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Research Paper

ASSOCIATION BETWEEN INTESTINAL PARASITIC INFECTIONS WITH ANEMIA AMONG PATIENTS ATTENDING A TERTIARY CARE HOSPITAL IN SOUTH INDIA: A CROSS-SECTIONAL STUDY

Dr. Sujitha M and Dr. Jeya M

Department of Clinical Microbiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram,Tamil Nadu, India.

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ABSTRACT

Background: Intestinal parasitic infections are a significant public health problem and are associated with nutritional deficiencies, including anemia. **Objective:** To evaluate the association between intestinal parasitic infections and anemia among patients attending a tertiary care hospital in South India. **Methods:** This cross-sectional study was a secondary analysis of data obtained from 510 patients attending a tertiary care hospital in South India. Stool samples were examined using standard microscopic and concentration techniques for the detection of intestinal parasites. Hemoglobin levels were obtained from laboratory records, and anemia was defined according to WHO criteria. The association between intestinal parasitic infections and anemia was assessed using the Chi-square test, and odds ratio (OR) with 95% confidence interval (CI) was calculated. **Results:** Out of 510 patients, 136 (26.7%) had parasitic infections and 148 (29.0%) were anemic. Among the anemic patients, 59 (39.9%) had associated parasitic infections. A total of 74 parasitic isolates were identified, with single infections in 44 (74.6%) and double infections in 15 (25.4%) patients. A statistically significant association was observed between parasitic infections and anemia ($\chi^2 = 17.63$, $p < 0.001$), with higher odds of anemia among infected patients (OR = 2.45). **Conclusion:** Intestinal parasitic infections are significantly associated with anemia, emphasizing the need for routine screening, timely treatment and strengthened public health measures such as improved sanitation, safe water and health education to reduce disease burden in resource-limited settings.

INTRODUCTION

Intestinal parasitic infections continue to be a major public health concern worldwide. Tropical and subtropical regions, characterized by hot and humid climatic conditions, provide favorable conditions for the transmission of intestinal parasitic infections associated with factors such as poverty, poor sanitation, contaminated drinking water can increase the burden of these infections.(1)Anemia is a significant global public health challenge, with a higher prevalence in Low- and lower-middle income countries. It predominantly affects vulnerable populations, including those residing in rural areas, in poorer households and populations with limited access to formal education. Iron deficiency, primarily resulting from inadequate dietary intake, is the most common nutritional deficiency and a leading cause of anemia. In addition, deficiencies of micronutrients such as vitamin A, folate, vitamin B12 and riboflavin can also contribute to anemia due to their essential roles in hemoglobin synthesis and erythropoiesis. Infectious disease can be another important cause of anemia, particularly in regions with a high burden of conditions such as malaria, tuberculosis, HIV and parasitic infections. In parasitic infections, anemia may result from impaired nutrient absorption and metabolism or by nutrient loss.(2)

The most common intestinal parasitic infections are helminths such as *Ancylostoma duodenale, Ascaris lumbricoides, Strongyloides stercoralis, Trichuris trichura and protozoa including Entamoeba histolytica, Entamoeba coli and Giardia intestinalis.* Anemia associated with parasitic infections occurs due to reduced iron absorption from the intestine, direct blood loss caused by the parasites and damage to the intestinal mucosa which interferes with absorption of micronutrients

Corresponding author:* **Dr. SUJITHA
Department of Clinical Microbiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram,Tamil Nadu, India.

and iron metabolism.(3)Microcytic anemia has been reported in association with *Ancylostoma duodenale, Trichuris trichiura, Strongyloidesstercoralis*, Macrocytic anemia reported in association with *Ascaris lumbricoides* infection and Normocytic anemia was commonly seen in patients infected with *Enterobius vermicularis and Balantidium coli.* (4)Cystoisosporiasis due to *cystoisospora belli* causes chronic diarrhea and malabsorption, leading to systemic complications and may contribute to anemia.(5)Fasciolopsiasis is usually asymptomatic, but in severe infections, intestinal malabsorption may lead to protein loss and may be associated with anemia.(6) Infection with *Schistosoma japonicum* can result in intestinal blood loss, leading to iron deficiency anemia as eggs migrate through the intestinal wall into the gut lumen.

Schistosomiasis may contribute to anemia through proinflammatory cytokine-mediated dyserythropoiesis, consistent with the pathophysiology of anemia of inflammation. (7) In addition to other well-known parasitic infections, infestations with *Diphyllobothrium latuminfection,Giardia lamblia infection*, Taenia infection may contribute to intestinal vitamin B12 malabsorption.(8) The prevalence of parasitic infections is higher in rural areas than in urban settings due to associated risk factors such as inadequate water sanitation, poor hand hygiene practices, barefoot walking, open air defecation, dietary habits and limited awareness of zoonotic transmission.

In a previous study conducted at a tertiary care hospital in Tamil Nadu, we reported theprevalence and associated risk factors of intestinal parasitic infections from different categories of patients.(9) However, the association between intestinal parasitic infections and anemia was not specifically analyzed. Therefore, the present study represents a secondary analysis of data obtained from the same study population to further evaluate the association between intestinal parasitic infections and anemia.

MATERIALS AND METHODS

Study design and setting

This was a cross-sectional study conducted at the Department of Microbiology, Rajah Muthiah Medical College and Hospital, Chidambaram,Tamil Nadu, South India. The present study represents a secondary analysis of data obtained from a previously conducted cross-sectional study carried out between January 2019 and June 2020.

Study population and sample size

A total of 510 patients attending the outpatient and inpatient departments were included in the original study. Patients of all age groups and both sexes, including children, adult males and females, antenatal women, and immunocompromised individuals, were considered. Among these, 136 patients were positive for intestinal parasitic infections. Data on anemia status were available for analysis, and 59 patients had both parasitic infection and anemia.

Inclusion and exclusion criteria

All patients who provided stool samples for parasitological examination during the study period were included. Patients who had received anti-helminthic treatment prior to sample collection or had incomplete data were excluded from the analysis.

Data collection

Demographic details and risk factors, including age, sex, socioeconomic status, hygiene practices, dietary habits, barefoot walking, and sanitation conditions, were collected using a predesigned proforma. Data related to hemoglobin levels and anemia status were obtained from laboratory records.

Laboratory procedures

Stool samples were collected and processed within 1–3 hours of collection. Direct microscopic examination using saline and iodine wet mounts was performed to detect trophozoites, cysts, ova, larvae, and oocysts. Concentration techniques, including formalin-ether sedimentation and saturated salt flotation methods, were employed to improve detection. Modified acid-fast staining was used for identification of coccidian parasites. Additional staining methods such as lactophenol cotton blue and methylene blue glycerol mounts were used for detailed morphological identification.

Definition of anemia

Anemia was defined based on hemoglobin levels according to standard WHO criteria. Patients were categorized as anemic or non-anemic based on age- and sex-specific cutoff values.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS software version 22. Descriptive statistics were expressed as frequencies and percentages. The association between intestinal parasitic infections and anemia was assessed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Ethical considerations

The present study is a secondary analysis of data obtained from a previously conducted study approved by the Institutional Ethics Committee of Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India.

RESULTS

A total of 510 samples were analyzed. Of these, 136 (26.7%) were positive for intestinal parasitic infections, and 148 (29.0%) patients were found to be anemic. Coexistence of intestinal parasitic infection and anemia was observed in 59 (11.6%) patients.

Association between parasitic infection and anemia

The association between parasitic infection and anemia is presented in Table 1. As shown in Table 1, parasitic infection was significantly associated with anemia ($\chi^2 = 17.63$, df = 1, $p < 0.001$). The odds of anemia were 2.45 times higher among parasite-positive individuals compared to parasite-negative individuals.

Table 1. Association between Parasitic infection and Anemia with Chi-square Analysis.

Group	Anemia (+)	Anemia (-)	Total
Parasite (+)	59	77	136
Parasite (-)	89	285	374

Total	148	362	510
Chi-square (χ^2)	17.63	df = 1	p < 0.001
Odds Ratio (OR)	2.45	95% CI	1.64–3.65

Age- and gender-wise distribution of anemia

Among the 148 anemia patients, 95 (64.2%) were female and 53 (35.8%) were male. The highest proportion of anemia cases was observed in the 31–40 years (18.9%) and 51–60 years (18.9%) age groups, followed by <10 years (16.2%) and 21–30 years (15.5%).

Age- and gender-wise distribution of parasite-positive anemia

Among the 59 patients with both parasitic infection and anemia, 44 (74.6%) were female and 15 (25.4%) were male. The highest prevalence was observed in the 31–40 years (22.0%) age group, followed by 21–30 years (20.3%) and 51–60 years (20.3%). However, the association between age group and gender in parasite-positive anemia patients was not statistically significant (p = 0.069).A comparative age and gender wise distribution of total anemia patients (n=148) and parasite-positive anemia patients (n=59) is shown in Figure 1.

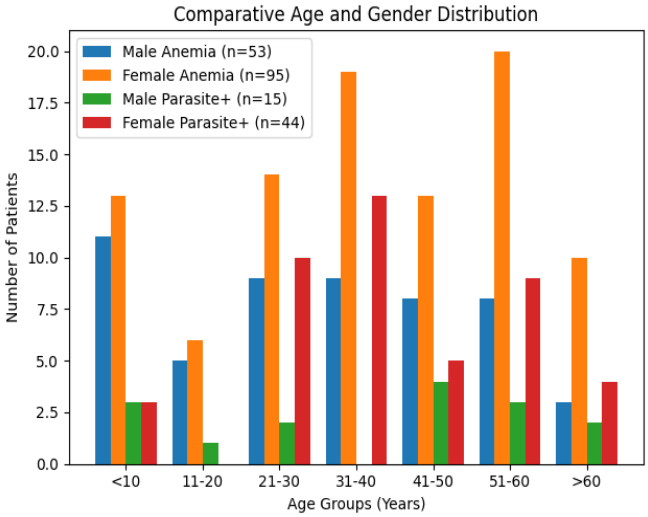

Figure 1. Comparative analysis of age and gender distribution among anemia patients and those with parasite-associated anemia.

Distribution of parasitic isolates

A total of 74 parasitic isolates were identified from 59 positive patients, indicating the presence of mixed infections. The most frequently identified parasites were *Ancylostoma duodenale* (27.0%), *Taenia* spp. (27.0%), and *Ascaris lumbricoides* (25.7%). Other isolates included *Enterobius vermicularis* (5.4%), Strongyloidesstercoralis (4.1%), *Entamoeba histolytica* (2.7%), *Balantidium coli* (2.7%), *Giardia lamblia* (1.4%), *Fasciolopsis* spp. (1.4%), *Schistosoma japonicum* (1.4%), and *Cystoisospora belli* (1.4%).The distribution of parasitic species showed a statistically significant variation (p< 0.001). The distribution of parasitic isolates is illustrated in Figure 2.

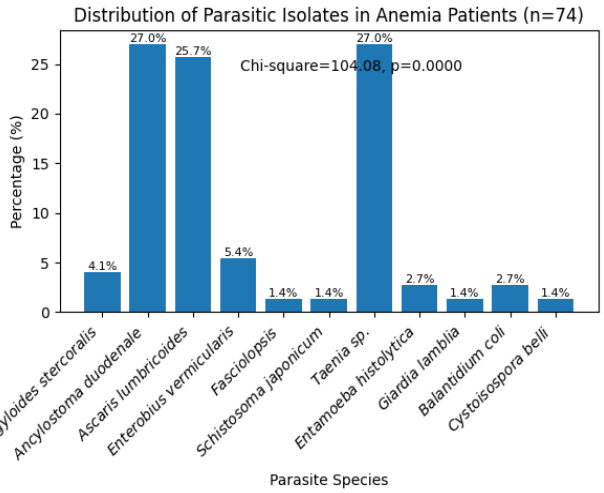

Figure 2. Parasite isolates distribution

Intestinal parasitic infections were significantly associated with anemia, mainly with helminths such as *Ancylostoma duodenale*, *Taenia* spp., and *Ascaris lumbricoides* contributing substantially to the burden of anemia in the study population.

DISCUSSION

The present study demonstrated a statistically significant association between intestinal parasitic infections and anemia, with parasite-positive individuals showing higher odds of anemia compared to parasite-negative individuals. The considerable prevalence of anemia observed in the present study indicates a substantial burden among the study population. Intestinal parasitic infections remain an important public health problem in developing countries and are commonly associated with nutritional deficiencies and anemia, particularly in populations with inadequate sanitation and hygiene practices. Similar findings were reported by Gopalakrishnan et al. from Tamil Nadu, who observed a high prevalence of intestinal parasitic infections and anemia among school children, with a significant association between intestinal parasitic infection and anemia.(1)

Among the identified parasites, *Ancylostoma duodenale* was the predominant isolate in the present study, followed by *Taenia* spp. and *Ascaris lumbricoides*. Hookworm infection is a well-established cause of iron deficiency anemia due to chronic intestinal blood loss and iron depletion as reported by Jourdan et al.(10)The predominance of hookworm infection observed in the present study highlights the continued burden of soil-transmitted helminth infections and their contribution to anemia in endemic settings.

A community-based study conducted in Puducherry by Jayaram et al. reported *Ascaris lumbricoides* and *Taenia* spp. as the predominant parasitic isolates among children. In contrast, the present study identified *Ancylostoma duodenale* and *Taenia* spp as the predominant parasite. This variation in parasite distribution may be attributed to differences in study population, environmental exposure, sanitation practices, geographic variation, and age groups included in the studies. (11)

The present study also demonstrated a higher prevalence of anemia among females compared to males. This finding is in agreement with reports from the World Health Organization,

which indicate that women are more vulnerable to anemia because of increased iron requirements, menstrual blood loss, nutritional deficiencies, and socioeconomic factors. Furthermore, parasite-associated anemia was more common among females in the present study, which may reflect differences in nutritional status, healthcare access, and exposure risk. Similar observations were reported by Gopalakrishnan et al. among adolescent female school children in Tamil Nadu.(1)

Age-wise analysis revealed that anemia and parasite-associated anemia were more common among adults, particularly in the 31–40 years age group. Similar findings have been reported in previous epidemiological studies, where higher prevalence of intestinal parasitic infections was observed among adults due to increased environmental and occupational exposure. However, the association between age and gender among parasite-positive anemia patients was not statistically significant in the present study.

In the present study, mixed parasitic infections were observed in 25.4%, whereas 74.6% had single isolate infections. The presence of multiple parasitic infestations indicates ongoing exposure to contaminated environmental and sanitary conditions, which may increase the risk of nutritional deficiencies and anemia. Similar findings have been reported in previous epidemiological studies where polyparasitism was associated with increased disease burden and may affect clinical outcomes.(4)

The statistically significant variation observed in the distribution of parasitic species in the present study indicates heterogeneity in parasite prevalence within the study population. The predominance of helminthic parasites emphasizes the importance of preventive strategies such as periodic deworming, improved sanitation, safe drinking water, and public health education. Early diagnosis and appropriate management of intestinal parasitic infections are essential to reduce the burden of anemia and associated complications.

Most previous studies from south India have focused primarily on pediatric or selected population groups. To the best of our knowledge, this is among the few studies from South India evaluating the association between intestinal parasitic infections and anemia across all age groups.

CONCLUSION

Secondary analysis of the study data demonstrated a significant association between intestinal parasitic infections and anemia. The findings highlight the importance of early detection and effective control measures to reduce the burden of parasite-associated anemia. Further large-scale multicentric studies are recommended to better understand the epidemiological and clinical impact of parasite-associated anemia.

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