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Profile of Fungal Species Isolated from patients consulting at the Parasitology-Mycology-Tropical Medicine Service of the Faculty of Medicine, Owendo, Gabon

MOUSSAVOU MABICKA Dimitri, M'BONDOUKWE Noé Patrick, MAYANDZA Christian, DIB Stephane, MOUTONGO Reinne, SIBI MATOTOU Roger, MBANG NGUEMA Ornella, PONGUI NGONDZA Bedrich, NDONG AKOMEZOGHE Luccheri, BOUYOU AKOTET Marielle Karine and MAWILI-MBOUMBA Denise Patricia*

Service of Parasitology-Mycology-Tropical Medicine, Faculty of Medicine, Université des Sciences de la Santé, BP 4009, Libreville, Gabon.

***Correspondence:**

MAWILI-MBOUMBA Denise Patricia, Service of Parasitology-Mycology - Tropical Medicine, Faculty of Medicine, Université des Sciences de la Santé, BP 4009, Libreville, Gabon.

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ABSTRACT

Background: Fungal infections are common. A better knowledge of their distribution could help to improve the care of the affected patients. In Gabon, such studies are not frequent. However, the service of Parasitology-Mycology-Tropical Medicine is the reference of Mycoses diagnosis. Thus, the aim of the present study was to determine the frequency of fungal species isolated from mycoses diagnosed within the Parasitology–Mycology - Tropical Medicine service, according to age and sex.

Methods: A retrospective study was conducted within the Parasitology–Mycology–Tropical Medicine Service of the Faculty of Medicine, Université des Sciences et de la Santé (USS) in Owendo, Gabon. The files of patients consulting at the SPMMT for fungal infections from 2012 to 2023 were collected. Age, sex, medical history, current treatments, clinical manifestations, and disease history were recorded.

Results: Overall, 1,767 patient records from 2012 to 2023 were collected. The sex ratio of the patients was 0.54 and their mean age was 36.5 ± 18.2 years. More than half (55.4%) of the samples had a fungal infection due to a yeast, and around 18.7% were due to other fungal groups including dermatophytes, pseudo-dermatophytes and moulds. More than half of the identified yeasts were of the genus Candida sp. (42.3%). The frequency of yeast lesions was significantly different according to gender; mainly found in women. Men were twice as frequently infected by dermatophytes, pseudo-dermatophytes, or moulds than women (p < 0.0001).

Conclusion: Fungal infection due to Candida spp and Dermatophytes are frequent in Gabon. Difference according to gender and age was found. Infections being more frequent among women and patients less than 50 years old. Biological identification of these infections is therefore crucial to provide appropriate care.

Keywords

Introduction

Mycoses are defined as a set of fungal infections caused by microscopic fungi. To date, more than 500 species of fungi have been identified worldwide as potentially pathogenic to humans, leading to three types of mycoses: superficial, subcutaneous, and deep [1]. Mycoses can develop on many parts of the body, but these microorganisms usually affect the skin or nails; when this occurs

it is called superficial disease, and when mucous membranes are involved it is called deep. These infections are a health concern due to unattractive physical sequelae and pain they can cause [2]. They can also lead to serious complications and increase mortality. Mycoses are cosmopolitan, especially in tropical, subtropical, and equatorial regions because the warm, humid climate favors the multiplication of micromycetes [3]. Thus, they are increasingly common, particularly among immunocompromised individuals and hospitalized patients, making awareness of these infections essential to improve diagnosis and treatment. Fungal infections are also promoted by many other factors, notably rubbing of folds, maceration, prolonged wearing of socks and closed shoes, and tight clothing [4]. The introduction of new treatments used against autoimmune diseases or cancer, notably targeted therapies but also, and especially, immunotherapy, are among other promoting factors [5]. The global prevalence of superficial mycoses is estimated at 25% [5,6]. In an earlier study conducted in Senegal, more than one third of patients (34.2%) had superficial mycoses [7].

In Gabon, the biological diagnosis of fungal infections is not widely deployed. Their management is mainly based on clinical assessment. At the Servise of Parasitology-Mycology-Tropical Medicine, diagnostic activities for fungal infections constitute a significant part of the service's activities. However, studies reporting the epidemiological and/or clinical aspects of fungal infections have not been regularly conducted in recent years [8]. It is therefore important to identify the real spectrum of agents responsible for these conditions, their prevalence, and their evolution according to the type of lesions observed, the gender, and age in order to establish targeted prevention strategies.

The aim of the present study was to determine the frequency of fungal species isolated from mycoses diagnosed within the Parasitology–Mycology - Tropical Medicine service, according to age and sex.

Methods
Study design
This was a retrospective study conducted within the Parasitology–Mycology–Tropical Medicine Service (SPMMT) of the Faculty of Medicine, Université des Sciences et de la Santé (USS) in Owendo, Gabon.

SPMMT is the reference laboratory in Gabon for the diagnosis of mycoses and parasitic diseases. Moreover, it provides updated data on the epidemiology of superficial and deep mycoses to the Health authorities by conducting scientific studies benefiting public health.

All the files of patients consulting at the SPMMT for fungal infections from 2012 to 2023 were analysed.

For the purpose of the study, the files were sorted as follows:

Selection criteria
The files selected were from patients who had undergone a mycological examination within the mycology unit or referred to the service for biological analysis for fungal infections.

Non-selection criteria
Files from patients with incomplete data were not selected in this study.

Data collection
Data were extracted from the mycology laboratory register made available. Data were routinely entered into Microsoft® Excel 2010 once weekly by laboratory staff. Variables considered for this study were: age, sex, patient clinical data, date of mycological examination, sampling sites, fungal species detected on direct examination and culture.

Data quality was checked by an operator. Data were then filtered column by column to verify the consistency of the entered information.

Biological diagnosis
Biological diagnosis of fungal infections was performed for patients attending the outpatient of the Parasitology–Mycology -Tropical Medicine Service or referred by other physicians. For all patients, medical records were completed with information on age, sex, medical history, current treatments, clinical manifestations, and disease history. After consultation, patients were registered and assigned an identification number. They were then directed to the laboratory for biological diagnosis.

Wood's lamp examination
A Wood's lamp was used for the patient's skin examination. Based on fluorescence, the differential diagnosis can be done for *Microsporum* infections (green fluorescence) or *Trichophyton* infections (non-fluorescent), *Pityriasis versicolor* or capitis (yellow fluorescence) and erythrasma (orange fluorescence) with nodules on hair.

Sampling
The nature, methods, and equipment of sampling depend on the mycological analysis requested by the clinician. Samples collected correspond to superficial lesions (skin, adnexa, and mucous membranes). Biopsies and deep biological fluids such as cerebrospinal fluid (CSF) and bronchoalveolar lavage (BAL) were collected in hospital settings by specialists.

Statistical analysis
R software version 4.3.2 was used. Proportions were calculated for qualitative variables, and means (± standard deviation) and medians (25th-75th percentiles) were calculated for quantitative variables. Sociodemographic and environmental risk factors were identified using the chi-square or Fisher's exact test. A significance level of less than 5% was considered for all analysis results.

Results
Patients characteristics
A total of 1,767 patient records collected from 2012 to 2023 were analysed. The sex ratio of the patients was 0.54 and their mean age was 36.5 ± 18.2 years. Patients aged 20–30 years and those over 51 years accounted for nearly half of the patients (48.0%; n = 729/1,727) (Table 1).

Table 1: Patients characteristics.

Population	Number (n)	Proportion (%)
Gender	**1727**	
Male	606	35.1
Female	1121	64.9
Age (in years)	**1518**	
< 20	245	16.1
20-30	368	24.2
31-40	293	19.3
41-50	251	16.5
≥51	361	23.8

Regardless of the year, individuals aged > 20 years were the most frequent in consultation, with a predominance of those aged 20–30 years and those over 51 years.

Frequency of collected samples types
The most frequent samples were from bare skin and the scalp/beard (n=1,402; 53.3%). Mucosal samples accounted for less than 5% of specimens (n=80/2,633) (Table 2). Across the study years, bare skin samples were the most numerous. Among patients with lesions localised to a single site, the majority were sampled from the scalp/beard (n=298; 34.1%), the skin (n=241; 27.7%), and the major folds (intertriginous areas) (n=105; 12.1%). For patients with lesions at two sites, the most frequent combinations were skin and scalp/beard (n=122; 23.6%), skin and nails (n=130; 25.2%), and skin and small folds (intertriginous areas) (n=81; 15.7%).

Table 2: Nature and sampling sites.

Nature and Site	Number (n)	Proportion (%)
Hairless skin	840	32.0
Scalp/Beard	562	21.3
Nails	335	12.7
Small body folds	318	12.0
Major body folds	294	11.2
Biological fluids *	204	7.8
Mucous membranes **	55	2.1
External Auditory Canal (EAC)	25	0.9
Total	2633	100

*Cerebrospinal fluid, pus, stools **Oral mucosa, intestinal mucosa, and vaginal mucosa.

Frequency of fungal agents according to the direct examination and culture
More than three-quarters (n=1339/1763) of patients yielded a positive direct examination result and more than two-thirds (n=1204/1764) were positive by culture. Based on culture, over half (n=979; 55.4%) of the samples had a fungal infection due to a yeast, and around 18.7% (n=225) were due to other fungal groups including dermatophytes, pseudo-dermatophytes and moulds. Patients were four times more frequently infected by yeasts.

Identification of fungal groups by age and sex
Men were twice as frequently infected by dermatophytes, pseudo-dermatophytes, or moulds than women (p < 0.0001) (Table 3). Patients aged 20–30 years were significantly less frequently infected by dermatophytes, pseudo-dermatophytes, or moulds (p < 0.0001).

Table 3: Frequency of fungal groups according to gender and age.

	Yeast		Other*		Negative culture		p
	N	%	N	%	N	%	
Gender							
Males	309	51.0	118	19.5	179	29.5	<0.0001
Females	646	57.6	102	9.1	373	33.3	
Age (in years)							
< 20	130	53.1	41	16.7	74	30.2	<0.0001
20-30	238	64.7	22	6.0	108	29.3	
31-40	161	55.0	45	15.4	87	29.7	
41-50	134	53.4	34	13.6	83	33.1	
≥ 51	175	485	49	13.6	137	37.9	

*Dermatophytes, pseudo-dermatophytes, moulds

Yeast infections were significantly found in nails (onychomycosis) and intertriginous areas. More than half of the identified yeasts were of the genus *Candida* sp. (42.3%) followed consecutively by *Malassezia* sp. (28.7%), *Trichosporon* sp. (3.8%) and *Cryptococcus* sp. (0.5%). The frequency of yeast lesions was significantly different according to gender; it was mainly infections due to *Candida* spp. (p<0.01), and to Malassezia sp. (p<0.01), in women (Table 4).

Table 4: Frequency of yeast genus identified according to gender.

Genus		Women		Men		p
		N	%	N	%	
***Candida* sp.**	Yes	381	50.9	179	41.9	0.003
	No	367	49.1	248	58.1	
***Malassezia* sp.**	Yes	261	34.9	120	28.1	0.02
	No	486	65.1	307	71.9	
***Trichosporon* sp.**	Yes	28	3.7	22	5.1	0.2
	No	720	96.3	405	94.9	
***Cryptococcus* sp.**	Yes	4	0.5	2	0.5	0.9
	No	744	99.5	425	99.5	

Lesions associated with the presence of *Candida spp.* were uncommon in patients under 20 years, whereas those due to *Malassezia* spp. were slightly less frequent in patients over 30 years. *Trichosporon* spp. was detected in one patient under 20 years old (Table 5).

Table 5: Frequency of yeast genus identified according to age groups.

Age (in years)	*Candida* sp.		*Malassezia* sp.		*Trichosporon* sp.		*Cryptococcus* sp.	
	n	%	n	%	n	%	n	%
< 20	6	7.3	82	24.0	1	2.2	0	0.0
20-30	29	35.4	127	37.0	16	35.5	1	20.0
31-40	8	9.7	54	15.7	12	26.7	2	40.0

| 41-50 | 16 | 19.5 | 40 | 11.7 | 7 | 15.6 | 1 | 20.0 |
| ≥ 51 | 23 | 28.1 | 40 | 11.6 | 9 | 20.0 | 1 | 20.0 |

**Géotrichum sp., Kodamaea sp., Saccharomyces sp.

Discussion

Mycoses are common worldwide, but their burden, particularly that of superficial mycoses, is greater in developing countries [9,10]. The study of epidemiological distribution of superficial and deep mycoses contribute to a better understanding of these pathologies and that of their pathogens. Despite a rising frequency of fungal infections, they receive little attention and few financial resources are allocated to their diagnosis and treatment, leading to a scarcity of data, especially in developing countries [11]. In addition, some studies report an impact of climate change on the incidence and geographical distribution of fungal infections [12]. Although these pathologies are "neglected," they constitute a significant portion of pharmacist advisory, activities. Thus, the prevalence of superficial and deep mycoses should be estimated and their causative species identified to improve such activity.

During the present study, covering 11 years of diagnostic activities, 1,767 patient records seen in consultation or who came to the Parasitology-Mycology-Tropical Medicine service to undergo mycological examinations were selected.

The examinations primarily concerned adults aged 20–30 years and those over 51 years. As routine, the majority of patients requesting examinations within the PMMTM are adults.

SPMMT was true for Sossou et al. in Togo, where patients who underwent mycological examination of their lesions had a median age of 31 years [13]. In contrast, in northern Greece, a retrospective study was conducted on the epidemiology of superficial mycoses between 2010 and 2014; the data came from patients aged 2 to 85 years [14].

In patients with suspicious lesions, the most frequent samples were taken from glabrous skin (32.0%), followed by the scalp/beard (21.3%). This contrasts with what was reported in a study conducted at the mycology laboratory of the University Hospital Center of Lomé, where the main skin lesions were those of glabrous skin (47.8%) and nail infections (31.4%) [13]. In the present study, the latter affected 12.7% of patients.

Moreover, nail and fingernail involvement was more frequent in women (72.3%). These data corroborate those previously published within SPMMT. Indeed, in a study conducted on the clinical and mycological aspects of onychomycosis in Gabon between 1986 and 2009, nearly two-thirds of the patients were women [15]. The most frequent clinical form, subungual onychomycosis, was located at the level of the toes (52.5%).

Patients with lesions were frequently infected on the scalp/beard, skin, and major skin folds. Studies of scalp lesions in sub-Saharan Africa are frequently conducted in children [16,17].

Skin lesions were frequent in women. The least affected patients (<15% of cases) were those under 20 years of age. The same was true for suspicious lesions in minor and major skin folds (<10.0% of cases).

Overall, the high frequency of fungal infections, found in more than two-thirds of the samples taken, could be explained by the prior referral of patients by medical professionals. Indeed, at the SPMMT, mycological examinations are performed routinely, and patients are regularly sent for diagnostic confirmation. Nevertheless, this prevalence is lower than that found by Ossou et al. in Togo. In Mali, Niare Doumbo et al. reported an underestimation of these conditions, linked to the lack of appropriate biological diagnosis [18].

Based on the type of fungi identified, yeasts were the main fungal group identified. Fungal infections due to *Candida* sp were common in women. However, it is important to distinguish contamination from true infections by observing the patient's clinical course after antifungal treatment. Indeed, the relationship between *Candida* species, which are very frequently identified in the lesions in this study, and the clinical course could be analysed in patients for whom data are available in order to definitively establish the pathogenicity of these fungal agents.

Nasr et al. also report that nearly a third of the samples taken from patients with suspicious lesions were infected by yeasts, particularly *Candida albicans* but also *non-albicans* [19]. In this study, dermatophytes predominated, as reported by Silva-Rocha et al., who also reported the presence of *C. parapsilosis* [20]. Niare-Doumbo et al. (2014) demonstrated, in a cross-sectional study conducted in Mali, significant airborne circulation of fungal agents in an oncology-hematology hospital ward, with a predominance *of Candida sp*p. and *Aspergillus sp*. [18]**.** This confirms the need to link these data to patients' clinical data.

In addition to *Candida* species, opportunistic yeasts of the genera *Trichosporon* and *Geotrichum*, responsible for both benign superficial infections and deep infections associated with high mortality, were identified during the study. Their prevalence is significant in this study among patients with suspicious lesions and underscores the importance of updating data on fungi isolated from the SPMMT. These data reinforce the importance of biological diagnosis of mycoses for appropriate therapeutic management of the patients concerned.

Limitations of the study

The main limit of this study is that it is retrospective, and some data are missing as well as certain analyses.

Conclusion

The present study highlights the high prevalence of fungal infections diagnosed at the service of Parasitology-Mycology-Tropical Medicine, mainly among women and patients less than 50 years old. Yeasts are predominant although infections due to

dermatophytes are non-negligible. These data show the need of biological diagnosis of these infections to provide appropriate care to the patients.

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