF MALNUTRITION AND INTESTINAL PARASITES IN PRESCHOOL SLUM CHILDREN IN LUCKNOW

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Objective: *To assess the point prevalence of intestinal parasites and their association with nutritional parameters.* ***Setting:*** *Anganwadi centers under the Integrated Child Development Scheme (ICDS) in Lucknow, North India.* ***Design****: Cross-sectional survey.* ***Methods:*** *By random draw, 32 out of 153 Anganwadi centers were selected. All eligible subjects registered with the Anganwadi worker were enrolled. These were 1061 children (48.3% girls and 51.7% boys) between the ages of 1.5 to 3.5 years.* ***Results:*** *Of these, 67.6% were underweight (weight for age <-2 SD), 62.8% were stunted (height for age <-2 SD) and 26.5% were wasted (weight for height <-2 SD). Parasites were detected in 17.5% (95% CI 15.3%-19.9%) children by a single direct fecal smear examination. Of these, Ascaris lumbricoides was found in 124 (68.1%) and Giardia lamblia in 60 (32.9%). There was no association between weight or height and parasite positivity. The mean hemoglobin levels for children who were smear positive versus smear negative for ascaris or giardia were 9.1 g/dl and 9.6 g/dl, respectively (p<0.0001).* ***Conclusion:*** *In the urban slums the point prevalence of intestinal parasites is 17.5% in the preschool children. Malnutrition and low hemoglobin levels are also widely prevalent. Urgent remedial steps are needed on community basis to improve their nutritional status and control parasitic infestation.*

Key words: *Ascaris lumbricoides, Giardia lamblia, Hemoglobin, Nutritional indices, Preschool children.*

MAJORITY of preschool children in India, as in other developing countries, are underweight and stunted(l). In India, approximately half of them are also anemic(2). Intestinal helminthic infestation is one of the multiple etiologies of malnutrition(3-6). Of the helminths, ascariasis has been associated with poor growth of preschool children(7-9). It is of interest to note that while no reduction in weight has been demonstrated in ascaris infested children (8), treating them has consistently resulted in weight gain(6,10). Of the protozoa, *Giardia lamblia* is most widely prevalent, world over, in preschool children(11). Workers have reported weight reduction in giardial infested, asymptomatic children(12,13). Anemia found in mlanourished children is usually attributed to deficient nutrient intake(5,614). Hookworm infestation, known to result in anemia due to chronic blood loss, is very uncommon in preschool age(4-6). The present study was conducted to-assess the nutritional status and prevalence of intestinal parasites, and to ascertain any association between the two, in the preschool children of Lucknow, North India.

Subjects and Methods

The study was carried out in the Anganwadi centers of the ICDS scheme in Lucknow, North India. Participants were children between the ages of 1.5 to 3.5 years, whose parents consented for the study. Out of 153 Anganwadi centers, 32 were randomly selected for the survey. Excluded were children likely to move out within six months. Personal interviews of mothers were done to collect information on socio-economic status of the family and history of passage of worms in the preceding 1 month in the enrolled child.

Anganwadi centers have been provided through the UNICEF, spring balance weighing scales manufactured by Salter (Anganwadi scales). The Anganwadi scales are hung from a ceiling and the child is strapped on it. Weight is read off the dial on the machine. Anganwadi scales are used in routine practice but since their calibration is not checked regularly, we calibrated bathroom scales (project scales) against the Anganwadi scales and used project scales to measure the standing weight in kilograms (sensitivity 100 g). If a child could not stand and was less than 10 Kg, lying down weight-was measured on Braun's infant scales (sensitivity 50 g). There was a high correlation (r=0.99) between the project scale and Anganwadi scale as determined by measuring 64 children on both the scales on the same day. The accuracy of the project scales was checked daily and prior to individual weight measurement, the zero error was noted and corrected. Standing height of the children was measured. For this, the child was made to stand on flat ground against a straight wall. The feet were kept together, back kept straight and eyes held parallel to the ground. A wooden scale was placed on the head, parallel to the ground, and a mark was made on the wall where the scale touched it. The child was then asked to step aside and the distance from the floor to the mark was measured by a tape, correct to the nearest 1 millimeter. Approximately 10% of weight and height measures were then validated by an independent project officer within one week of the initial survey. If the two readings of the same child differed by more than 200 g, a mean of the two was considered for analysis.

The hemoglobin levels were estimated by a single project officer by visual color estimation using Sahli's hemoglobinometer(15) in the center itself. While we calibrated the instrument weekly, actual validation of hemoglobin level was not done.

Mothers were instructed to collect fresh fecal specimen of the child in a labelled glass vial provided. If the mother had not collected the stool specimen the first time, two more visits were made on consecutive days for this. Budgetery and manpower constraints overrided the potential benefits of repeated stool examination of individual subjects. Within 8 hours of collection, direct fecal examination was done on fresh specimen for ova of helminths and saline iodine staining for the detection of protozoa (16). Approximately 10% of the stools were re-examined by a different technician. If there was discrepancy between the results of these two, a third examination was done by the project investigator or co-investigator, whose report was then taken as final. The persons involved with the stool examination were different from the evaluator responsible for hemoglobin estimation or those measuring the weight and height of the children.

Epi Info6 statistical software (17) was used to calculate the weight for age, height for age and weight for height 'Z' scores, on comparing with the World Health Organization's recommended standards (National Center for Health Statistics) for nutritional anthropometry. Using a 'Z' score of <-2.00 as cut off, children falling below this in the weight for age parameter were classified as "underweight", height for age parameter as "stunted" and weight for height parameter as "wasted".

Anthropometric data and nutritional indices were compared between smear positive and smear negative children, using chi square test for categorical and Student's 't' test for continuous variables. Chi square test for trend was performed to assess the effect of age and seasonality on the parasite positivity rates.

Results

We recruited 1061 children (52% males and 48% females) between the ages of 1.5 to 3.5 years from 32 randomly selected Anganwadi centers from January till July 1995. The mean age was 33.8 mo (SD 9.7 mo). With respect to religion, 66.9% of the subjects were Hindus and 33.1% Muslims. History of passage of round worms in the preceding 1 month was reported by 38 children (3.6%; 95% CI 2.6%-4.8%).

Point Prevalence of Parasites

Stool examination was done in 1040 children. Mothers of 21 children from 5 different centers were unable to collect the stool specimen on three consecutive visits. A single direct fecal smear examination was positive for ova of *Ascaris lumbricoides* in 124 (11.9%; 95% CI 10.05%-14.1%), cyst or trophozoite of *Giardia lamblia* in 60 (5.8%; 95% CI 4.5%-7.4%) and any parasite in 182 children (17.5%; 95% CI 15.3%-19.9%). In only two instances, both the parasites were present together. Only 4 out of 124 children (10.5%; 95% CI 3.4%-23.5%) with smear positive for *Ascaris* had history of passage of round worms in the preceding 1 month. We did not observe any trend in the prevalence of ascaris or giardia in relation to age. Also, we did not observe seasonality patterns in ascaris or giardia isolation rates, and these were similar for winter months (January-March), and summer months (April-July).

Calibration of Project Scales

Project scales were calibrated with standard weights of 5 Kg and 10 Kg. The coefficient of variation between standard weight and measurement by investigator was within ± 200 g.

Nutritional Indices and Parasite Positivity

Among the total sample surveyed, 67.6% (95% CI 64.7%-70.3%) were underweight, 62.8% (95% CI 59.8%-65.6%) were stunted and 26.5% (95% CI 23.9-29.2) were wasted. The mean weight was 10.1 Kg (SE 0.07) and the mean height was 81.9 cm (SE 0.3). The mean weight of children with and without any parasites was 10.34 Kg (SD 2.05) and 10.09 Kg (SD 2.13), respectively (p=0.15). The mean height of children with and without any parasites was 82.34 cm (SD 8.27) and 81.79 cm (SD 8.37), respectively (p=0.6).

The proportion of wasting tended to be higher in ascaris negative as compared to ascaris positive children (27.7% versus 19.4%; p=0.05)(*Table* I). With the above exception, with individual parasites, ascaris or giardia (*Table* I), on considering either continuous or other categorical measures of nutritional anthropometry, no association could be found.

The mean hemoglobin was 9.5 g/dl (SE 0.03). Hemoglobin <10 g/dl was found in 587 children (55.3%; 95% CI 52.3%-58.3%). Children with stool positive for ascaris or

TABLE I—*Comparison of Nutritional Parameters in Children with Stool Positive and Stool Negative for Ascaris lumbricoides and Giardia lamblia*

Nutritional parameters	Ascaris positive (n=124)	Ascaris negative (n=916)
Continuous measures		
Weight (Kg)	10.39(2.06)	10.11(2.13)
Height (cm)	82.32(8.23)	81.85(8.38)
Hemoglobin (g/dl)	9.1(0.97)	9.58 (0.89)$^{+}$
Categorical measures		
Wasted	24 (19.4)	254 (27.7)*
Stunted	74 (59.7)	577 (62.9)
Underweight	77 (62.1)	626 (68.3)
Nutritional parameters	**Giardia positive (n=60)**	**Giardia negative (n=980)**
Continuous measures		
Weight (Kg)	10.24(2.05)	10.13(2.13)
Height (cm)	82.47(8.31)	81.87(8.36)
Hemoglobin (g/dl)	9.1 (0.97)	9.58 (0.89)$^{+}$
Categorical measures		
Wasted	20 (33.3)	258 (26.3)
Stunted	34 (56.7)	617 (62.9)
Underweight	40 (66.7)	663 (67.7)

*p = 0.05; $^{+}$p < 0.0001

For continuous measures, values are depicted as mean (SD) and for categorical measures, as number (%).

giardia (*Table I)* had statistically lower mean hemoglobin levels when compared to those who were stool negative for these respective parasites.

Discussion

We observed that nearly two-thirds of preschool children were underweight in the urban slum of Lucknow. Protein energy malnutrition has been reported in 81.8% of the preschool children of the urban slums of Delhi (18). *Ascaris lumbricoides* was found in 11.9% of the preschool children in the urban slums of Lucknow and was the commonest intestinal parasite. There have been reports on this aspect from other parts of India (19,20) and rest of the world(8,9). However, in the fishing villages of South India, hookworm infestation was found in approximately half of the children(21). This seems feasible as the distribution of ascaris and hookworm has been found to be independent of each other(22).

Even though ascaris is known to be associated with protein energy malnutrition(6,23) similar body weights have been found in the infested and non-infested children in cross-sectional studies(10). The reason offered for the above observation is that in ascaris-endemic community there may be frequent movements from infected to non-infected states and vice-versa(24). Since nutritional status reflects cumulative experience of children over a long period, a cross-sectional study design with one time stool examination is not an accurate way to classify a child's long term infection status(25). Thus, such studies have failed to demonstrate weight difference between infested and non-infested children. The evidence for malnutrition comes from the fact that ascaris infested children have shown better weight gain after anthelminthic treatment(6,11).

Giardia lamblia was found in 5.8% of the preschool children in the urban slums of Lucknow and was the commonest protozoal infestation here, as has been reported from New Delhi(14) and other parts of the world(12). Workers have found giardial infested children to weigh less than the non-infested ones(13,14,26). However, we found no difference in the weight of children without stool positive for giardia.

We have found a negative association between hemoglobin levels and both, ascaris and giardial, infestations in preschool children. This has not been substantiated by other workers(13,14,26,27). Islek *et al.* (28), on the contrary, found no changes in iron absorption in non-anemic *Ascaris* infested children.

The current study was not designed to prove or disprove causal association between ascaris and giardial positivity and anemia. Yet, the association between low hemoglobin and parasite positivity seems plausible because both ascaris and giardia are lodged in the duodenum and jejunum, the site of iron absorption(3). Mucosal changes there have been reported in studies from animal and humans in both types of infestations(12). Gastric juices that facilitate iron absorption(3) have been found to be reduced in ascariasis(27). Shortened gut transit time and steatorrhea which accompanies both types of infestations(12) can potentially reduce iron absorption from the gut(3). Therefore, our hypothesis is that ascariasis and giardiasis can result in iron deficiency anemia and further studies are needed to substantiate this postulate.

Validation of hemoglobin levels in the community set up was not possible. Hemoglobin estimations were done by one single observer, blinded to the results of stool examination, to reduce inter-observer variability. If there was any intra-observer variation, it was likely to be similar for the infested and non-infested children.

In conclusion, in the current study the majority of preschool children were found to be malnourished and also had anemia. The point prevalence of intestinal parasites was 17.5%. Urgent remedial steps are needed on community basis to improve the nutritional status and control parasitic infestation in preschool children. Since we have observed that children with parasitic infestation had lower hemoglobin than the non-infested ones, further studies with much larger sample size are needed to assess the effect of control of parasitic infestation on improvement in hemoglobin levels.

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