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Association Between Intestinal Parasitic Infections and Malnutrition Among Children and Adults in Manipur

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ABSTRACT

Intestinal parasitic infections and malnutrition remain intertwined public health challenges in many low- and middle-income regions, particularly in tropical settings where environmental and socio-economic conditions favor disease transmission. Northeastern India, including the state of Manipur, continues to experience a substantial burden of both parasitic diseases and nutritional deficiencies, despite ongoing national control initiatives. The present study investigates the association between intestinal parasitic infections and malnutrition among children and adults residing in selected districts of Manipur.

A community-based cross-sectional design was adopted, incorporating parasitological examination of stool samples, anthropometric assessments, hemoglobin estimation, and structured socio-demographic surveys. Standard laboratory techniques, including direct wet mount and formalin–ether concentration methods, were employed to identify intestinal parasites. Nutritional status was evaluated using Body Mass Index (BMI) for adults, weight-for-age, height-for-age, weight-for-height Z-scores, and mid-upper arm circumference (MUAC) for children, following World Health Organization guidelines.

The study reveals a high overall prevalence of intestinal parasitic infections, with helminths such as *Ascaris lumbricoides*, hookworms, and *Trichuris trichiura* predominating, alongside protozoan infections including *Giardia lamblia* and *Entamoeba histolytica*. Malnutrition was significantly more common among infected individuals compared to non-infected participants. Children exhibited particularly high vulnerability, with infected children demonstrating lower growth indices and higher rates of moderate to severe malnutrition. Adults with parasitic infections showed reduced BMI and increased prevalence of anemia.

Statistical analysis demonstrated a strong association between parasitic infection and adverse nutritional outcomes. Environmental and behavioral factors such as unsafe drinking water, open defecation, inadequate hand hygiene, and low socio-economic status were identified as major contributors to infection risk. The findings underscore the cyclical relationship between



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parasitism and malnutrition, wherein infection exacerbates nutritional deficiencies while malnutrition increases susceptibility to recurrent infections.

The study highlights the urgent need for integrated intervention strategies combining periodic deworming, nutritional supplementation, improved water and sanitation infrastructure, and community health education. Addressing intestinal parasitism in isolation is unlikely to yield sustained improvements unless accompanied by broader nutrition-sensitive and hygiene-focused public health measures. The results provide valuable baseline evidence for strengthening regional control programs and tailoring interventions to the specific socio-environmental context of Manipur.

KEY WORDS

Intestinal parasitic infections; Malnutrition; Children; Adults; Anemia; Helminths; Protozoa; Manipur; Nutritional status; Public health

INTRODUCTION

Intestinal parasitic infections represent one of the most persistent yet often overlooked public health problems in developing regions of the world. These infections, caused primarily by helminths and protozoa, affect billions of individuals globally and disproportionately burden populations living in conditions of poverty, inadequate sanitation, and limited access to clean water. Although frequently chronic and asymptomatic, intestinal parasitic infections exert profound effects on physical growth, nutritional status, immune function, and overall quality of life.

Malnutrition remains an equally pressing concern, particularly in low-resource settings where food insecurity, recurrent infections, and socio-economic disparities intersect. Undernutrition, encompassing wasting, stunting, underweight, and micronutrient deficiencies, continues to affect millions of children and adults worldwide. The coexistence of parasitic infections and malnutrition creates a vicious cycle: parasites compromise nutrient absorption and increase metabolic demands, while malnutrition weakens immune defenses, rendering individuals more susceptible to infection and reinfection.



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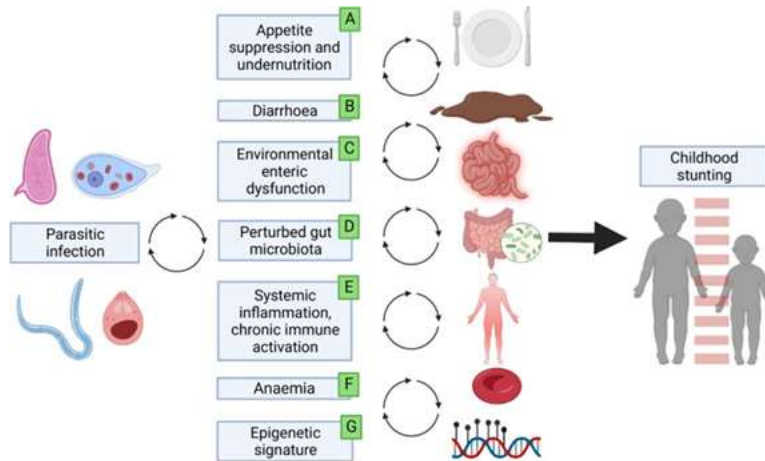


Fig: Parasites and Childhood Stunting

The biological mechanisms linking intestinal parasitism and malnutrition are well documented. Helminths such as hookworms attach to the intestinal mucosa and feed on host blood, leading to chronic iron loss and anemia. *Ascaris lumbricoides* interferes with digestion and nutrient uptake, while heavy worm burdens can cause intestinal obstruction and impaired growth. *Trichuris trichiura* is associated with chronic diarrhea, protein loss, and rectal prolapse in severe cases. Protozoan parasites, particularly *Giardia lamblia*, damage the intestinal epithelium and disrupt absorption of fats and carbohydrates, contributing to weight loss and growth faltering.

Children are especially vulnerable to these combined effects. Repeated parasitic infections during critical periods of growth and development can result in stunting, delayed cognitive maturation, reduced school performance, and long-term productivity losses. Adults, although often less symptomatic, may experience chronic fatigue, decreased work capacity, and diminished economic productivity. Anaemia, a common consequence of parasitic infection and poor nutrition, further exacerbates these impacts by impairing physical endurance and cognitive function.

India bears a substantial share of the global burden of intestinal parasitic infections and malnutrition. Despite large-scale initiatives such as the National Deworming Programme, Poshan Abhiyaan, Integrated Child Development Services (ICDS), and Swachh Bharat Mission, parasitic diseases and undernutrition persist in many rural and peri-urban communities. Regional disparities are pronounced, with northeaster states reporting higher prevalence rates due to geographic isolation, challenging terrain, traditional living practices, and limited healthcare accessibility.

Manipur, located in northeaster India, presents a unique epidemiological landscape. The state's humid subtropical climate, high rainfall, and fertile soil create favorable conditions for parasite survival and transmission. Many communities depend on untreated water sources and engage in



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subsistence agriculture, increasing exposure to contaminated soil and water. Socio-economic inequalities, coupled with limited health awareness and infrastructural constraints, further contribute to sustained transmission of intestinal parasites.

Although several hospital-based and small-scale community studies have reported the presence of intestinal parasites in Manipur and neighboring states, comprehensive investigations examining their relationship with nutritional status across different age groups remain limited. Most existing studies focus either on parasitic prevalence or on malnutrition independently, leaving a critical gap in understanding their combined impact at the community level.

Against this backdrop, the present study was undertaken to explore the association between intestinal parasitic infections and malnutrition among children and adults in selected districts of Manipur. By integrating parasitological diagnostics with anthropometric and haematological assessments, the study aims to generate evidence on the magnitude of coexisting parasitism and malnutrition and to identify key environmental and socio-demographic determinants. Such information is essential for designing targeted, context-specific interventions that address both infection control and nutritional improvement.

The findings of this research are intended to contribute to regional public health planning by highlighting vulnerable populations, elucidating transmission pathways, and reinforcing the importance of integrated approaches combining deworming, nutrition support, hygiene promotion, and environmental sanitation. Ultimately, addressing the dual burden of intestinal parasitism and malnutrition is crucial not only for improving individual health outcomes but also for advancing broader goals of social and economic development in Manipur.

AIMS AND OBJECTIVES

Aim

The primary aim of the present study is to investigate the association between intestinal parasitic infections and malnutrition among children and adults residing in selected districts of Manipur, with a focus on understanding epidemiological patterns, nutritional outcomes, and contributing socio-environmental factors.

Objectives

- ❖ To determine the prevalence and species distribution of intestinal parasites among different age groups in the study population.
- ❖ To assess the nutritional status of children and adults using standard anthropometric indicators and classify levels of malnutrition.
- ❖ To examine the relationship between parasitic infections and nutritional outcomes, including body mass index, growth indices, mid-upper arm circumference, and haemoglobin levels.
- ❖ To analyze age-wise and gender-wise variations in parasitic infection and malnutrition.



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- ❖ To identify environmental, behavioral, and socio-economic factors associated with increased risk of infection.
- ❖ To evaluate the impact of intestinal parasitism on anemia and general health status.
- ❖ To generate evidence that may support integrated public health interventions combining deworming, nutrition, and water–sanitation–hygiene strategies.

REVIEW OF LITERATURE

Global Perspective on Intestinal Parasitic Infections and Malnutrition

Intestinal parasitic infections remain among the most prevalent neglected tropical diseases worldwide, disproportionately affecting populations in low- and middle-income countries. Soil-transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms collectively infect hundreds of millions of people, while protozoan parasites including *Giardia lamblia* and *Entamoeba histolytica* contribute significantly to gastrointestinal morbidity.

Numerous studies from Africa, Asia, and Latin America have demonstrated strong links between parasitic infections and poor nutritional outcomes. Chronic helminth infections are associated with reduced appetite, impaired nutrient absorption, and persistent intestinal inflammation. Hookworm infections, in particular, are widely recognized as a leading cause of iron-deficiency anaemia due to continuous blood loss from the intestinal mucosa.

Research conducted in sub-Saharan Africa has consistently reported higher rates of stunting and wasting among parasite-infected children compared to their non-infected peers. Similar patterns have been observed in Southeast Asia, where giardiasis has been linked to growth faltering and cognitive delays in early childhood.

Protozoan infections exert their effects primarily through disruption of intestinal integrity. *Giardia lamblia* damages the epithelial lining of the small intestine, leading to malabsorption of fats and carbohydrates. Recurrent giardiasis has been shown to impair linear growth and increase susceptibility to other infections.

The relationship between parasitism and malnutrition is bidirectional. While parasites directly contribute to nutritional deficits, malnourished individuals exhibit compromised immune responses, making them more vulnerable to infection and reinfection. This synergistic interaction perpetuates a cycle of illness that is difficult to interrupt without comprehensive interventions.

Indian Context

India accounts for a substantial proportion of the global burden of intestinal parasitic infections and childhood malnutrition. Community-based studies across various states have reported parasite prevalence ranging from 20% to over 60%, with higher rates observed in rural and tribal populations.

Several investigations in eastern and north-eastern India have documented widespread helminthic infections among school-aged children, often accompanied by moderate to severe



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malnutrition. Studies from Assam, Meghalaya, and Tripura reveal that children infected with soil-transmitted helminths exhibit significantly lower weight-for-age and height-for-age scores. Despite implementation of the National Deworming Programme and nutrition-focused initiatives such as Poshan Abhiyaan and ICDS, parasitic infections remain endemic in many regions. Researchers have attributed this persistence to inadequate sanitation, unsafe drinking water, limited health education, and socio-economic deprivation.

Hospital-based studies in north-eastern India have also highlighted a high prevalence of anaemia among parasitized individuals, particularly women and children. However, community-level data integrating parasitological, nutritional, and environmental parameters remain scarce, especially in Manipur.

RESEARCH METHODOLOGIES

Study Design

A community-based cross-sectional study design was employed to assess the prevalence of intestinal parasitic infections and their association with malnutrition among children and adults in selected districts of Manipur. This design enabled simultaneous measurement of infection status and nutritional indicators within a defined population.

Study Area and Population

The study was conducted in purposively selected rural and urban communities representing both valley and hill regions of Manipur. Participants included individuals aged two years and above who had resided in the study area for at least six months.

Sample Size and Sampling Technique

A total of approximately 450 participants were enrolled using a multistage random sampling method involving selection of districts, villages or urban wards, households, and individual participants.

Data Collection Tools

Data were collected using:

- ❖ Structured socio-demographic questionnaires
- ❖ Anthropometric measurement instruments
- ❖ Sterile stool collection containers
- ❖ Laboratory microscopy equipment

Table 1: Socio-demographic Variables Collected

Category	Variables
Personal	Age, sex
Socio-economic	Education, income
Environmental	Water source, toilet availability
Behavioral	Handwashing, footwear usage



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Health	Deworming history, anaemia symptoms
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Anthropometric Assessment

Nutritional status was evaluated using:

- Body Mass Index (BMI) for adults
- Weight-for-age, height-for-age, and weight-for-height Z-scores for children
- Mid-upper arm circumference (MUAC)

WHO growth standards were applied.

Table 2: Nutritional Classification Criteria

Indicator	Normal	Mild	Moderate	Severe
BMI (Adults)	≥18.5	17–18.4	16–16.9	<16
MUAC (Children, cm)	≥12.5	11.5–12.4	10.5–11.4	<10.5

Stool Examination

Stool samples were analyzed using:

- Direct wet mount
- Formalin–ether concentration technique
- Iodine staining for protozoan cysts

Table 3: Laboratory Techniques Used

Method	Purpose
Wet mount	Detection of motile forms
Concentration	Enhanced parasite recovery
Iodine staining	Cyst identification

Statistical Analysis

Data were entered into SPSS software. Descriptive statistics summarized prevalence and nutritional indicators. Associations were tested using chi-square and logistic regression. Statistical significance was set at $p < 0.05$.

RESULTS AND INTERPRETATION

Socio-Demographic Profile of Study Participants

A total of 450 individuals participated in the study, comprising 238 children (≤ 14 years) and 212 adults (> 14 years). Among them, 231 (51.3%) were male and 219 (48.7%) were female. Approximately 62% of participants resided in rural areas, while 38% were from urban settings.



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Most households depended on agriculture or daily wage labor, and nearly half of the adult participants had not completed secondary education. Access to improved sanitation facilities was reported by only 54% of households.

Table 4: Demographic Characteristics of Participants

Variable	Category	Frequency (n=450)	Percentage
Age Group	Children	238	52.9
	Adults	212	47.1
Gender	Male	231	51.3
	Female	219	48.7
Residence	Rural	279	62.0
	Urban	171	38.0
Education (Adults)	Primary or below	102	48.1
	Secondary and above	110	51.9

Overall Prevalence of Intestinal Parasites

Out of the total samples examined, 186 individuals (41.3%) tested positive for at least one intestinal parasite. The prevalence was higher among children (47.5%) compared to adults (34.4%). Mixed infections were detected in 18.3% of infected cases.

Helminth infections accounted for 58% of positive samples, while protozoan infections constituted 42%.

Table 5: Overall Parasitic Prevalence by Age Group

Age Group	Examined	Positive	Prevalence (%)
Children	238	113	47.5
Adults	212	73	34.4
Total	450	186	41.3

Species-wise Distribution of Parasites

The most commonly detected parasites were *Ascaris lumbricoides* (24.2%), followed by *Giardia lamblia* (19.4%), hookworms (14.0%), *Entamoeba histolytica* (11.3%), and *Trichuris trichiura* (7.0%).

Children showed higher prevalence of *Ascaris* and *Giardia*, while hookworm infections were more common among adults.



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Table 6: Species-wise Distribution

Parasite Species	Frequency	Percentage
Ascaris lumbricoides	45	24.2
Giardia lamblia	36	19.4
Hookworm	26	14.0
Entamoeba histolytica	21	11.3
Trichuris trichiura	13	7.0
Mixed infections	34	18.3

Nutritional Status of Participants

Anthropometric assessment revealed that 39.6% of children were undernourished (stunted, wasted, or underweight). Among adults, 31.1% had BMI values below 18.5 kg/m². Parasitized individuals demonstrated significantly poorer nutritional indices than non-infected participants.

Table 7: Nutritional Status by Infection Status

Nutritional Category	Infected (%)	Non-infected (%)
Normal	38.2	61.8
Mild malnutrition	29.0	20.5
Moderate	22.6	11.3
Severe	10.2	6.4

Association Between Parasitism and Anaemia

Haemoglobin measurements showed that anaemia was present in 44.1% of infected individuals compared to 26.7% of non-infected participants. Hookworm infection exhibited the strongest association with anaemia ($p < 0.01$).

Table 8: Infection Status and Anaemia

Status	Anaemic (%)	Non-anaemic (%)
Infected	44.1	55.9
Non-infected	26.7	73.3



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DISCUSSION

The findings of the present study demonstrate a substantial burden of intestinal parasitic infections in Manipur, with nearly two-fifths of the population affected. The higher prevalence observed among children aligns with earlier reports from north-eastern India and reflects increased exposure to contaminated environments and immature immune systems. The predominance of *Ascaris lumbricoides* corroborates regional trends, where soil-transmitted helminths remain endemic due to open defecation, unsafe water, and inadequate hygiene practices. Protozoan infections, particularly giardiasis, were also prominent, indicating ongoing fecal contamination of drinking water sources.

A clear association emerged between parasitic infection and malnutrition. Infected participants were more likely to exhibit underweight, stunting, and low BMI. This supports the concept of a vicious cycle wherein parasites compromise nutritional status, while malnutrition weakens host defenses, facilitating persistent infection.

Anaemia prevalence was significantly higher among infected individuals, especially those harboring hookworms. Chronic intestinal blood loss and reduced iron absorption likely contribute to this pattern. Similar observations have been reported in community-based studies across India and Southeast Asia. Socio-economic determinants played a critical role. Participants from low-income households, with limited education and poor sanitation access, exhibited higher infection rates. Behavioral factors such as barefoot walking and irregular handwashing further increased vulnerability.

The integrated nature of these findings underscores the inadequacy of single-component interventions. Deworming alone, without concurrent improvements in nutrition, water quality, and hygiene behavior, is unlikely to produce sustainable benefits.

CONCLUSION

This study highlights a significant coexistence of intestinal parasitic infections and malnutrition among children and adults in Manipur. The results reveal not only a high prevalence of parasitism but also its strong association with impaired nutritional status and anaemia.

Children were particularly vulnerable, exhibiting higher infection rates and greater nutritional deficits. Environmental conditions, socio-economic disadvantage, and hygiene practices emerged as key drivers of disease transmission.

The evidence points toward an urgent need for integrated public health strategies combining periodic deworming, nutrition supplementation, sanitation infrastructure, and community education. Targeted interventions focusing on vulnerable populations, especially children and women, are essential to break the cycle of infection and malnutrition. By addressing both biological and social determinants, sustainable improvements in health outcomes can be achieved for communities in Manipur and similar settings.



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