e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(4); 1216-1223

Original Research Article

Immunocompromised Patients and Parasitic Infections: A Cross-Sectional Study

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Received: 12-02-2024 / Revised: 13-03-2024 / Accepted: 15-04-2024
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Conflict of interest: Nil

Abstract:

Background: Parasitic infections pose a significant global health threat, especially in immunocompromised individuals. Immunosuppressive therapies for autoimmune diseases, organ transplants, and malignancies increase susceptibility to parasitic infections. Socio-demographic factors like living conditions and healthcare access also influence infection rates. Protozoa like Cryptosporidium and helminths such as Strongyloides stercoralis are common pathogens in immunosuppressed patients. This study aimed to assess parasite prevalence and its association with clinico-social variables to perform targeted interventions for disease control and management.

Methods: This cross-sectional observational study, conducted at a tertiary care center in North India over two years (November 2021 to October 2023), examined stool samples from immunosuppressed patients. Patients aged ≥18 years, receiving immunosuppressive therapy or with documented immunocompromised status, were included. Data on socio-demographics, medical history, and risk factors were collected via structured questionnaires. Laboratory investigations included parasitological and serological examinations. Statistical analysis comprised descriptive statistics, prevalence estimation, and chi-square tests ($p < 0.05$), ensuring accuracy and reliability of results.

Results: In our study, 264 immunocompromised patients were enrolled. Tuberculosis (31.1%), HIV infection (18.9%), and diabetes mellitus (20.1%) were prevalent. Parasitic infections were detected in 62 patients (23.5%). Giardia lamblia (8.0%) and Ascaris lumbricoides (4.5%) were predominant. Significant associations were found between parasitic infections and age ($p = 0.0003$), consumption of contaminated food or water ($p < 0.0001$), contact with soil or feces ($p = 0.001$), exposure to pets or livestock ($p = 0.0004$), and participation in outdoor recreational activities ($p = 0.0005$). Laboratory parameters indicated alterations in hemoglobin, white blood cell count, platelet count, liver and renal function tests, and immunoglobulin levels among parasite-positive individuals.

Conclusion: The findings suggest the need for targeted interventions, including proactive screening, preventive measures, and timely management of parasitic infections in immunosuppressed populations.

Keywords: Immunosuppression, Parasite, Tuberculosis, Transplantation, Helminths.

Introduction

Parasitic infections remain a significant global health concern, particularly in populations with compromised immune systems. Immunosuppressive conditions, whether induced by medical intervention or underlying diseases, pose a heightened risk for acquiring and experiencing severe manifestations of parasitic infections [1].

Despite advancements in healthcare and medical interventions, parasitic diseases continue to affect millions worldwide, especially in regions with inadequate sanitation, poor healthcare access, and socio-economic disparities [2]. Immunosuppressive therapies are commonly employed in various medical settings to manage autoimmune diseases, prevent organ rejection post-transplantation, and treat malignancies.

While these interventions are crucial for patient care, they can significantly weaken the immune system, leaving individuals vulnerable to opportunistic infections, including parasitic infections [3]. Moreover, the socio-demographic background of individuals plays a pivotal role in determining their susceptibility to parasitic infections, influenced by factors such as living conditions, access to clean water and sanitation, nutritional status, and healthcare resources [4].

Several parasitic organisms including protozoa and helminths have been identified as causative agents of infections in immunocompromised individuals. Protozoan parasites like Cryptosporidium, Toxoplasma gondii and Giardia lamblia along with helminthic parasites such as Strongyloides stercoralis, Ascaris lumbricoides, and Schistosoma spp., are among the most prevalent pathogens encountered in this population [5,6,7]. These parasites can cause a spectrum of clinical manifestations ranging from asymptomatic carriage to severe systemic illness depending on factors such as parasite load, immune status of the host and concurrent medical conditions [8].

Understanding the epidemiology and clinical implications of parasitic infections in immunosuppressed patients is essential for guiding diagnostic and therapeutic strategies, as well as implementing preventive measures to reduce morbidity and mortality associated with these conditions [9]. Additionally, investigating the socio-demographic determinants of parasitic infections in this population can provide valuable insights into the underlying risk factors and inform targeted interventions aimed at mitigating disease burden [10,11]. Therefore, this study aimed to assess the prevalence of parasitic infections among immunosuppressed patients and to explore the association between infection rates and clinicosocial variables, including age, gender, socio-economic status, educational level, and living conditions. By elucidating the complex interplay between host susceptibility, parasite exposure, and socio-demographic factors, this research endeavors to contribute to the development of more effective prevention and control strategies for parasitic diseases in immunocompromised populations.

Materials and Methods

Study Design and Setting: This cross-sectional observational study was conducted in the department of Microbiology of the tertiary care center of North India, for a period of 2 years between July 2021 to June 2023 among the Patients with a confirmed diagnosis of immunosuppression whose stool sample for examination was received in the department.

Study Participants: Participants were selected based on specific eligibility criteria to ensure the relevance and reliability of the study findings. Inclusion criteria encompassed immunosuppressive patients aged 18 years and above, irrespective of gender or ethnic background, who were either receiving immunosuppressive therapy or had a documented immunocompromised status due to underlying medical conditions. Patients with a confirmed diagnosis of immunosuppression, such as organ transplant recipients, individuals undergoing chemotherapy or radiation therapy for malignancies, and those with autoimmune diseases requiring immunosuppressive medications, were included in the study. Exclusion criteria were defined to minimize confounding factors and ensure the homogeneity of the study population. Patients with a history of recent parasitic infections or receiving treatment for parasitic diseases within the past six months were excluded from participation. Additionally, individuals with severe systemic illness or conditions precluding participation in study procedures, such as cognitive impairment or psychiatric disorders, were excluded. Participants were included from various departments within the healthcare facility, including outpatient clinics, inpatient wards and specialized immunology or transplant units. Prior to enrollment in the study, potential participants were provided with detailed information about the study objectives, procedures, potential risks and benefits, and their rights as research subjects. Informed consent was obtained voluntarily from each participant or their legally authorized representative after addressing any queries or concerns they may have had. Participants were assured of the confidentiality and anonymity of their data and given the option to withdraw from the study at any time without repercussions.

Data Collection: A structured questionnaire was administered to participants to collect detailed socio-demographic data. This included age, gender, marital status, occupation, household income, educational level, and residential area. Additionally, information regarding access to clean water and sanitation facilities, presence of domestic animals, and recent travel history to endemic regions was recorded. Relevant clinical information pertaining to participants' medical history was obtained from medical records. This included underlying medical conditions necessitating immunosuppressive therapy, duration and type of immunosuppressive treatment, concurrent medications, history of previous parasitic infections, and any recent symptoms suggestive of parasitic disease.

Participants were queried about potential risk factors associated with parasitic infections, such as consumption of contaminated food or water, contact with soil or feces, exposure to pets or livestock, and participation in outdoor recreational activities. Anthropometric measurements including height and weight were obtained using standardized techniques. Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared, and nutritional status was classified according to established criteria. In addition to stool and serum sample collection for parasitological and serological examinations, other laboratory investigations were conducted to assess participants' immune status and general health parameters. These included complete blood count (CBC), liver and renal function tests, and measurement of immunoglobulin levels.

Parasitological Examination: Stool samples were collected from participants using sterile containers and were transported to the laboratory under appropriate storage conditions. Upon receipt, stool specimens were processed for the detection of intestinal parasites using a comprehensive approach:

A. **Direct Microscopic Examination:** Fresh stool samples were examined microscopically using saline and iodine mounts to detect the presence of parasite eggs, cysts, or trophozoites and larvae. The examination was performed at various magnifications to enhance sensitivity.
B. **Concentration Methods:** To enhance the detection of parasitic elements, stool samples were subjected to concentration techniques such as sedimentation and flotation. Sedimentation involved the centrifugation of stool suspensions followed by examination of the sediment for parasite eggs, larvae, or cysts. Flotation techniques utilized flotation solutions (e.g., zinc sulfate) to float parasite eggs to the surface, facilitating their visualization under the microscope.
C. **Specific Staining Techniques:** Specialized staining methods were employed for the identification of specific parasites. Modified acid-fast staining was utilized for the detection of Cryptosporidium spp., providing enhanced contrast for oocysts visualization. Other staining techniques, such as trichrome stain and iron-hematoxylin stain, were used for the identification of protozoan parasites like Giardia lamblia and Entamoeba histolytica.
D. **Serological Tests:** In addition to stool examination, serum samples were collected from participants and subjected to serological testing for the detection of antibodies against selected parasitic antigens.

Enzyme-linked immunosorbent assay (ELISA) and immunofluorescence assay (IFA) were commonly employed techniques for serodiagnosis, offering high sensitivity and specificity for detecting parasitic infections. All parasitological examinations were performed by experienced laboratory technologists following standard operating procedures to ensure accuracy and reliability of results. Quality control measures, including the use of positive and negative controls, were implemented to monitor the performance of laboratory tests. Positive findings were confirmed by repeat testing or by consultation with a parasitologist, when necessary.

Statistical Analysis: Data analysis was conducted using appropriate SPSS version 20.0, including descriptive statistics to summarize demographic and clinical characteristics of the study population, prevalence estimation for parasitic infections, and inferential statistics (chi-square test) to assess the association between parasitic infections and socio-demographic variables. Statistical significance was set at $p < 0.05$.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee of the Institution.

Results

In our study a total of 264 immunocompromised patients were enrolled during defined period of study. Autoimmune diseases, organ transplantation, and chemotherapy were present in 9.8%, 10.2%, and 9.8% of individuals, respectively. Notably, tuberculosis (TB) exhibited the highest prevalence at 31.1%, followed by Human Immunodeficiency Virus (HIV) infection at 18.9%, and diabetes mellitus at 20.1%. Overall, 62 out of 264 participants (23.5%) tested positive for parasitic infections.

The most prevalent protozoan parasites were Giardia lamblia (8.0%) followed by Cryptosporidium spp. (5.3%) and Entamoeba histolytica (3.4%). Among helminths, Ascaris lumbricoides (4.5%) showed the highest prevalence, followed by Strongyloides stercoralis (3.0%) and other intestinal helminths (2.3%) (Table 1).

Table 1: Findings of Parasitological Examination Among Study Participants (N=264)

Parasite Species	**Frequency**	**%**
Protozoa		
Cryptosporidium spp.	14	5.3
Giardia lamblia	21	8.0
Entamoeba histolytica	9	3.4
Helminths		
Strongyloides stercoralis	8	3.0
Ascaris lumbricoides	12	4.5
Other Intestinal Helminths	6	2.3
Total	62	23.5

The analysis of various demographic and environmental variables revealed significant associations with parasitic infection among the study participants. Individuals with parasitic infections were found to be significantly older than those without (46.5 ± 9.5 years vs. 41.5 ± 9.5 years, p = 0.0003). Marital status showed a statistically significant difference between the two groups, with a higher proportion of married individuals in the parasite-absent group compared to the parasite-present group (p = 0.046). Occupation also demonstrated a near-significant association, with a slightly higher prevalence of working individuals among those with parasites (p = 0.055). Notably, several environmental factors exhibited significant associations with parasitic infection. Consumption of contaminated food or water (p < 0.0001), contact with soil or feces (p = 0.001), exposure to pets or livestock (p = 0.0004), and participation in outdoor recreational activities (p = 0.0005) were all significantly associated with the presence of parasites (Table 2).

Table 2: Comparison of Demographic and Environmental Characteristics of Study Participants Stratified by Parasite Status (N=264)

Variables	Parasite Present (n=62)	Parasite Absent (n=202)	P value
	Frequency (%)/ Mean ± SD		
Age	46.5 ± 9.5	41.5 ± 9.5	0.0003
Gender			
Male	45 (72.6%)	125 (61.9%)	0.123
Female	17 (27.4%)	77 (38.1%)	
Marital Status			
Single	19 (30.6%)	71 (35.1%)	0.046
Married	34 (54.8%)	131 (64.9%)	
Divorced/Widowed	5 (8.1%)	4 (2.0%)	
Occupation			
Working	28 (45.2%)	96 (47.5%)	0.055
Homemaker/Not working	11 (17.7%)	29 (14.4%)	
Student	22 (35.5%)	49 (24.3%)	
Retired	1 (1.6%)	16 (7.9%)	
Others	0 (0.0%)	12 (5.9%)	
Household Income			
Low	33 (53.2%)	118 (58.4%)	0.287
Middle	22 (35.5%)	52 (25.7%)	
High	7 (11.3%)	32 (15.8%)	
Educational Level			
Primary or below	21 (33.9%)	59 (29.2%)	0.542
Middle/Secondary/Higher secondary	31 (50.0%)	98 (48.5%)	
Graduation or above	10 (16.1%)	45 (22.3%)	
Residential Area			
Urban	43 (69.4%)	128 (63.4%)	0.387
Rural	19 (30.6%)	74 (36.6%)	
Access to Clean Water			
Yes	48 (77.4%)	173 (85.6%)	0.125
No	14 (22.6%)	29 (14.4%)	
Sanitation Facilities			
Adequate	53 (85.5%)	181 (89.6%)	0.371
Inadequate	9 (14.5%)	21 (10.4%)	
Presence of Domestic Animals			
Yes	32 (51.6%)	93 (46.0%)	0.442
No	30 (48.4%)	109 (54.0%)	
Travel History to Endemic Regions			
Yes	17 (27.4%)	36 (17.8%)	0.098
No	45 (72.6%)	166 (82.2%)	
Consumption of Contaminated Food or Water			
Yes	40 (64.5%)	60 (29.7%)	<0.0001
No	22 (35.5%)	142 (70.3%)	
Contact with Soil or Faeces			

Yes	18 (29.0%)	24 (11.9%)	0.001
No	44 (71.0%)	178 (88.1%)	
Exposure to Pets or Livestock			
Yes	20 (32.3%)	26 (12.9%)	0.0004
No	42 (67.7%)	176 (87.1%)	
Participation in Outdoor Recreational Activities			
Yes	24 (38.7%)	36 (17.8%)	0.0005
No	38 (61.3%)	166 (82.2%)	

The analysis of medical and clinical factors revealed significant associations with parasitic infection. While frequencies of underlying medical conditions such as autoimmune diseases, organ transplantation, chemotherapy, tuberculosis (TB), Human Immunodeficiency Virus (HIV), and diabetes mellitus (DM) showed no significant differences between groups (p > 0.05), individuals with parasitic infections had a longer duration of immunosuppressive treatment (16.5 ± 6.2 months vs. 14.8 ± 5.7 months, p = 0.045), a higher prevalence of previous parasitic infections (29.0% vs. 12.9%, p = 0.002), and a greater likelihood of presenting symptoms suggestive of parasitic disease (45.2% vs. 15.8%, p < 0.0001). Differences in height (p = 0.037) and weight (p = 0.066) were observed, though BMI did not show significant differences (p = 0.279) (Table 3).

Table 3: Clinical Characteristics of Study Participants Stratified by Parasite Status (N=264)

Variables	**Parasite Present (n=62)**	**Parasite Absent (n=202)**	**P value**
	Frequency (%)/ Mean ± SD		
Underlying Medical Conditions			
Autoimmune Diseases	4 (6.5)	22 (6.5)	0.833
Organ Transplantation	6 (9.7)	21 (9.7)	
Chemotherapy	8 (12.9)	18 (8.9)	
Tuberculosis (TB)	18 (29.0)	64 (31.7)	
Human Immunodeficiency Virus (HIV)	12 (19.3)	38 (18.8)	
Diabetes Mellitus (DM)	14 (22.6)	39 (19.3)	
Duration of Immunosuppressive Treatment (months)	16.5 ± 6.2	14.8 ± 5.7	0.045
History of Previous Parasitic Infections			
Yes	18 (29.0)	26 (12.9)	0.002
No	44 (71.0)	176 (87.1)	
Symptoms Suggestive of Parasitic Disease			
Yes	28 (45.2)	32 (15.8)	<0.0001
No	34 (54.8)	170 (84.2)	
Height (cm)	165.3 ± 7.2	167.8 ± 8.5	0.037
Weight (kg)	62.5 ± 9.8	65.2 ± 10.2	0.066
Body Mass Index (Kg/m^2)	22.9 ± 3.1	23.4 ± 3.2	0.279

Individuals with parasitic infections displayed significant alterations in laboratory parameters compared to those without. Parasite-positive individuals exhibited lower hemoglobin levels, elevated white blood cell counts, and reduced platelet counts. Liver function tests indicated higher alanine aminotransferase and alkaline phosphatase levels in parasite-positive individuals. Renal function tests showed elevated blood urea nitrogen and serum creatinine levels, alongside reduced glomerular filtration rates in parasite-positive individuals. Moreover, parasite-positive individuals demonstrated elevated IgG and IgM levels (Table 4).

Table 4: Laboratory Test findings Among Study Participants (N=264)

Variables	**Parasite Present (n=62)**	**Parasite Absent (n=202)**	**P value**
	Mean ± SD		
Complete Blood Count (CBC)			
Hemoglobin (g/dL)	10.5 ± 2.2	11.2 ± 2.0	0.019
White Blood Cell Count (x10^3/μL)	7.8 ± 2.1	7.2 ± 1.5	0.013
Platelet Count (x10^3/μL)	246.3 ± 47.4	261.7 ± 53.6	0.043
Liver Function Tests			

Alanine Aminotransferase (IU/L)	26.2 ± 11.9	22.6 ± 8.8	0.010
Aspartate Aminotransferase (IU/L)	30.1 ± 12.2	28.6 ± 10.3	0.338
Alkaline Phosphatase (IU/L)	82.3 ± 22.1	75.2 ± 18.5	0.012
Total Bilirubin (mg/dL)	1.0 ± 0.3	0.9 ± 0.4	0.070
Renal Function Tests			
Blood Urea Nitrogen (mg/dL)	21.2 ± 5.9	18.3 ± 4.6	0.0001
Serum Creatinine (mg/dL)	0.9 ± 0.2	0.8 ± 0.1	< 0.0001
GFR (mL/min/1.73m²)	89.3 ± 10.3	95.8 ± 8.6	< 0.0001
Immunoglobulin Levels			
IgG (mg/dL)	1289.2 ± 210.3	1151.8 ± 183.2	< 0.0001
IgA (mg/dL)	201.3 ± 47.2	198.2 ± 35.4	0.579
IgM (mg/dL)	156.2 ± 30.6	143.6 ± 24.5	0.001

Discussion

The present study sheds light on the prevalence of parasitic infections among immunosuppressive patients and explores their association with socio-demographic factors and clinical parameters. Our findings reveal a considerable prevalence of parasitic infections (23.5%) among immunosuppressed individuals, corroborating previous studies by Missaye et al., Sherpa et al., Anand et al., Saraswathi et al., and Kinani et al., that have highlighted the heightened susceptibility of this population to parasitic diseases [12-16]. The high prevalence underscores the importance of vigilance and proactive screening for parasitic infections in immunosuppressed patients, as these infections can lead to significant morbidity and mortality if left untreated [17-19].

The association between parasitic infections and various socio-demographic factors revealed several noteworthy findings. Older age was significantly associated with parasitic infections, which is consistent with previous research by Al-Megrin et al., Uppal et al., and Vaiyavatjamai et al., demonstrating age-related changes in immune function that may predispose older individuals to parasitic infections [20-22]. Additionally, marital status showed a significant association, with married individuals exhibiting a higher prevalence of parasitic infections compared to single or divorced/widowed individuals. This finding may reflect differences in exposure risks or transmission dynamics within marital relationships, warranting further investigation [23,24].

Occupational factors also demonstrated notable associations with parasitic infections. While the association between occupation and parasitic infections did not reach statistical significance in our study, there was a trend towards higher prevalence among working individuals.

Occupational exposures, such as contact with soil or contaminated water, may contribute to the increased risk of parasitic infections in certain occupational settings [25-28]. Future studies incorporating detailed occupational histories and exposure assessments are warranted to elucidate the role of occupation in parasitic infection risk among immunosuppressed individuals [29-31].

Furthermore, environmental factors such as access to clean water, sanitation facilities, and exposure to domestic animals or livestock showed no significant associations with parasitic infections in our study. These findings contrast with previous studies Srirangaraj et al., Azami et al., and Adams et al., highlighting the importance of environmental factors in the transmission of parasitic infections [32-34]. However, it is important to note that our study may have been underpowered to detect small but clinically significant associations, and further research with larger sample sizes is needed to explore these relationships.

The clinical parameters assessed in our study provided valuable insights into the impact of parasitic infections on hematological, hepatic, renal, and immunological parameters among immunosuppressed individuals. Individuals with parasitic infections exhibited significant alterations in laboratory parameters indicative of hematological and hepatic dysfunction, as well as renal impairment. These findings underscore the systemic impact of parasitic infections on physiological parameters and highlight the importance of comprehensive clinical evaluation in immunosuppressed patients presenting with suspected parasitic infections [35-37].

Limitations of the study: The study has several limitations that should be considered when interpreting the results. Firstly, the cross-sectional design limits the establishment of causality between parasitic infections and associated factors. Additionally, the study was conducted at a single center, potentially limiting the generalizability of findings to broader populations. The reliance on self-reported data may introduce recall bias, impacting the accuracy of certain variables. Furthermore, the exclusion of patients with severe systemic illness may have led to underrepresentation of the most vulnerable individuals. Lastly, the use of serological tests for parasite detection may have yielded false-negative results in some cases, affecting the accuracy of prevalence estimates.

Conclusion

In conclusion, our study contributes to the growing body of literature on parasitic infections in immunosuppressive patients and provides valuable insights into the epidemiology, risk factors, and clinical implications of these infections. The findings suggest the need for targeted interventions, including proactive screening, preventive measures, and timely management of parasitic infections in immunosuppressed populations. Future research should focus on elucidating the mechanisms underlying the associations observed in this study and developing effective strategies for the prevention and control of parasitic infections in vulnerable populations.

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