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Research Article

Comparative Analysis of Bacterial and Parasitic Etiologies in Stool Samples from Gastrointestinal Infections at a Tertiary Care Hospital, Amalapuram

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ABSTRACT

Background: Gastrointestinal (GI) infections constitute a major public health challenge in developing regions, primarily attributed to compromised sanitation and water safety. While bacterial pathogens are routinely isolated, parasitic etiologies are frequently underdiagnosed due to inconsistent screening protocols. In the Indian context, this diagnostic limitation often results in empirical antimicrobial misuse, as clinical differentiation between these agents is difficult. Furthermore, environmental conditions in coastal districts like East Godavari facilitate soil-transmitted helminthiasis, establishing a concurrent burden of bacterial and parasitic disease. Consequently, standard diagnostic reliance on bacterial culture alone risks leaving parasitic infections untreated, necessitating integrated prevalence data to refine therapeutic strategies.
Aim: This study aimed to perform a comparative analysis of bacterial and parasitic etiologies in stool samples collected from patients presenting with GI infections at a tertiary care facility.
Methods: A cross-sectional observational study was conducted at the Department of Microbiology, KIMS & RF, Amalapuram. A total of 250 non-duplicate stool samples were processed. Bacterial isolation was performed using standard microbiological culture techniques, while parasitic detection utilised conventional microscopy and concentration methods.
Results: Of the 250 stool specimens evaluated, enteric pathogens were detected in 98 samples, corresponding to an overall prevalence of 39.2%. Bacterial etiologies constituted the preponderance of infections (24.0%), followed by parasitic infestations (13.2%) and mixed coinfections (2.0%). Pathogenic *Escherichia coli* (10.0%) and *Ancylostoma duodenale* (6.4%) were identified as the predominant bacterial and parasitic agents, respectively.Demographic analysis indicated that rural residence was the only significant predictor of infection ($p=0.002$), while age and gender showed no statistical significance
Conclusion: The predominance of *Escherichia coli* and *Ancylostoma duodenale*, significantly associated with rural residence, highlights a persistent dual burden of enteric disease driven by environmental sanitation gaps. These findings necessitate targeted rural WASH interventions and mandate the integration of parasitological screening with bacterial culture to prevent diagnostic oversight and antimicrobial misuse.

Keywords: *Gastrointestinal infections, Bacterial aetiology, Parasitic aetiology, Escherichia coli, Giardia lamblia, Amalapuram.*

INTRODUCTION

Gastrointestinal (GI) infections remain one of the most persistent public health challenges facing developing nations, accounting for a substantial proportion of outpatient morbidity and hospital admissions.[1] In Low- and Middle-Income Countries (LMICs), the burden of enteric disease is inextricably linked to environmental determinants, specifically inadequate sanitation infrastructure and limited access to potable water.[2] Within the Indian subcontinent, diarrheal diseases continue to be a leading cause of mortality and morbidity across all age groups, driven by a complex etiological spectrum that encompasses bacterial, viral, and parasitic agents.[3]

The bacterial epidemiology of acute gastroenteritis in India is well-documented. Pathogens such as *Escherichia coli*, *Salmonella* species, *Shigella* species, and *Vibrio cholerae* are frequently isolated from clinical specimens.[4] Among these, diarrheagenic *E. coli* strains have consistently emerged as dominant etiological agents, particularly in regions with compromised water safety.[5] Consequently, clinical management protocols often rely heavily on empirical antibacterial therapy.[6] However, this bacterial-centric focus frequently obscures the role of parasitic pathogens, which contribute significantly to both acute dysentery and chronic enteropathy.[7]

Parasitic infestations, particularly those caused by Soil-Transmitted Helminths (STHs) like *Ancylostoma duodenale* and *Ascaris lumbricoides*, as well as protozoa such as *Entamoeba histolytica*, present a distinct challenge.[8] Unlike self-limiting bacterial infections, parasitic burdens often result in long-term nutritional deficits, anemia, and growth retardation if left untreated.[9] This is of particular relevance to the East Godavari district and the Konaseema region, where the tropical climate, high water table, and predominantly agrarian economy create optimal conditions for the transmission of helminths and waterborne protozoa.[10]

Despite this dual burden, a critical diagnostic gap exists in routine clinical practice. Standard investigation of gastroenteritis frequently prioritizes bacterial culture and sensitivity testing, while parasitological examination is often relegated to a secondary status or omitted entirely unless specifically requested.[11] This diagnostic imbalance risks the underdiagnosis of parasitic mono-infections and mixed coinfections, potentially leading to the inappropriate use of antibiotics and the progression of untreated parasitic disease.[12]

Current literature from India typically addresses these etiologies in isolation—focusing either exclusively on bacterial enteric pathogens or conducting community surveys for parasitic prevalence.[13] There is a paucity of comparative hospital-based studies that simultaneously evaluate the prevalence of both bacterial and parasitic agents within the same symptomatic patient population.[14] Addressing this gap is essential for refining syndromic management guidelines.

Therefore, this study was undertaken at a tertiary care teaching hospital in Amalapuram to conduct a comparative analysis of bacterial and parasitic etiologies in patients presenting with gastrointestinal symptoms. By establishing the region-specific prevalence of organisms such as *E. coli* and *Ancylostoma duodenale*, this research aims to inform more comprehensive diagnostic strategies and promote rational therapeutic interventions suited to the local epidemiological context.

AIM AND OBJECTIVES

Aim

The primary objective of this study was to evaluate and compare the prevalence of bacterial and parasitic etiologies among patients presenting with symptomatic gastrointestinal infections at a tertiary care centre in Amalapuram.

Objectives

1. To isolate and characterize enteric bacterial pathogens (specifically *Escherichia coli*, *Salmonella*, and *Shigella* species) and parasitic agents (protozoa and soil-transmitted helminths) from stool specimens using conventional culture and concentration techniques.
2. To determine the proportional distribution of bacterial versus parasitic infections to establish the predominant etiology within the local patient population.
3. To correlate infection positivity with sociodemographic variables, specifically examining the statistical association between disease prevalence and rural versus urban residence, age, and gender.
4. To identify the frequency of concurrent infections, specifically documenting cases of mixed bacterial and parasitic etiology to highlight potential diagnostic complexities.

MATERIAL AND METHODS

Study Design and Setting

This cross-sectional observational study was conducted at the Department of Microbiology, Konaseema Institute of Medical Sciences (KIMS) and Research Foundation, Amalapuram.

Study Population

The study included patients presenting with clinical features indicative of gastrointestinal infection, including diarrhea, dysentery, and abdominal pain. A total of 250 non-duplicate stool samples were collected for analysis.

Sample Processing

Bacteriological Analysis: Stool specimens were inoculated onto selective and differential media, including Blood Agar, MacConkey Agar, Xylose Lysine Deoxycholate (XLD) Agar, Deoxycholate Citrate Agar, and Bile Salt Agar.[15] The plates were incubated for 18-24 hours at 37°C. Suspected colonies were subjected to preliminary tests like Gram's staining, hanging drop for motility, catalase, and oxidase tests. Their identity was established by biochemical tests like: fermentation of a variety of sugars, indole test, citrate utilization, urease production, MR and VP tests, and TSI test.[16]

Parasitological Analysis: Specimens were subjected to macroscopic examination to detect the presence of mucus, blood, or adult worms. Microscopic evaluation included direct saline and iodine wet mounts. To enhance diagnostic sensitivity, the formol-ether concentration technique was employed for all samples.[17]

Statistical Analysis

Data were analyzed using standard statistical software. Categorical variables were presented as frequencies and percentages. Comparative analysis was performed using the Chi-square test, with a p-value < 0.05 considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee at Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram. Informed consent was obtained from all participants before sample collection.

RESULTS

Demographic and Clinical Characteristics

Out of 250 stool specimens processed, 98 (39.2%) were positive for enteric pathogens. Statistical analysis identified residence as the only significant demographic predictor of infection (p=0.002). Participants living in rural areas had a positivity rate of 47.4% (72/152), which was significantly higher than the 26.5% (26/98) observed in urban participants.

In contrast, age was not a statistically significant factor (p=0.445). Although the infection rate rose from 20.0% in children under five to 41.2% in adults (age >15 years), these differences were not statistically distinct. Similarly, gender did not significantly influence infection rates (p=0.237), with males (42.6%) and females (34.3%) showing comparable prevalence.

Table 1: Demographic and Clinical Profile (n = 250)

Variable	Total (n=250)	Bacterial Only (n=60)	Parasitic Only (n=33)	Mixed Infection (n=5)	p-value
Age Group					
<5 Years	5	1	0	-------	
5–14 Years	58	10	9	1	
≥15 Years	187	49	24	4	
Sex					
Male	148	39	21	3	
Female	102	21	12	2	
Residence					
Rural	152	43	25	4	
Urban	98	17	8	1	

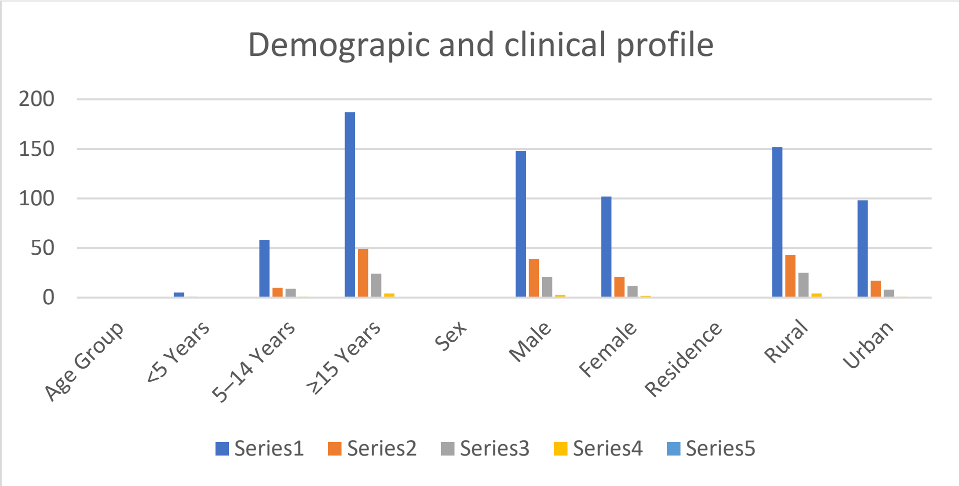

Figure 1.Demographic distribution and etiological profile of study participants.

The bar chart illustrates the stratification of the study population (N=250) by age, gender, and residence. Series 1 represents the total number of participants; Series 2 denotes bacterial infections; Series 3 represents parasitic infections; and Series 4 indicates mixed coinfections. The data highlights a higher burden of infection in adults (age>15 years), males, and rural residents.

Etiological Distribution

Bacterial infections were the predominant etiology, accounting for 24.0% (60/250) of the total sample. Pathogenic Escherichia coli was the most frequently isolated organism (10.0%), followed by other enteric bacteria (12.0%). Shigella flexneri (1.2%) and Salmonella enterica ser. Typhi (0.8%) were detected less frequently.

Parasitic agents were identified in 13.2% (33/250) of the study population. The soil-transmitted helminths *Ancylostoma duodenale* (6.4%) and *Ascaris lumbricoides* (3.6%) were the most common parasitic isolates. Co-infections involving both bacterial and parasitic pathogens were rare, occurring in only 2.0% (5/250) of cases.

Table 2: Prevalence of Bacterial Isolates

Bacterial Isolate	**Number (60)**	**Percentage (%)**
Escherichia coli (Pathogenic)	25	10.0
Salmonella enterica ser. Typhi	02	0.8
Shigella flexneri	03	1.2
Other enteric bacteria	30	12.0
Total	60	24

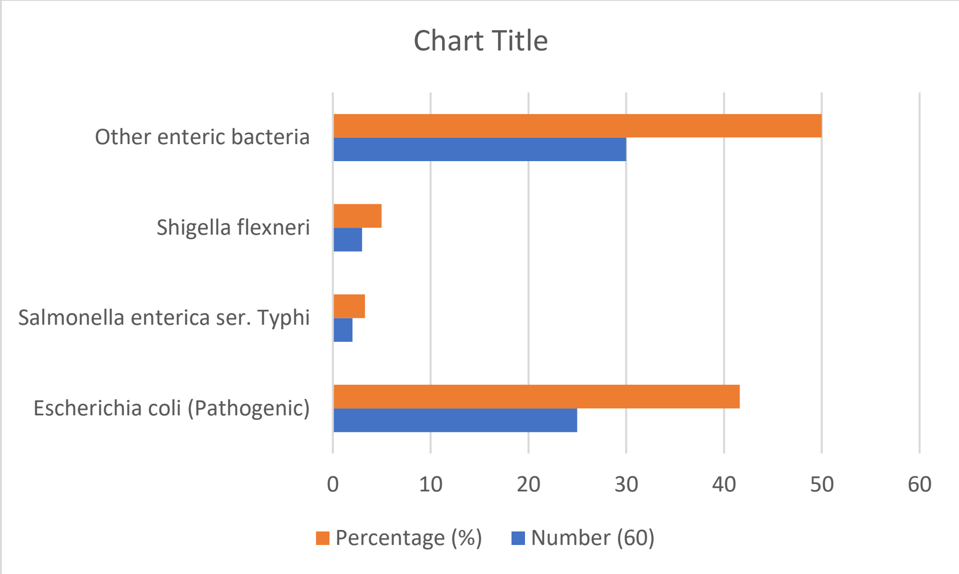

Figure 2: Distribution of isolated bacterial pathogens illustrating the predominance of *Escherichia coli* and other enteric bacteria among the positive samples (N=60)

Table 3:Distribution of parasitic etiological agents isolated from the study population (N=250).

Parasitic Isolate	***N (33)***	***Percentage (%)***
Giardia lamblia	*02*	*0.8*
Entamoeba histolytica	*04*	*1.6*
Ascaris lumbricoides	*09*	*3.6*
Ancylostoma duodenale	*16*	*6.4*
Strongyloidesstercoralis	*02*	*0.8*
Total	*33*	*13.2*

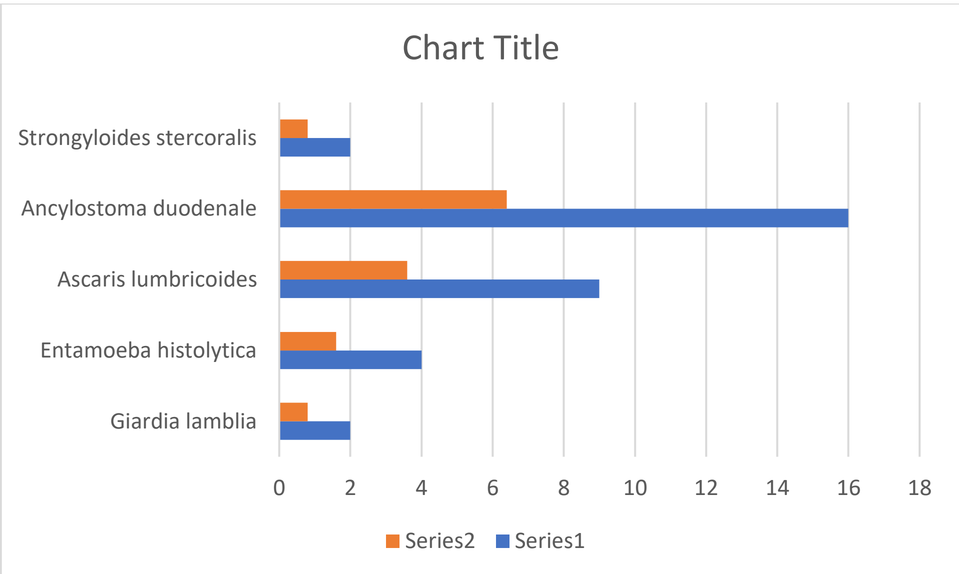

Figure 3: Frequency distribution of parasitic pathogens (N=33), illustrating the predominance of the soil-transmitted helminth Ancylostoma duodenale (6.4%) followed by Ascaris lumbricoides (3.6%).

Table 4: Profile of concurrent bacterial and parasitic mixed infections detected in the study (n=5).

Parasitic Isolates and bacteria (Mixed infections)	***N (5)***	***Percentage (%)***
Ancylostoma duodenale and E.coli	*02*	*0.8*
Ascaris lumbricoides and Other enterobacteria	*03*	*1.2*
Total	*05*	*2.0*

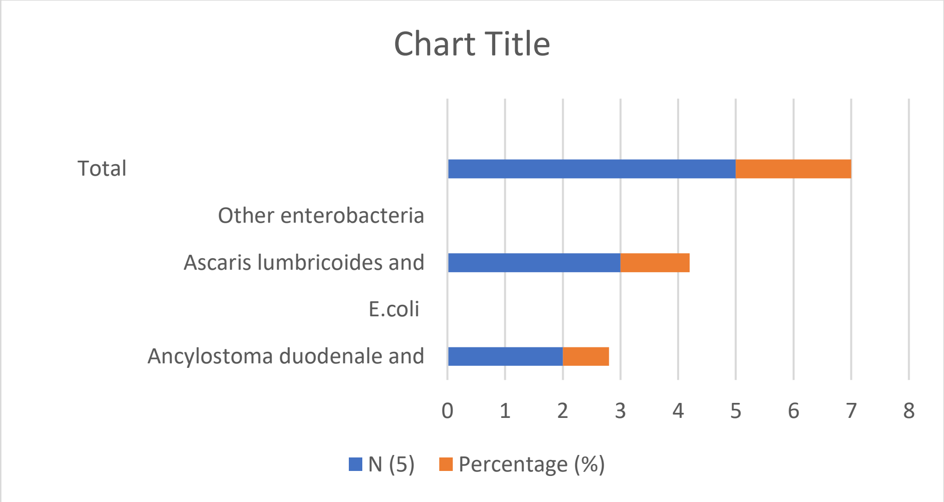

Figure 4: Distribution of mixed coinfections, illustrating the specific overlap between soil-transmitted helminths (Ancylostoma duodenale, Ascaris lumbricoides) and enteric bacteria.

DISCUSSION

Our analysis revealed that 39.2% of the processed stool samples contained enteric pathogens, with bacterial infections (24.0%) occurring more frequently than parasitic ones (13.2%). This pattern mirrors trends seen in other Indian tertiary care studies, where bacteria typically drive the majority of acute gastroenteritis cases.[18]

Among bacterial isolates, pathogenic *Escherichia coli* was the most common agent, comprising 10.0% of the total samples. This finding supports existing national data indicating that *E. coli* remains a leading cause of endemic diarrhea, likely due to persistent issues with water safety and fecal-oral transmission.[19] In contrast, we isolated *Shigella flexneri* (1.2%) and *Salmonella enterica* ser. Typhi (0.8%) at much lower rates. These lower figures may reflect specific local epidemiological conditions in the Konaseema region or seasonal variations at the time of sample collection.[20]

A key observation in this study was the high frequency of the soil-transmitted helminth *Ancylostoma duodenale* (6.4%), which was more prevalent than common protozoa like *Entamoeba histolytica* (1.6%) or *Giardia lamblia* (0.8%). While urban-focused research often cites *Giardia* as the primary parasite,[21] our data highlights a distinct burden of worm infestations in this population. This is directly supported by our demographic analysis, which showed that living in a rural area was the only significant risk factor for infection ($p=0.002$). The sharp contrast in positivity between rural (47.4%) and urban (26.5%) participants suggests that environmental factors, such as farming activities and inadequate sanitation infrastructure, play a critical role in sustaining these infections.[22]

We also detected concurrent bacterial and parasitic coinfections in 2.0% of cases. Although these mixed infections are rare, they are clinically significant because standard antibiotic treatments do not address the underlying parasitic burden.[23]For instance, we found cases where *Ancylostoma duodenale* co-occurred with *E. coli*, necessitating a more comprehensive treatment approach.[24]

Regarding demographics, infection rates were statistically similar across all age groups ($p=0.445$) and between genders ($p=0.237$). This implies that exposure to these pathogens is widespread in the community and not limited to a specific group.[25] However, the study has limitations; specifically, the small number of children under five years ($n=5$) makes it difficult to fully assess susceptibility in early childhood.[26] Additionally, since this was a cross-sectional study using culture and microscopy, we could not evaluate viral causes or track a specific transmission source.[27]

Implications

The high prevalence of enteric infection (39.2%) observed in this study is driven largely by bacterial pathogens (24.0%), notably pathogenic E. coli, rather than parasites (13.2%). This distribution suggests that water and food safety issues are the dominant transmission vectors. Rural residence emerged as the only significant risk factor ($p=0.002$), reflecting likely gaps in sanitation infrastructure in these areas. While less common, the detection of Ancylostoma duodenale indicates that soil-transmitted helminthiasis remains a relevant concern. Interestingly, infection rates were comparable across all age groups, suggesting widespread environmental exposure affects the entire population.

Study Limitations

While this study successfully characterizes the burden of both bacterial and parasitic agents, the small number of participants under five years of age limits conclusions regarding early-childhood susceptibility. Furthermore, the cross-sectional nature of the data precludes causal analysis of specific transmission sources.

CONCLUSION

This study confirms that enteric infections are highly prevalent and disproportionately affect rural residents. Intervention strategies should focus on rural WASH improvements. Future studies require larger sample sizes for children under five and should employ molecular techniques to refine pathogen identification.[28,29]

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