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Research Article

Prevalence of Intertriginous Candidiasis Amongst Female Residents of Hostels in a Tertiary Institution in Port Harcourt, Rivers State

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ABSTRACT

Intertriginous candidiasis is a condition that occurs in skin folds caused by *Candida* and its increasing prevalence due to poor lifestyle is becoming a serious health issue. This study was carried out to determine the prevalence of intertriginous candidiasis amongst female residents of hostels in Rivers State University, Port Harcourt. Forty (40) samples were aseptically collected from the inframammary fold (IMF) and armpits of females (aged 18-27 years) in hostels B, C, D, H and NDDC Hostel using sterile swab sticks. The samples were analyzed using standard microbiological methods. The mean fungal population ranged between $1.4\pm0.3 \times 10^2$, $1.7\pm0.7 \times 10^2$, $1.8\pm0.4 \times 10^2$, $1.9\pm0.4 \times 10^2$ to $2.5\pm1.0 \times 10^2$ SFU/ml for Hostel D, C, NDDC, Hostel B and H respectively with no significant difference ($p\geq0.05$) across the hostels. Fifteen (15) *Candida albicans* isolates were identified using lactophenol cotton blue method and germ tube test. The NDDC hostel recorded the highest prevalence (33.33%) of intertriginous candidiasis among female students while female occupants from Hostel H recorded the least prevalence (6.66%). The age specific prevalence indicated that, intertriginous candidiasis was more prevalent among females between ages 23-27 (80%) group. The susceptibility pattern result showed that 46.67% of the *Candida albicans* were resistant to fluconazole and 53.33% were sensitive to fluconazole at 100% concentration. Good personal hygiene and regular check-ups for females in the hostels is recommended in order to avoid complicated health problems since intertriginous candidiasis poses a major health challenge.

Keywords: Intertriginous candidiasis, prevalence, armpit, female hostel, *Candida albicans*, germ tube test.

Introduction

Intertriginous candidiasis is an inflammatory condition of skin folds, induced or aggravated by heat, moisture, maceration, friction, and lack of air circulation (Wolf *et al*., 2011). Intertriginous is a normal flora, which frequently is worsened by infection, which most commonly is with *Candida*. Intertriginous commonly affects the axilla, perineum, inframammary creases, and abdominal folds, and it can also affect the neck creases and inter-digital areas.

Intertriginous is caused by skin-on-skin friction in areas of occlusion that have increased moisture (Kalra *et al*., 2014). Intertriginous is most commonly seen in patients who are overweight, obese, or incontinent. Symptoms may include rashes, red or purple patches (area with an altered surface), white, flaky substance over affected areas, scaling, or shedding of the skin with flakes, cracks in the skin, soreness, erythema, which results in areas of redness, maceration, or the appearance of soft white skin, creamy satellite pustules at margins of affected areas (pimples filled with pus) and red and white lesions in your mouth, as seen in oral thrush. About 70% of all *Candida* overgrowth occurs in women (if we consider the population of people over 15 years of age). As both men and women are equally exposed to antibiotics, this increase lies somewhat with the use of birth control pills, and primarily with candida's fondness for progesterone.

Women often have flare-ups coinciding with their period, a time when progesterone levels are higher. By the way, there are two types of estrogen, alpha estrogen produced by the female organs, and beta estrogen produced by the adrenal glands.

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Both men and women need and produce beta estrogen and not only are these estrogens inhibited by *Candida*, but the adrenal fatigue caused by the *Candida* overgrowth will result in even lower beta estrogen production (Crouss *et al.*, 2018).

These imbalances need to be corrected, but as men naturally produce much less progesterone than women, they do not supply such a readily available food source for the *Candida*. Thus, out- of-control *Candida* overgrowth affects many more women than men but men are not safe from these infections (Eschenbach, 2004).

In general, you can prevent most Candida infections by keeping the skin clean and dry, by using antibiotics only as the doctor directs, and by following a healthy lifestyle including proper nutrition (Jurden *et al*., 2012). An antifungal is a pharmaceutical fungicide or fungistatic used in the treatment and prevention of different types of fungal infections (mycosis) like aspergillosis, candidiasis, cryptococcal meningitis (Tomisikova, 2002). Due to their resistance most of them are normally administered topically or vaginally, though depend on the health condition being treated. Systemic antifungal drugs are administered orally or intravenously. Clinically, few azole antifungal drugs are used systemically. These may include ketoconazole, itaconazole, fluconazole, voriconazole, posaconazole and isavuconazole (EMDEX, 2013) Hence, this research is carried out to determine the prevalence of intertriginous candidiasis amongst female residents of hostels in a tertiary institution in Port Harcourt, Rivers State.

Materials and Methods

Description of study Area

The study was carried out in Hostels B, C, D, H and NDDC hostel; five (5) different hostels in the Rivers State University, Port Harcourt, Rivers State, Nigeria.

Collection of Samples

A total of forty (40) females were swabbed in their armpit and on the infra-mammary fold which is under the breast of each of the female using sterile swab sticks from the different hostels under hygienic condition in Port Harcourt Rivers State, and transported to the Department of Microbiology Laboratory Rivets State University for further analyses.

Microbiological Analysis

Fungal Enumeration

A direct plating was conducted on the swabbed samples and was streaked onto Sabouraud dextrose agar (SDA) plates which have been fortified with tetracycline antibiotics for the inhibition of bacterial growth and incubated at ambient temperature (25-27^{o}C) for 3-5 days. The plates were counted and recorded to obtain the spore forming unit per mililitre (SFU/ml). Discrete spores were sub-cultured onto fresh Sabouraud Dextrose Agar plate and the isolates preserved in agar slant in Bijou bottles for subsequent analyses.

Identification of the Fungal Isolates

The morphological characteristics such as the shape and color of the isolate were used for primary identification. The isolates were further identified after staining with lactophenol cotton blue and examined with ×40 objective lens which reveals the structure of the hyphae and the arrangement of the spores. The germ tube test was used to identify the *Candida* species (Dhawale and LaMaster, 2003).

Preparation of Standard Fungal Suspension and Sabouraud Dextrose Agar

The fungal suspension was prepared by emulsifying pure cultures of the isolates in a sterile saline solution and adjusted to 0.5 Mcfarland turbidity standard to test for susceptibility (Cheesbrough, 2005).

Preparation of the Antifungal Concentrations

Hundred percent (100%, 200mg/ml) of the fluconazole (Antifungal drug) was prepared by; 200mg of fluconazole dispensed in 2ml of distilled water to obtain 100% of the antifungal drug (fluconazole) (Pitt and Hocking, 2004).

Susceptibility Pattern of the Fungal Isolates to Fluconazole

Agar Well Diffusion Method

A sterile swab stick was dipped into the tube containing the fungal suspension and the swab was used to swab the surface of the petri dish evenly which contain already prepared Sabouraud dextrose agar and rotating the plates to about 60^{o} to ensure even distribution of the fungi. The agar was allowed to dry for about 3minutes. With Sterile cock borer, wells of 4mm in diameter were made on the surface of the agar.

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The fluconazole prepared (100%, 200mg/ml) was dispensed into the wells and allowed to diffused into the agar (Pitt and Hocking, 2004). The plates were incubated at 37˚C for about 24hours.

After incubation, the diameter of each zone of inhibition was measured in mm using a meter rule on the underside of the plate and recorded for reference purpose using the Clinical Laboratory Standard Institute (CLSI, 2019) to interprets the current antifungal breakpoints and interpretative categories for yeast of broth micro-dilution and percentage resistance and susceptible were calculated and recorded as follows: Resistant ≤ 2mm and Susceptible ≥ 8mm for Fluconazole.

Data Analysis

The data obtained was analyzed using analysis of variance (ANOVA) to test for significance using the Statistical Package for Social Science (SPSS) version 22 (Bewick *et al*., 2004).

Results

The result of fungal population ($\times 10^2$ SFU/ml) amongst female residents of Hostels in the tertiary institution is shown in Table 1.

The mean fungal population between 1.4±0.3 $x10^2$, 1.7±0.7 $x10^2$, 1.8±0.4 $x10^2$, 1.9±0.4 $x10^2$ to 2.5±1.0 $\times 10^2$ SFU/ml for Hostel D, C, NDDC, Hostel B and H respectively with a significant difference ($p \leq 0.05$) across the hostels.

The prevalence of intertriginous candidiasis was among female students is shown in Figure 1. The highest prevalence (33.33%) of intertriginous candidiasis was among female students from NDDC hostel and Hostel H had the least prevalence (6.66%).

Table 2 shows the age specific prevalence which indicated that, intertriginous candidiasis was more prevalent among females between ages 23-27(80%).

Table 1: Population of fungi ($\times 10^2$ SFU/ml) amongst female residents of Hostels in a tertiary institution

Sampling	Female Hostel				
	B	**C**	**D**	**H**	**NDDC**
1	1.2	3.4	1.5	1.4	1.2
2	2.3	1.4	1.0	1.4	1.8
3	2.0	1.6	1.1	1.2	1.3
4	2.3	1.0	1.7	3.3	2.1
5	2.1	1.5	1.8	3.4	2.2
6	2.4	1.6	1.2	3.1	2.5
7	1.5	1.4	1.4	3.2	1.8
8	1.8	1.7	1.3	3.3	1.9
Mean±SD	1.9 ± 0.4^{ab}	1.7 ± 0.7^{b}	1.4 ± 0.3^{c}	2.5 ± 1.0^{d}	1.8 ± 0.4^{cd}
P-value	0.010	0.001	0.030	0.000	0.000

*Means with different alphabet along the rows shows a significant difference ($p \leq 0.05$)

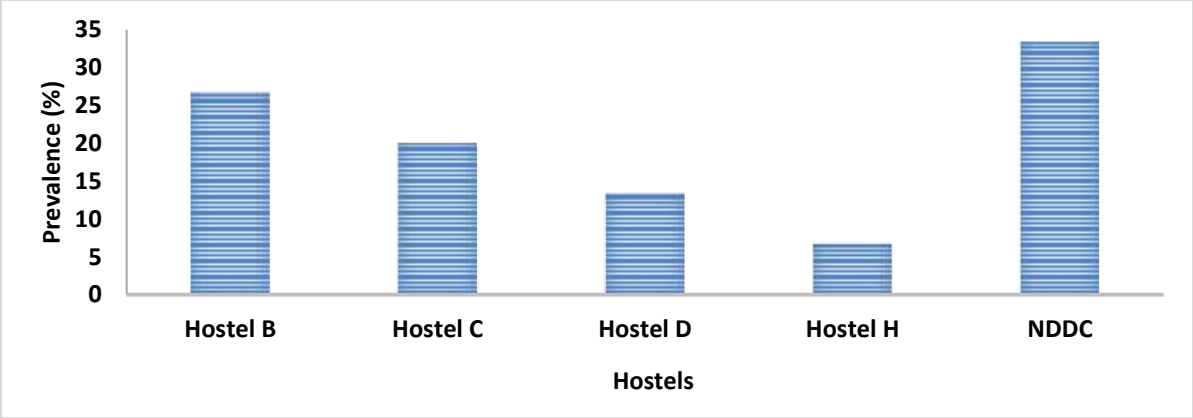

Figure 1: Prevalence of Intertriginous Candidiasis among Females in the Hostels

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Table 2: Age Specific Prevalence of Intertriginous Candidiasis Among the Studied Females

Age	No.	Frequency (%)
18-22	14	3(20%)
23-27	26	12(80%)
Total	40	15 (100%)

The susceptibility pattern of the *Candida albicans* that were isolated and identified is shown in Table 3. A total of fifteen (15) *Candida* were isolated and identified in this study. The susceptibility pattern result showed that about (46.67%) of the *Candida albicans* were resistant to fluconazole and 53.33% were susceptible to fluconazole at 100% concentration as revealed in Table 3. The result also revealed that NDDC hostel (33.33%) has the highest percentage resistance compared to the other hostels as revealed in Table 3 and Table 4.

Table 3: Susceptibility Pattern of *Candida albicans* to Fluconazole (200mg) Among the Studied females

Isolate Code	Isolate	Zones of Inhibition (mm)	Interpretation
HB -1	*Candida albicans*	21	S
HB -2	*Candida albicans*	26	S
HB -3	*Candida albicans*	17	S
HC -1	*Candida albicans*	22	S
HC -2	*Candida albicans*	19	S
HD -1	*Candida albicans*	0	R
HD -2	*Candida albicans*	0	R
HH -1	*Candida albicans*	20	S
HH -2	*Candida albicans*	21	S
NDDC -1	*Candida albicans*	0	R
NDDC -2	*Candida albicans*	0	R
NDDC -3	*Candida albicans*	0	R
NDDC -4	*Candida albicans*	18	S
NDDC -5	*Candida albicans*	0	R
NDDC -6	*Candida albicans*	0	R

Key: ≤2mm -Resistant; ≥8mm Susceptible (Fluconazole), R-Resistant, S-Susceptible; HH-Hostel H, HB-Hostel B, HC-Hostel C, HD-Hostel D and NDDC-Niger Delta Development Commission Hostel

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Table 4: Percentage Resistance and Susceptibility of *Candida albicans* to Fluconazole (200mg) Among the Studied females from the Different Hostels

Hostel	Resistance n (%)	Susceptible n (%)	Overall Resistance n(%)	Overall Susceptibility n(%)
B	0(0.00)	3(20.0)		
C	0(0.00)	2(13.33)		
D	2(13.33)	0(0.00)	7(46.67)	8(53.33)
H	0(0.00)	2(13.33)		
NDDC	5(33.33)	1(6.67)		

Discussion

The prevalence of intertriginous candidiasis varies according to the geography, demography, type of fungal pathogen and many other environmental factors (Kuhbacher *et al*., 2017). There was a high fungal count from the females of the different hostels which could probably be due to the use of unclean shaving equipment, allowing of hairs in the armpit which in turns cause the accumulation of fungal population as well as improper cleaning of the infra-mammary fold during bathing (Yoon *et al*., 2014). Hostel H has the highest fungal population which might be due to the population density of the students living in the hostel. It can also be as a result of the students with nutritional deficiencies and endocrine disorders. Besides these, local factors like xerostomia, ulcerations, radiation-induced mucositis, trauma-induced skin damage, and skin maceration increase the morbidity rate (Sadeghi *et al*., 2019).

Moreover, underlying diseases, immunosuppressive states, antibiotic therapy, and skin environment variation are the factors due to which the commensal *C. albicans* switched into a true pathogen (Palese *et al*., 2018). The high prevalence of intertriginous candidiasis among females' residents of Rivers State University which might be due to environment and the social status of the population (Zareshahrabadi *et al*., 2021). Other studies from South Korea and Chile also reported a high proportion of *Candida*-infected females (Yoon *et al*., 2014).

The occurrence of this organism in females might be due to occupational activities, personal hygiene and exposure to other contaminated female population (Maranhao *et al*., 2019).

Prevalence was also high among adults (higher) age group which might be due to the fact that these populations have more involvement in job markets and social activities with high chance of exposure to *Candida* infections (Khadadadi *et al*., 2021). However, the use of contraceptives and antibiotics has been shown as risk factors for *Candida* infection among these age groups (Khadadadi *et al*., 2021). The high infection rate of *Candida albicans* is due to their ability to grow in different morphological forms like true hyphae, pseudo-hyphae and unicellular budding yeast which enhance its virulence and invading host cell activity (Nam *et al*., 2022). The resistance to fluconazole as reported in this study might be due to their weak inhibitory activity or improper usage in clinical settings (Zhou *et al*., 2022). This corroborate with the work of Taudorf *et al*. (2019) who reported that a higher percentage of *Candida albicans* where resistant to the azole antifungal. The higher percentage of resistance of the female students from NDDC hostels to fluconazole might be due to higher level of misuse amongst the residents and the lack of national guidelines for treating intertriginous candidiasis, the misuse of available antifungal drugs occurs and which endorses antifungal drug resistance (Markogiannakis *et al*., 2021). However, it is important to note that a higher percentage of the isolates were susceptible to the antifungal compared to the percentage of resistant isolates. The fungistatic nature of azole drugs imposes a robust direct selection of antifungal-resistant species (Das *et al*., 2019).

This study has demonstrated a significant occurrence in the prevalence of intertriginous candidiasis and varying resistance to fluconazole antifungal agent. There is need for proper hygiene to reduce the activity of this fungus and antifungal susceptibility need to be monitored continuously to reduce their resistance.

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