DS (Child) H J 2024; 40(1): 46-50

ORIGINAL ARTICLE

Prevalence and Outcome of Fungal Infection Among Immunocompromized Children in A Tertiary Care Hospital

AKM Khairul Islam[1], Md. Abdul Wohab[2]

Abstract

Background: *Invasive fungal infections (IFIs) are a growing concern in critically ill and immunocompromised pediatric populations, particularly in low-resource settings. Factors such as prolonged hospitalization, use of broad-spectrum antibiotics, and hematologic malignancies contribute to increased risk. However, there is limited regional data from Bangladesh.*

Objective: *To assess the prevalence, spectrum, and outcomes of IFIs among immunocompromised children in a tertiary care hospital in Bangladesh.*

Methods: *This cross-sectional study was carried out at the Department of Paediatric Hemato-Oncology, Bangladesh Shishu Hospital & Institute, from October 2023 to March 2024. A total of 110 children under 18 years of age, with an absolute neutrophil count (ANC) below 500/μL and a fever persisting for more than 3-4 days, clinically suspected of having an invasive fungal infection, were enrolled in the study. Children over 18 years of age, those with normal eosinophil counts, or with no history of fever were excluded. Information on symptoms, test results, and outcomes was collected. Blood cultures and organ-specific samples were used to detect fungal infections.*

Results: *Among the 110 children, 27 (24.5%) were diagnosed by PCR as fungal infections. The majority (44.4%) were ≤5 years old, and 63.0% were male. Acute lymphoblastic leukemia was the most common comorbidity (63.0%). PCR was positive in 51.9% of cases. The predominant pathogens were Candida albicans (25.9%) and Aspergillus fumigatus (22.2%), followed by Mucor and Aspergillus flavus (14.8% each). An overall survival rate of 92.6% was observed.*

Conclusion: *Invasive fungal infections (IFIs) were identified in 24.5% of cases, with Candida and Aspergillus species being the most common pathogens. Early diagnosis and prompt initiation of targeted antifungal therapy were key factors in achieving favorable outcomes. The overall survival rate was high at 92.6%.*

Keywords: *Invasive fungal infections, immunocompromised children, leukemia, PCR,* candida albicans*,* aspergillus*, Bangladesh.*

1. Assistant Professor, Department of Emergency, Observation and Referral Unit. Bangladesh Shishu Hospital & Institute, Dhaka.
2. Associate Professor, Department of Paediatric Hemato-oncology, Bangladesh Shishu Hospital & Institute, Dhaka.

Correspondence to: Dr. AKM Khairul Islam, Assistant Professor, Emergency, Observation and Referral Unit, Bangladesh Shishu Hospital & Institute. Cell: 01712721744, E-mail: khairul38rmc@gmail.com

Received: 16 April 2024; **Accepted**: 30 May 2024

Introduction

Fungal infections, particularly invasive fungal infections (IFIs), have become an increasingly recognized problem in healthcare settings worldwide, especially among critically ill and immuno-compromised patients. Their prevalence is notably higher in Intensive Care Units (ICUs), where factors such as prolonged hospitalization, mechanical ventilation, indwelling devices, and the widespread use of broad-spectrum indiscrimination antibiotics contribute significantly to the risk of IFIs.[1] Despite this growing concern, there remains a scarcity of comprehensive regional data evaluating the incidence, associated factors, and outcomes of IFIs in tertiary care hospitals.

Broad-spectrum antibiotic usage has been strongly associated with the emergence of fungal infections by disrupting the normal microbial flora and promoting fungal overgrowth.[1] Neonates and immunocompromised children are particularly vulnerable, with Candida and Aspergillus species being among the most commonly implicated pathogens. Diagnosing IFIs remains a major challenge, especially in neonates and low-birth-weight infants, where early empirical antifungal therapy is often necessary due to the limitations of standard diagnostics.[2]

Recent data from Bangladesh identified approximately 11% probable IFIs among critically ill hospitalized children, including 4.53% with invasive candidiasis, 7.97% with aspergillosis, and 0.72% with histoplasmosis.[3] Globally, similar trends have been reported, with increasing incidence and mortality associated with fungal infections in both pediatric and adult ICU populations.[4,5] According to WHO, fungal infections are a growing public health threat, prompting the release of the Fungal Priority Pathogens List to guide research and action.[6] The burden of IFIs is further compounded by delays in diagnosis, antifungal resistance, and limited therapeutic options, all of which contribute to poor patient outcomes.[7-11]

This unique setting presents an opportunity to investigate the relationship between broad-spectrum antibiotic use and the incidence of IFIs in a tertiary care hospital. By generating localized data, this study aims to provide actionable insights to inform clinical decision-making, enhance antifungal stewardship, and improve patient safety and outcomes within critical care environments.

Materials and Methods

This study was done as an observational, cross sectional study from October 2023 to March 2024. The study was conducted at the Department of Paediatric Hemato-oncology, Bangladesh Shishu Hospital & Institute (BSHI). A total of 110 children under 18 years of age, with an absolute neutrophil count (ANC) below 500/μL and a fever persisting for more than 3–4 days, clinically suspected of having an invasive fungal infection, were enrolled in the study. Patients who were above 18 years of age, with normal eosinophil count, with no history of fever were excluded. Demographic information, clinical signs, risk factors, investigational data were recorded in a predesigned questionnaire. For blood culture, 1–3 mL of blood was collected. Additional relevant samples were obtained based on the suspected organ system involvement. These included tissue biopsies, skin scrapings, bronchoalveolar lavage, pleural fluid, sputum, cerebrospinal fluid (CSF), urine, and others as clinically indicated. Common molecular techniques include real-time PCR followed by DNA sequencing or pyrosequencing. Data was entered and analysed on SPSS version 25. Appropriate test was applied for both qualitative and quantitative data, $p<0.05$ was considered statistically significant

Results

Total 110 children conducted in the department of Paediatric Hemato-oncology of Bangladesh Shishu Hospital & institute during 6 months follow up. 27 children were fungal infection and their prevalence of 24.5% (Table I).

Table I
Prevalence of fungal infection in paediatric patients

	Number of patients
Total patients	110
Fungal infection	27
Percentage of fungal infection	24.5

Among the study population 44.4% were aged 5 years or younger, followed by 37.0% in the 5-10 year age group, and 18.5% were older than 10 years. In terms of gender distribution, **male children**

predominated, accounting for **63.0%** of the participants, while **females constituted 37.0%** (Table II).

Table II
Baseline characteristics of the study participants

	Frequency	Percentage
Age (years)		
0-5	12	44.4
5-10	10	37.0
>10	5	18.5
Sex		
Male	17	63.0
Female	10	37.0

Acute lymphoblastic leukemia (ALL) was more prevalence (63.0%) than acute myeloid leukemia (AML) (37.0%). Serum PCR for fungal pathogens was positive in 51.9% of cases, indicating a notable burden of IFIs. The mean WBC count was 65.99 ± 80.66 $\times 10^9$/L, showing considerable variation, likely due to the patients' underlying hematologic conditions (Table III).

Table III
Investigations of the study participants

Investigations	Frequency	Percentage
Type of acute leukemia		
ALL	17	63.0
AML	10	37.0
Serum PCR		
Positive	14	51.9
Negative	13	48.1
Total WBC count (x10^9/L)	65.99±80.66	

Sputum samples had the highest positivity in both fungal microscopy (25.93%) and culture (33.3%). Gastric aspirates also showed notable fungal presence on microscopy (7.41%) and culture (25.93%). Blood cultures were positive in 22.2% of cases despite negative microscopy. Lower detection rates were observed in oral swabs, bronchoalveolar lavage (BAL), endotracheal (ET) aspirates, stool, and urine. Interestingly, ET aspirates were positive on microscopy but yielded no growth in culture. Urine showed the highest fungal detection by microscopy among non-respiratory samples (11.1%) (Table IV).

Table IV
Fungal and culture profile

	Microscopy fungal	Culture
Blood	0	6 (22.2)
Sputum	9 (25.93)	9 (33.3)
Gastric aspirate	7 (7.41)	7 (25.93)
Oral swab	2 (3.70)	2 (7.41)
Bronchoalveolar lavage	1 (3.70)	1 (3.70)
ET aspirate	1 (3.70)	00
Stool	1 (3.70)	1 (3.70)
Urine	3 (11.1)	1 (3.70)

The most commonly isolated organism was Candida albicans, accounting for 25.9% of the infections, followed closely by Aspergillus fumigatus at 22.2%. Both Mucor and Aspergillus flavus were each identified in 14.8% of cases, indicating a notable presence of both mucormycosis and aspergillosis. Other Candida species were also isolated, including C. glabrata (11.1%), C. parapsilosis (7.4%), and C. crusei (3.7%) (Table V).

Table V
Pathogens of proven fungal infection (n=27)

Type of pathogens	Frequency	Percentage
C. albicans	7	25.9
Aspergillus fumigatus	6	22.2
Mucor	4	14.8
Aspergillus flavus	4	14.8
C. glabrata	3	11.1
C. parapsilosis	2	7.4
C. crusei	1	3.7

Out of 27 participants, **92.6% survived**, while **7.4% died**, indicating a **high overall survival rate** among the study population (Table VI).

Table VI
Outcome of the study participants

Outcome	Frequency	Percentage
Death	2	7.4
Survival	25	92.6

Discussion

In this study, the incidence of invasive fungal infections (IFIs) among immunocompromized children at Bangladesh Shishu Hospital & Institute was found to be 24.5%. For instance, Zawitkowska et al[10] reported a 21.5% incidence of fungal infections in pediatric patients with acute lymphoblastic leukemia during the COVID-19 pandemic in Poland, while Kalita et al[11] observed fungal growth in 58.04% of ICU samples in a tertiary care center in India. Similarly, Al Hajri et al[12] documented an incidence of 16.1% in a pediatric leukemia cohort in Oman, and Badiee et al[13] reported a 16.3% rate among children with hematologic neoplasms in Iran.

The present study showed that Candida albicans (25.9%) and Aspergillus fumigatus (22.2%) were the most common causative organisms, consistent with other studies. Bediee et al[13] also identified C.albicans and Aspergillus flavus as predominant agents,while Kalita et al[11] found C. albicans in 32.7% and A. fumigatus in 12.1% of isolates. The diversity of fungal pathogens observed reflects the importance of accurate species identification to guide targeted antifungal therapy.

The majority of children with IFIs in our study were under 5 years of age (44.4%) and male (63.0%). This demographic pattern is similar to that of Nathani et al[14] who noted a predominance of children aged 3-9 years and a male-to-female ratio of 2.93:1. Zawitkowska et al[10] and Kalita et al.[11] also reported a higher proportion of male patients in their cohorts.

Acute lymphoblastic leukemia (ALL) was the most common underlying malignancy in our study (63.0%), followed by acute myeloid leukemia (AML) (37.0%). This pattern is consistent with the findings of Badiee et al[13] and Al Hajri et al[12] both of whom identified ALL as the predominant diagnosis in children with IFIs.

In terms of diagnostic approach, serum PCR was positive in 51.9% of cases. Molecular diagnostics, including PCR-based techniques, have proven to be effective for early detection of IFIs, reducing the time required compared to traditional cultures.[7] Badiee et al[13] also demonstrated the value of real-time PCR, which was positive in 10 of their cases.

The overall mortality rate in our study was 7.4%, which is notably lower than the mortality rates reported in similar studies. Badiee et al[13] reported a 50% mortality rate among pediatric patients with IFIs, and Al Hajri et al[12] observed a 19% mortality rate. In contrast, Zawitkowska et al[10] documented a 5.1% mortality rate due to fungal infections, which is comparable to our findings. This relatively low mortality may reflect early diagnosis and prompt initiation of antifungal treatment in our setting.

The study findings emphasize the need for early suspicion and diagnosis of IFIs, particularly in neutropenic, critically ill, or oncologic paediatric patients. Given the rising incidence of fungal infections globally and the high associated morbidity and mortality, timely initiation of empirical antifungal therapy based on risk factors and local epidemiology is crucial.[15,16]

Conclusion

In conclusion, this study demonstrates a notable prevalence (24.5%) of invasive fungal infections (IFIs) in immunocompromised children. Candida albicans being the most frequently isolated. Despite the infection burden, the overall survival rate remained high at 92.6%.

References

1. Hadia R, Chauhan A, Thakkar B, Patel D, Bagban M, Rajput HS. Assessing the Impact of Broad-Spectrum Antibiotics on Fungal Infection Rates in ICU Patients: Implications for Patient Safety. *J Young Pharm* 2025;**17**:387-93.
2. Sharifi S, Mosayebi Z, Valizadeh M, Moghtaderi M. A Study of the Incidence and Outcome of Fungal Infections in the Neonatal Intensive Care Units; A Seven-year Surveillance. *J Pediatr Nephrol* 2024;**12**: E46525. DOI: 10.22037/jpn.v12i1.46525.
3. Shaly NJ, Pervez MM, Huq S, Ahmed D, Ahsan CR, Sarmin M, et al. Invasive fungal infections in under-five diarrheal children: experience from an urban diarrheal disease hospital. *Life* 2022;1**2**:94. DOI: 10.3390/life12010094.
4. Gupta A, Xess I, Soneja M, Keri VC, Sikka K, Siddharth V, et al. Audit for antifungal treatment usage in adults with invasive fungal infection: A prospective observational study. *Indian J Med Microbiol* 2025;**53:**100784. DOI: 10.1016/ j.ijmmb.2024.100784.
5. Kainz K, Bauer MA, Madeo F, Carmona-Gutierrez D. Fungal infections in humans: the silent crisis. *Microb Cell* 2020;**7**:143-45.

6. World Health Organization. WHO fungal priority pathogens list to guide research, development and public health action. Vol. 1. Geneva: WHO; 2022.

7. Fang W, Wu J, Cheng M, Zhu X, Du M, Chen C, et al. Diagnosis of invasive fungal infections: challenges and recent developments. *J Biomed Sci* 2023;**30**:42. DOI: 10.1186/s12929-023-00926-2.

8. Reddy GKK, Padmavathi AR, Nancharaiah YV. Fungal infections: pathogenesis, antifungals and alternate treatment approaches. *Curr Res Microb Sci* 2022;**3:**100137. DOI: 10.1016/j.crmicr.2022.100137.

9. Verweij PE, Chowdhary A, Melchers WJG, Meis JF. Azole resistance in *Aspergillus fumigatus*: Can we retain the clinical use of mold-active antifungal azoles? *Clin Infect Dis* 2016;**62**:362-68.

10. Zawitkowska J, Drabko K, Lejman M, Add another 3 authors name et al. Incidence of bacterial and fungal infections in Polish pediatric patients with acute lymphoblastic leukemia during the pandemic. *Sci Rep* 2023;**13**(1):22619. DOI: 10.1038/s41598-023-50093-5.

11. Kalita K, Sarwat T, Mahajan S, Kowalczyk A, Czy¿ewski K, Dziedzic M, et al. Incidence of fungal infections in intensive care units in a tertiary care centre, West Uttar Pradesh. *Int J Acad Med Pharm* 2024;**6**:425-30.

12. Al Hajri H, Al-Salmi W, Al Hinai K, et al. Invasive fungal infections in children with leukemia in a tertiary hospital in Oman: An eight-year review. *Curr Med Mycol* 2023;**9**:16-22.

13. Badiee P, Zareifar S, Haddadi P, Jafarian H. Incidence of fungal infections in pediatric patients with hematologic neoplasms. *Arch Pediatr Infect Dis* 2017;**5**(3):e41317. DOI: 10.5812/pedinfect.41317.

14. Nathani M, Mandal P, Kaur R, Chandra J. A study on clinical profile of invasive fungal infection in neutropenic children in a tertiary care teaching hospital. *Int J Contemp Pediatr* 2022;**9**:746-52.

15. Freifeld AG, Bow EJ, Sepkowitz KA. Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2011;**52**:e56–e93.

16. WHO fungal priority pathogens list to guide research, development and public health action. Vol. 1. Geneva: World Health Organization; 2022.