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ANALYSIS OF THE EPIDEMIOLOGICAL PROFILE OF POSITIVE URINE CULTURES FOR FUNGAL INFECTION IN BELÉM, PARÁ, IN THE POST–COVID-19 PANDEMIC SCENARIO, WITH A FOCUS ON THE CANDIDA GENUS

ANÁLISE DO PERFIL EPIDEMIOLÓGICO DE UROCULTURAS POSITIVAS PARA INFECÇÃO FÚNGICA EM BELÉM, PARÁ, NO CENÁRIO PÓS-PANDEMIA DE COVID-19, COM FOCO NO GÊNERO CANDIDA

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ABSTRACT

Candida-related nosocomial fungal infections represent a significant public health concern, particularly in the post-COVID-19 context. Data from northern Brazil remain scarce, underscoring the need for regional epidemiological studies. To describe the frequency of Candida-related fungal infections in hospital settings in Belém, Pará, Brazil, and to evaluate their distribution according to year, age group, sex, and etiological agent. Observational, retrospective, descriptive study analyzing 1,192 positive urine cultures for fungal infections collected at Laboratory Ruth Brazão between January 2020 and December 2023. Variables included etiological diagnosis, sample date, age group (WHO classification), and sex. Data were analyzed using Microsoft Excel, with qualitative variables expressed as absolute and relative frequencies and quantitative variables as mean ± standard deviation. A mean of 298 ± 111 positive cultures per year was recorded, with a peak in 2021 (n = 459; 38.51%). Women predominated (65.02%), and elderly individuals represented the largest age group (53.10%). *Candida albicans* was the most prevalent species (56.62%), followed by *C. tropicalis* (21.43%), *C. parapsilosis* (10.46%), and *C. glabrata* (7.43%). *C. albicans* remained the leading etiological agent of candiduria in Belém, while non-albicans *Candida* species — especially *C. tropicalis* and *C. parapsilosis* — showed considerable local relevance, raising questions about the applicability of the WHO fungal priority pathogens list to the regional context. The 2021 peak is likely attributable to pandemic-related immunosuppressive therapies. These findings highlight the need for region-specific surveillance strategies in northern Brazil.

Keywords: Candiduria; Nosocomial fungal infections; *Candida albicans*; COVID-19; Amazon.

RESUMO

Infecções fúngicas nosocomiais associadas a *Candida* representam uma preocupação significativa de saúde pública, particularmente no contexto pós-COVID-19. Dados da região Norte do Brasil permanecem escassos, ressaltando a necessidade de estudos epidemiológicos regionais. O objetivo foi descrever a frequência de infecções fúngicas associadas a *Candida* em ambiente hospitalar em Belém, Pará, Brasil, e avaliar sua distribuição segundo ano, faixa etária, sexo e agente etiológico. Trata-se de um estudo observacional, retrospectivo e descritivo que analisou 1.192 uroculturas positivas para infecções fúngicas, coletadas no Laboratório Ruth Brazão entre janeiro de 2020 e dezembro de 2023. As variáveis incluíram diagnóstico etiológico, data da coleta, faixa etária (classificação da OMS) e sexo. Os dados foram analisados utilizando o Microsoft Excel; variáveis qualitativas foram expressas em frequências absolutas e relativas, e variáveis quantitativas como média ± desvio padrão. Registrou-se uma média de 298 ± 111 culturas positivas por ano, com um pico em 2021 (n = 459; 38,51%). Houve predominância do sexo feminino (65,02%), e os idosos constituíram a maior faixa etária (53,10%). *Candida albicans* foi a espécie mais prevalente (56,62%), seguida por *C. tropicalis* (21,43%), *C. parapsilosis* (10,46%) e *C. glabrata* (7,43%). *C. albicans* manteve-se como o principal agente etiológico de candidúria em Belém, enquanto espécies de *Candida* não-*albicans* — especialmente *C. tropicalis* e *C. parapsilosis* — demonstraram relevância local considerável, levantando questionamentos sobre a aplicabilidade da lista de patógenos fúngicos prioritários da OMS

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ao contexto regional. O pico observado em 2021 é provavelmente atribuível a terapias imunossupressoras relacionadas à pandemia. Esses achados destacam a necessidade de estratégias de vigilância específicas para a região Norte do Brasil.

Palavras-chave: Candidúria; Infecções fúngicas nosocomiais; *Candida albicans*; COVID-19; Amazônia.

1. INTRODUCTION

According to the I*nfectious Diseases Society of America* (IDSA), globally, only 5 of the approximately 15 species of the *Candida* genus (*C. albicans, C. glabrata, C. tropicalis, C. parapsilosis,* and *C. krusei*) account for more than 90% of infections caused by this group and their invasive forms (candidemia or invasive candidiasis), with urine culture being considered the gold standard for the diagnosis of candiduria (Pappas et al., 2016).

Furthermore, a study conducted in Spain and published in 2025, which analyzed more than 100,000 urine cultures from a hospital setting, demonstrated that the main agents responsible for candiduria were, in decreasing order, *C. albicans, C. glabrata,* and *C. tropicalis* (Castellano-Sánchez et al., 2025).

In Brazil, a 2009 review study demonstrated that the urinary tract is the site most prone to the development of nosocomial infections, with data showing the presence of the *Candida* genus in 22% of urine cultures from hospitalized patients (Vidigal; Svidzinski, 2009).

In addition, the COVID-19 pandemic scenario should be highlighted. It contributed to an increase in nosocomial fungal infections, since the mode of infection of these pathogens is primarily opportunistic, especially in cases of immunodeficiency (e.g., AIDS) or immunosuppression (e.g., drug-induced) (Shah; Deshpande; Shah, 2024).

Associated with this, in 2022, the World Health Organization (WHO) published a priority pathogen list regarding the main pathogens associated with nosocomial fungal infections (NFIs), divided into three priority levels (critical, high, and medium). At the critical

priority level, four agents were identified, including two *Candida* species (*C. auris* and *C. albicans*) (World Health Organization, 2022).

Finally, in the state of Pará, specifically in the city of Belém, a study using data from 2008 to 2017 reported a candidemia prevalence of 2.5% among all hospitalized patients, both with and without HIV/AIDS. *Candida spp., Cryptococcus spp.,* and *Histoplasma spp.* were highlighted among the main etiological agents involved in these infections (Ohnishi et al., 2022).

Given this context, there is a need to thoroughly investigate nosocomial fungal infections (NFIs) to develop more effective control and treatment strategies. Although there is a significant number of studies regarding these infections, there remains a lack of data from northern Brazil, particularly in the post COVID-19 pandemic scenario. Therefore, the present study aimed to describe the number of *Candida*-related fungal infections in hospital settings in Brazil, specifically in the city of Belém, and to evaluate the frequency of these infections according to age, sex, and etiological agent.

2. METHODOLOGY

This study is characterized as an observational, retrospective, descriptive study with the collection of primary data obtained from urine culture examinations.

A total of 1,192 positive urine cultures for fungal infections from the municipality of Belém were analyzed at the Laboratory Ruth Brazão between January 2020 and December 2023.

The examinations were performed using the 72-hour culture technique, and the requesting institutions were hospitals. Samples could originate from either outpatient or hospitalized patients (general ward or intensive care unit).

The variables analyzed were etiological diagnosis of the fungal infection, sample date, age group (according to WHO classification), and sex of the infected patients.

Microsoft Excel software was used for data analysis. Qualitative data were represented using absolute and relative frequencies, whereas quantitative data were expressed as mean ± standard deviation.

This study was approved by the Research Ethics Committee of the Federal University of Pará under opinion number CAAE 85027524.0.0000.5174. Based on Resolution No. 466/2012 regarding the use of patient medical record data with anonymous retrospective analysis, the requirement for informed consent was waived. To access the medical records, the researchers involved signed a Data Use Commitment Agreement (TCUD).

3. RESULTS

Of the 1,192 examinations performed by the Laboratory Ruth Brazão with positive results for nosocomial fungal infections, the mean was 298 ± 111 examinations per year. The distribution from 2020 to 2023 was 216, 459, 283, and 234 cases, respectively, as illustrated in **Table 1**.

Regarding the sample profile, represented in **Table 2**, the population consisted of 413 (34.65%) men, 775 (65.02%) women, and 4 (0.04%) cases with sex not reported. The predominant age group was older adults/elderly individuals, with 633 cases (53.10%), followed by 417 adults (34.98%), 102 children (8.56%), and 40 adolescents (3.36%).

Regarding the etiological diagnosis, represented in **Table 3**, the main species identified was *Candida albicans*, accounting for 671 cases (56.62%), while 43.38% corresponded to non-*albicans Candida* (NAC), mainly represented by *Candida tropicalis* (21.43%), *Candida parapsilosis* (10.46%), and *Candida glabrata* (7.43%)

Table 1: *Distribution of Fungal Infection Cases Analyzed from 2020 to 2023*

Year	n	%
2020	216	18,12%
2021	459	38,51%
2022	283	23,74%
2023	234	19,63%
Mean	**298 ± 111**	

Source: Authors, 2026.

Table 2: *Profile of Patients with Urine Cultures Analyzed from 2020 to 2023*

Age Group	n	%
Children (0-9)	102	8,56
Adolescents (10-19)	40	3,36
Adults (20-64)	417	34,98
Elderly (> 65)	633	53,10
Gender		
Male	413	34,65
Female	775	65,02
Not reported	4	0,34

Source: Authors, 2026.

Table 3: *Distribution of Etiological Agents of Fungal Infection Cases Analyzed from 2020 to 2023*

Etiology	n	%
Candida albicans	671	56,62
Candida tropicalis	254	21,43
Candida parapsilosis	124	10,46
Candida glabrata	88	7,43
Candida dubliniensis	12	1,01
Candida lusitaniae	11	0,93
Candida guilliermondii	8	0,68
Candida krusei	8	0,68
Candida ciferri	3	0,25
Candida kefyr	3	0,25
Candida rugosa	2	0,17
Candida duobushaemulonii	1	0,08

Source: Authors, 2026.

4. DISCUSSION

As cited by the Infectious Diseases Society of America (Pappas et al., 2016), the main species of the *Candida* genus accounted for 96.62% of all positive urine cultures for *Candida* reported in this study. However, only *C. krusei* was not among the five most prevalent species. Despite the priority list provided by the World Health Organization (World Health Organization, 2022), some criticisms are pertinent, particularly the fact that it does not consider regional differences that influence the geographic distribution of fungi.

Consequently, if the list is followed strictly by the Brazilian governmental institutions, substantial resources may be allocated to fungi with limited statistical significance in the local context, while other relevant pathogens may potentially be neglected (Casalini; Giacomelli; Antinori, 2024).

Supporting this perspective, a review study published in 2025 also corroborated that the priority list released by the WHO in 2022 is highly subject to criticism, as it presents different epidemiological contexts of nosocomial fungal infections depending on the geographic region. For example, in the United States, India, Spain, Taiwan, and several African countries, non-*albicans Candida* (NAC) species (e.g., *C. parapsilosis*, *C. glabrata*, *C. tropicalis*, and *C. guilliermondii*) rank first in reported cases, whereas *C. albicans* occupies the second or third position. *C. parapsilosis* is highly prevalent in Latin America and is strongly associated with nosocomial fungal infections in neonates (Cabrera-Guerrero et al., 2025).

Notably, the present study demonstrated that *C. tropicalis* and *C. parapsilosis* accounted for 21.43% and 10.46% of the cases recorded by the Laboratório Ruth Brazão, respectively. However, these species are classified only within the high-priority category (10th and 11th positions, respectively, out of a total of 19 pathogens). Based on the data presented here, only *Candida albicans* justifies its inclusion in the critical-priority group.

Regarding the demographic profile of the population with positive urine cultures for *Candida*, the predominance of women (65.02%) and the peaks of prevalence at the extremes of age (children and older adults) are consistent with the classical literature (Sobel et al., 2011).

With respect to the significant increase in cases observed in 2021, this finding may be associated with hospitalizations during the COVID-19 pandemic. The use of corticosteroids and broad-spectrum antibiotics favored fungal proliferation, especially of the *Candida* genus, by reducing the population of *Clostridia* bacteria in the gastrointestinal tract. These bacteria produce butyrate and maintain a state known as epithelial hypoxia, which inhibits fungal proliferation (Savage et al., 2024).

5. CONCLUSION

Therefore, this study updates and fills important gaps regarding statistical data on *Candida*-related fungal infections in the state of Pará, within the Amazon region. As limitations, it should be noted that the data were collected only from hospitals whose analyses are performed by the Laboratory Ruth Brazão, and that other clinically relevant information was not discriminated in the laboratory requests, such as whether the patient was admitted to an intensive care unit (ICU).Finally, further studies of this nature are recommended in other locations throughout northern Brazil.

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