

Original Article

Indoor Air and Surface Fungal Contamination in the Special Care Baby Unit of a Tertiary Hospital in Jos, Nigeria

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ABSTRACT

Fungi frequently contaminate the indoor air as well as surfaces of hospital equipment and furniture. This pose a significant risk for neonates in the Special Care Baby Unit. This study aimed to determine the rate of fungal contamination of indoor air and surfaces of the special care baby unit of a tertiary health facility in Jos, Nigeria. The study was carried out at the special care baby unit of the Jos University Teaching Hospital. Indoor air samples were obtained using sedimentation method whereas samples from surfaces were collected using sterile pre-moistened cotton tipped swab sticks. The swab sticks were inoculated onto sabouraud dextrose agar plates which were incubated along with indoor air culture plates for seven days. Univariate analysis was carried out using STATA (version 14IC). Fungal contamination rate of the special care baby unit was 20.2%. *Aspergillus* species (29.6%) was the most predominant fungus isolated. Most of the fungi were isolated from the outborn term and outborn preterm rooms of the special care baby unit. The fungi isolated include *Aspergillus* spp, *Candida* spp, *Penicillium* spp, *Cladosporium* spp, *Curvularia* spp, *Fusarium* spp, *Paecilomyces* spp, *Alternaria* spp, and *Rhodotorula* spp. Fungi are a major cause of indoor air as well as surface contamination in special care baby unit of the hospital. Routine cleaning and disinfection will lead to a reduction in the fungal load.

Keywords: *Aspergillus* species, fungi, indoor air, surface contamination

INTRODUCTION

Fungi are ubiquitous in the hospital environment by virtue of spread from place to place through air, water etc.¹ The most frequent fungi that can be found in indoor air and surfaces of the hospital include; *Candida albicans* and some species of *Aspergillus*, *Penicillium*, and *Cladosporium*.² The sources and reservoir of fungi in the hospital environment include ventilation systems, hospital food, plumbing systems, medical equipment, hospital furniture, cots and bed linen.³ Medical equipment in hospital rooms pose a significant risk particularly in the

neonatal intensive care unit.⁴ This is true for equipment with inaccessible interior or crevices. Other equipment such as incubators, respirators or computers accumulate dust which most often contain fungal spores that consequently become a source of infection.⁵ The neonatal intensive care unit (NICU) and the Special Care Baby Unit (SCBU) requires the highest standard of microbiological purity, especially where premature neonates are kept.⁶ Therefore, it is essential to ensure that the medical devices and furniture in the NICU SCBU are not contaminated by fungi. Fungal infection in very low birth weight (VLBW) neonates is a serious health care associated infection.^{2,7} Health Care Associated Infection (HCAI) caused by fungi

have frequently been reported in hospitalized neonates in NICU with a high morbidity and mortality.^{2,8,9} Many HCAI are exogenously due to the increase use of air conditioning systems, which along with other factors such as humidity and structural defects are a great source of fungal spread.¹⁰⁻¹²

Fungal spores, under favorable condition can develop in different hospital environment, but do not pose a significant threat in immunocompetent individuals, but fatal in hospital inpatients particularly neonates in the SCBU and Intensive Care Unit (ICU).¹⁰⁻¹³ Several factors such as fungal concentration, genus and species diversity, as well as their distribution dynamics in the hospital environment play important role in HCAI.¹⁴ There are several studies in hospitalized patients affected by fungal infections due to airborne filamentous fungi present in the environment, but few of such have been reported in Nigeria characterizing the airborne fungi microbiota in the ICU or SCBU environment.¹⁵⁻¹⁶

MATERIALS AND METHODS

The survey of airborne as well as surface fungi was performed using samples collected from the different sections of the Special Care Baby Unit in a tertiary hospital facility in Jos, Nigeria.

Air sampling was performed through the sedimentation plate method using sabouraud dextrose agar (SDA) medium (oxoid, U.S.A). The culture plates were placed at approximately one meter above the ground and five meters apart in the different sections (out-born term and preterm room, in-born term and preterm room, septic treatment room, neonatal ICU and isolation room) of the SCBU. The plates were exposed for a period of 20 minutes after which they were transported to the laboratory and incubated at 28°C for seven days.

Surface swab samples were collected from predefined surfaces (neonatal incubators, baby cots, resuscitaire) with premoistened cotton tipped swab sticks in the different sections of the special care baby units. The swabs were immediately inoculated onto plates that contained sabouraud dextrose agar (SDA) and plates of SDA plus 50ug/ml of chloramphenicol and incubated at 28°C for a period of seven days.

The culture plates were observed daily and fungi isolated were subsequently identified by both macroscopic and microscopic features of each colony isolated. The moulds were identified on the basis of the colony features and morphological characteristics of direct wet mount

preparation with lactophenol cotton blue. Yeasts were identified using Brilliance Candida Agar (oxoid U.S.A) following the manufacturer's instruction.

RESULTS

Fungi were isolated in 71 of 351 (20.2%) samples: In 40 of 220 samples (18.2%) of indoor air (Table 1) of the special care baby unit and 31 of 131 samples (23.7%) collected from surface of medical equipment and baby cots (Table 2). Nine genera of fungi were isolated (figure 1) from the Special Care Baby Unit of the hospital. These include; *Aspergillus spp*, *Candida spp*, *Penicillium spp*, *Cladosporium spp*, *Curvularia spp*, *Fusarium spp*, *Paecilomyces spp*, *Alternaria spp*, and *Rhodotorulla spp*. *Aspergillus spp* (29.6%) was the most predominant fungi isolated from the SCBU. Most of the fungi were isolated from the outborn term and outborn preterm rooms of the SCBU.

Table 1; Fungal isolates recovered from air samples in the Special Care Baby Unit of a tertiary hospital in Jos, Nigeria.

Fungi	Frequency	Percentage (%)
<i>Aspergillus spp</i>	15	37.5
<i>Penicillium spp</i>	11	27.5
<i>Cladosporium spp</i>	5	12.5
<i>Fusarium spp</i>	3	7.5
<i>Curvularia spp</i>	3	7.5
<i>Paecilomyces spp</i>	2	5
<i>Alternaria spp</i>	1	2.5
Total	40	100

Table 2: Fungi isolated from equipment surfaces in the Special Care Baby Unit of a tertiary hospital in Jos-Nigeria

Fungi	Frequency	Percentage (%)
<i>Candida spp</i>	18	58.1
<i>Aspergillus spp</i>	6	19.4
<i>Penicillium spp</i>	5	16.1
<i>Fusarium spp</i>	1	3.2
<i>Rhodotorulla spp</i>	1	3.2
Total	31	100

OBT: Out born term; OBP: Out born preterm; IBT: In born term; IBP: In born preterm; NICU: Neonatal intensive care unit; EBT: Exchange blood transfusion; ST: Septic treatment; IR: Isolation room.

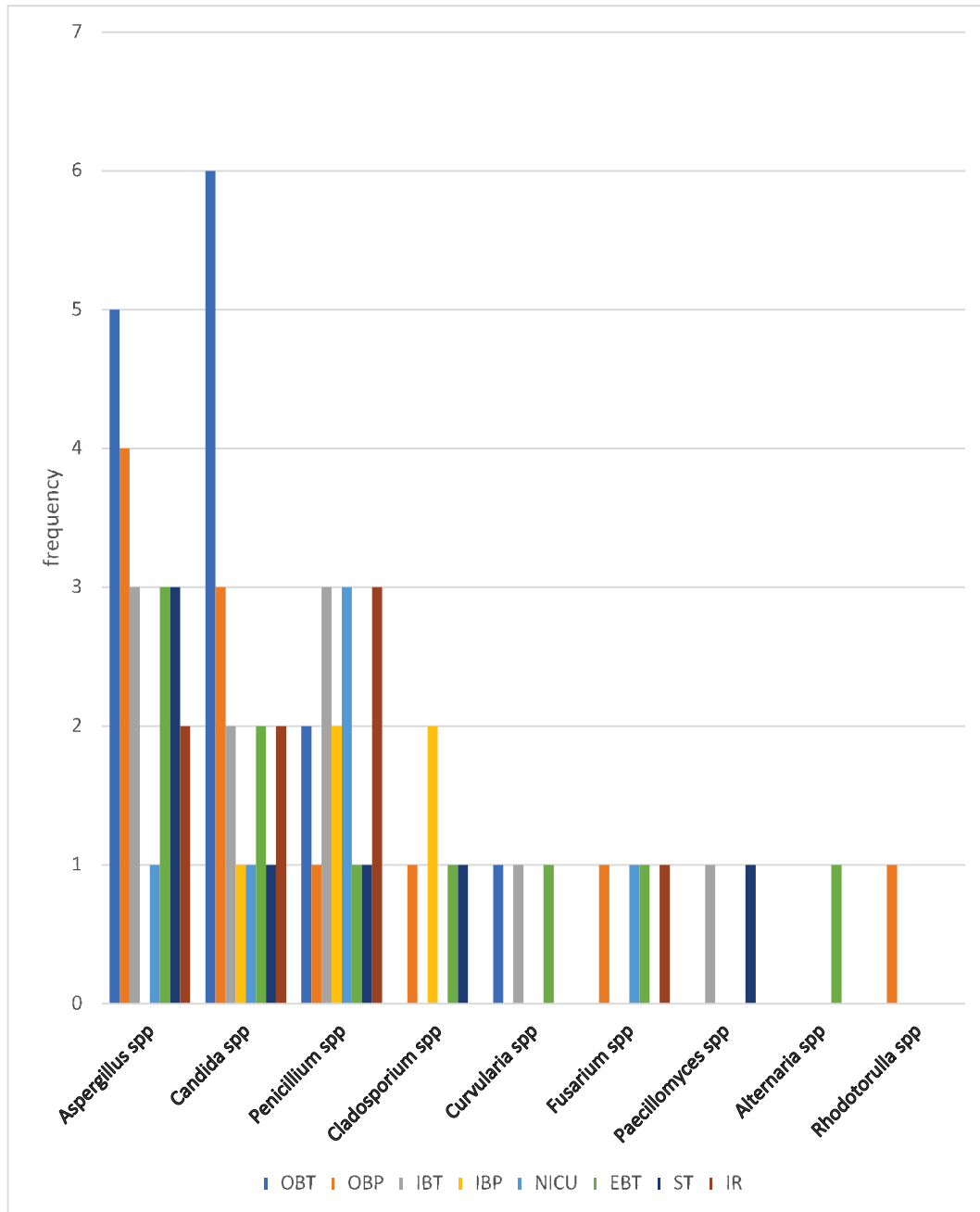


Figure1: fungi isolated from the different sections of the Special Care Baby Unit of a tertiary health care facility in Jos, Nigeria

DISCUSSION

Hospital environment contamination studies have been reported in the past in which *Aspergillus spp*, *Penicillium spp*, *Cladophialophora spp* and *Fusarium spp* have been documented as leading agent of fungal contamination.¹⁷⁻¹⁸

Considering the pathogenic nature of these agents, *Aspergillus spp*, *Candida spp* and *Penicillium spp* were the predominantly isolated agents from almost all the units of the SCBU in the hospital. These findings are in keeping with several other fungal airborne contamination studies^{14,19,21} in which overcrowding of neonates, unacceptably small distances between cots and infrequent decontamination of neonates' cots may lead to increased contamination of neonates' cots. Furthermore, other factors including concentration of decontaminant, nature of surface contaminating fungi, contact time with surfaces, and care of cleaning material are reported to be associated with high levels of contamination of inanimate surfaces. Despite the routine cleaning and disinfection procedures of hospital equipment and surfaces, a high rate of contamination was observed in the indoor air and surfaces in the SCBU of the hospital. The presence of the fungal agents is very significant particularly in SCBU where neonates whose immunity is very low are admitted for care. These neonates are at risk of disseminated infections, multiple brain abscesses and pneumonia^{16,22,23}

Aspergillus spp that was predominantly isolated in this study is worldwide in distribution, and responsible for different syndromes or infections such as endocarditis, otomycosis, osteomyelitis etc.^{16,17-21}

In hospital environment, air borne fungi are a potential risk for patients because of possible inhalation of conidia.²⁰ Widespread presence of *Aspergillus spp* is a major extrinsic factor for invasive Aspergillosis, caused by *Aspergillus fumigatus* (*A. fumigatus*) and other species of *Aspergillus* such as *A. flavus*, *A. niger* and *A. terreus*, depending on the season.^{15,20}

The out born term room of the SCBU had the highest fungal contamination, probably because the neonates were delivered in peripheral hospitals and brought into the SCBU of the tertiary hospital or because of the natural migration of the fungal spores on the clothes of visitors coming into the SCBU from outside. Several systems used for treating or humidifying room air can be colonized easily and create a reservoir of spores in the hospital indoor environment.^{3,7,11,14}

Some studies have shown a correlation between *Aspergillus* concentration and development of

Aspergillosis; and a correlation between a high number of air borne fungal spores and cases of invasive Aspergillosis.^{5,9,19,20,24}

CONCLUSION

Fungal contamination of indoor air as well as surfaces of equipment in healthcare environment particularly the special care baby unit where neonates are managed, may increase fungal infection. However, the isolation of fungal strain requires more control measures, regular surveillance and cleaning along with restriction of visitors to reduce or totally eliminate the fungal load.

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