CJST *Caribbean Journal of Science and Technology*, **2022**, *10(2)*, 17-23

Review Article

Dermatophytes and Dermatophytoses Acquisition Among School-Age Children in Cameroun, Ivory Coast, Mali and Nigeria: A Systematic Review

David OM [1*], Ogunleye O[1], Adeola PO[1], Olawusi AC[1], Owabumoye JB[1], Ogidi C[2], Adetulubo AD [1]

Article DOI:
10.55434/CBI.2022.20103

Author's Affiliations

[1]Department of Microbiology, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria

[2]Department of Microbiology, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria

Corresponding Author

David OM
david.oluwole@eksu.edu.ng

Received- 5th October 2022,
Accepted- 10th November 2022

ISSN 0799-3757

http://caribjscitech.com/

Abstract

Fungal infections tend to be the most commonly diagnosed skin disease in Africa and with a high percentage of incidence among school-age children. This epidemiological survey summarized the epidemiological trends of dermatophytoses reported in West African countries. The review protocol was done in March 2019 through a literature search using Medline, Google Scholar, PubMed and African Journals Online (AJOL) databases to download all published papers reporting fungal infections among school-age children in West Africa. The period included in the reports was February 2007 to January 2019. A total number of 36,299 samples were investigated by the authors across West African countries and a total of 6262 were recorded positive with dermatophytes segregated by male and female. Tinea capitis has a prevalence of 44.4% and mainly affected children of ages 6–10 years (78.09%). This was followed by Tinea corporis and Tinea unguium with a prevalence of 19.4% and 13.9% respectively. *Trichophyton* species [n=67 (54.92%)], *Microsporum* species [n=34 (27.87%)], *Aspergillus* species [n=6 (4.92%)] and *Epidermophyton* species [n=5 (4.10%)] are most keratinophilic fungi isolated. The scalp [n=2471 (38.51%)], scalp and body [n= 2142 (33.38%)] and toe and nails [n=479 (7.46%)] were the most affected body parts recorded. Tinea capitis remains a common infection among the subjects, and various interventions are needed to reduce the spread of dermatophytic infections in this category.

Keywords: Dermatophytes; Epidemiology; West Africa Skin infections; Dermatophytoses; Diseases.

Introduction

Dermatophytes are fungi that have a well-developed biological mechanism to degrade nonliving cornified layer of the epidermis or keratinized tissues which are usually found in the skin, hair, and nails of human and other animals. They lack ability to penetrate viable tissue of an immunocompetent host[1]. Dermatological problems manifesting as primary and secondary cutaneous complaints constitute at least 30% of all outpatient visits to a paediatrician[2,3]. Medical treatments, immune-compromised conditions, malnutrition, surgeries and exposure to heavy metals (like mercury) have responsibility for the increase in fungal infections[4-6]. Other factors that can predispose one to fungal infections include personal hygiene, crowded living and poor sanitary condition, size of family, age, warm humid climate, socioeconomic status, and international travels[7-9].

Farm workers that are exposed to various reservoirs of dermatophytes like mud, cow dung, manure, dust and soil are prone to both superficial and other forms of mycoses[10-12].

The prevalence of superficial mycotic infections is on the rise in the recent time has risen to such a level in the last decades that skin mycoses now affect more than 20–25% of the world's population, making them one of the most frequent forms of infections[13]. The distribution of the dermatomycoses, their causative agents and the prevailing infection patterns vary with geographical location and are also affected by a wide range of environmental and cultural factors[14-15]. In addition, the frequency of dermatomycoses is fostered by low socioeconomic status: crowded living conditions which provide multiple opportunities for skin-to-skin contact. Proximity to animals and long use of antibacterial drugs contribute to the high prevalence of dermatophytes. Dermatophytosis inflicts a lot of psychosocial trauma due to attached social stigma, ulceration, and sometimes irritation as well as representing a potential source of secondary bacterial infections[16]. Fungal infections caused by dermatophytes had been extensively reported to be a public health problem in Nigeria and all over the world[17-19].

This, however, cannot still be overemphasized as the contagious nature among animal communities; the high cost of treatment, the difficulty of control, and the public health consequences explain their great importance[20]. More so, adequate information provided on the reported cases will help focus on the provision of adequate patient management, diagnosis, control programmes and antifungal drug resistance surveillance. Hence, this systematic study/review attempts to summarize current epidemiological trends for fungal infections. Its main focus is on dermatophytes in Cameroun, Ivory Coast, Mali and Nigeria where these infections have the highest prevalence in sub-Saharan Africa.

Experimental

Search Criteria

A systematic literature search for articles on dermatophytes in selected West African countries was done in March 2019. The period included in this search was from January 2007 to January 2019. The literature search was done using African Journals Online (AJOL), Google Scholar, Medline, NCBI and PubMed databases and other relevant literature to identify all published papers reporting fungal infection rates from West Africa. The search terms used were fungal infections and West Africa, mycosis and West Africa, dermatophytosis in West Africa, dermatophytosis in each of the countries in West Africa, skin infections, mycosis, dermatophytes, and prevalence of dermatophytes in each of the West African countries. Published articles from Nigeria and neighboring West African countries such as Cameroon, Mali, Ivory Coast, Senegal, Burkina Faso, Togo, and Ghana were considered for further analysis. During the searching, abstracts were reviewed and relevant studies with full-text articles concerning the objective were sought for. Duplicate studies were excluded. Articles on the worldwide epidemiology of invasive fungal infections were reviewed for citations of publications (journal articles and books) from those countries. The references in all relevant papers were reviewed for additional publications that may not have been cited elsewhere. However, a manual search of the reference lists of all the selected articles was also performed to identify other relevant articles for final selection. Articles were selected if the following inclusion criteria were fulfilled: availability of full-text article in English; studies were performed on humans and site of infection was appropriately stated. In addition, for each of the papers, the study design include a population base (hospital, community, and special cohorts), diagnostic criteria on dermatophytosis, survey methods, and results were reviewed. More so, specific populations at risk were used although, most papers on dermatophytosis reported children as most affected.

Eligibility of the Studies

Studies focusing on dermatophytosis, with relevant data stated were selected (**Fig. 1**).

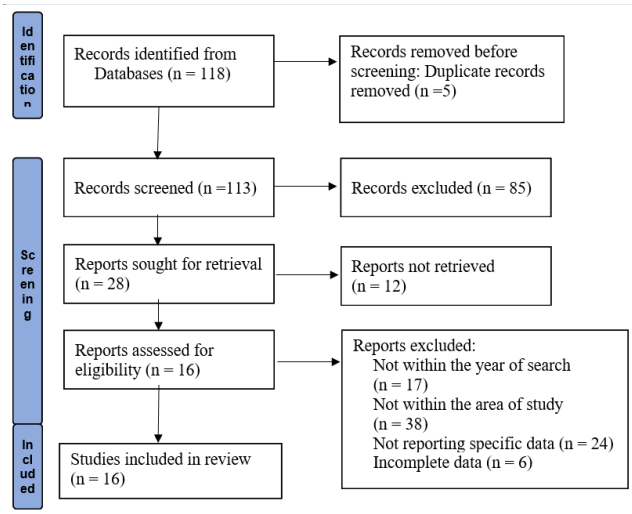

Fig. 1. Identification of studies included in the review of dermatophytes and dermatophytoses acquisition among school-age children.

Inclusion Criteria

Observational studies done in schools, hospitals and communities were included in the

study. The objective of the study was to find out the epidemiology of dermatophytes in West African countries.

Exclusion Criteria

Case reports, editorials, commentaries, letters to the editor and unpublished material were excluded from this study. Articles, in which data were not expressed and as well without citation were excluded from the study. Articles which do not relate to the geographical area of study were also excluded.

Results & Discussion

The incidence of dermatophytosis according to the age group is presented in **Table 1**. The age range of the study participants is < 1–15 years. The age group predominantly infected was 6 -10 years (78.09%) followed by 11-15years (15.43%). The lowest incidence was from the age group < 1- 5 years (6.49%) respectively. The total number of subjects reported in all the studies were 36,299. **Table 2** shows the total number of subjects screened in the studies that were reviewed from the countries were the primary investigations were conducted. A total of 6,262 were positive to dernmatophytes with a prevalence of 172.51 per 1000 persons screened. Although, sex of the subjects from Ivory Coast was not specified. A total of 67 (54.92 %) out of 122 organisms isolated from different dermatophytic infections were reported to be *Trichophyton* spp. *Trichophyton* was the most predominantly isolated species followed by *Microsporum* with 27.87 % (n=34) and *Epidermophyton* (4.09 %) as shown in **Table 3**.

Table 1: Age distribution of school age children with dermatophytosis in the studies

Age	Total	Percentage (%)
< 1 -5	2354	6.49
6 – 10	28345	78.09
11 – 15	5600	15.43

Table 2: Incidence of dermatophytes according to sex and country distribution

Country	Sex/ Gender	No.Screened	No. Positive	Incidence(perthousand)
Nigeria	M	6815	1923	269.85
	F	6548	1275	188.38
	Sub-total	***13363***	***3198***	
Cameroun	M	2800	303	108.21
	F	1801	74	41.08
	Sub-total	***4601***	***377***	
Ivory Coast	M	NS*	1819	NS*
	F	NS*	639	NS*
	Sub-total	***17745***	***2455***	
Mali	M	286	142	496.50
	F	304	90	296.05
	Sub-total	**590**	***232***	
Total		**36299**	**6262**	**172.51**

NS*-notspecified

Table 3: Prevalence of dermatophytic fungi in cases of dermatophytosis among school children

Genus	Species	No. of Occurrence	% of Occurrence
Trichophyton	*schoenleinii*	7	10.45
	verrrucosum	7	10.45
	mentagrophytes	13	19.40
	tonsurans	10	14.93
	yaoundei	1	1.49
	rubrum	11	16.42
	concentricum	1	1.49
	soudanense	8	11.94
	violaceum	6	8.96
	terrestre	1	1.49
	interdigitale	1	1.49
	other species	1	1.49
		n = 67	100
Microsporum	*gallinae*	2	5.88
	gypseum	6	17.65
	canis	7	20.59
	audouinii	11	32.35
	ferrugineum	3	8.82
	nauum	2	5.88
	langeronii	2	5.88
	other species	1	2.94
		n= 34	100
Epidermophyton	*floccosum*	4	80
	Other species	1	20
		n= 5	100
Aspergillus	*fumigatus*	3	50.00
	niger	2	33.33
	flavus	1	16.67
		n= 6	100
Candida	*albicans*	n= 2	100
Penicillium	NS*	n= 2	100
Mucor	NS*	n= 2	100
Trichoderma	NS*	n= 1	100
Rhizopus	NS*	n= 1	100
Alternaria	NS*	n= 1	100
Acremonium	NS*	n= 1	100

NS - Not specified*

As shown in **Table 4**, a total of 36,299 subjects were screened while only 6,417 were infected with dermatophytes. Studies from Ivory Coast screened the highest number of subjects (n=17,745) with 138.51 incidences per 1000, followed by those from Nigeria with 13,363 with 239.32 incidences per 1000 while 4,601 subjects were screened in Cameroun with an incidence of 81.93per 1000. Nigeria has the highest number of children infected by dermatophytes followed by the Ivory Coast. Of all the countries from which the primary studies were conducted, Mali has the highest incidence of 393.22 per 1000.

Table 4: Distribution of dermatophytes among the school age children based on countries

Countries	No of Articles	Total No. Sampled	Total No Infected	Incidence Per Thousand)
Nigeria	13	13,363	3198	239.32
Cameroun	1	4,601	377	81.93
Ivory coast	1	17,745	2,455	138.35
Mali	1	590	232	393.22
	Total	36,299	6,417	176.78

Tinea capitis was the most prevalent clinical feature among the dermatophytosis reported. Tinea capitis accountyed for 44.4% of the dermatophytosis reported followed by Tinea corporis and Tinea unguium with percentage prevalence of 19.4% and 13.9 % respectively (**Table 5**). The distribution of dermatophytes in the articles as shown in Table 6. the primary data were collected from different subjects from different places were the subjects were recruited. Twelve out of sixteen studies were from school-based while 3 and 1 were from community and hospital respectively (**Table 6**). **Table 7** shows the distribution of dermatophytes and the body part affected. Most isolates were recovered from the scalp [n=2471 (38.51%)], followed by scalpwithother parts of the body [n=2142 (33.38%)] were the main body affected by the infection.

Table 5: Prevalence of various clinical types of dermatophytes

Clinical Features	No of Appearance	Percentage (%) of Appearance
Tinea capitis	16	44.4
Tinea unguium	5	13.9
Tinea faciei	2	5.6
Tinea corporis	7	19.4
Pityriasis versicolor	1	2.8
Tinea pedis	3	8.3
Tinea cruris	1	2.8
Tinea mauum	1	2.8
Total	**36**	**100**

Table 6: Study base of the study and the source of the data for the determination of demertophytes in school children

Type of study	No of Articles	Total No. Investigated	Total No. Positive	Incidence Per Thousand
School-based	12	33753	5905	169.60
Community-based	3	2114	463	219.01
Hospital-based	1	432	49	113.42
Total	16	37362	6417	171.77

Table 7: Distribution of dermatophytes according to sites of infection among the subjects

Parts Affected	Frequency In Articles	Percentage Occurrence
Scalp	2471	38.51
Hand	112	1.74
Trunk	80	1.25
Skin	46	0.71
Ear	21	0.33
Face	189	2.94
Toe and nails	479	7.46
Nails only	28	0.44
Head only	413	6.43
Body only	336	5.23
Finger	21	0.33
Groin	14	0.22
Feet	35	0.54
Finger nails	7	0.11
Scalp with body	2142	33.38
NS*	24	0.38
Total	6417	100

NS- Not specified*.

The word cloud of the key words found in the article used was shown in **Fig. 2** while the map of the countries where the primary research were conducted were shown in Figure 3.

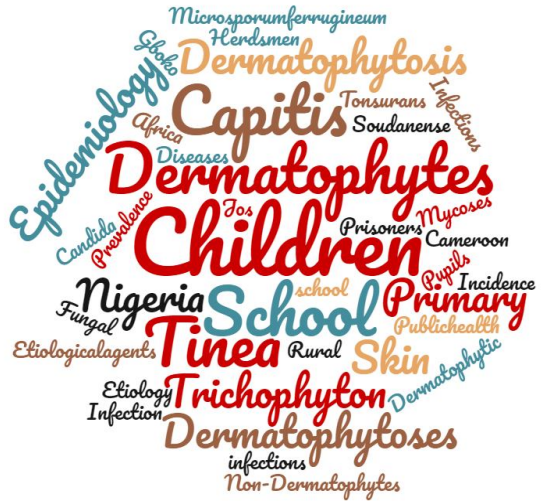

Fig. 2. Word cloud showing the frequency of the keywords used in the articles.

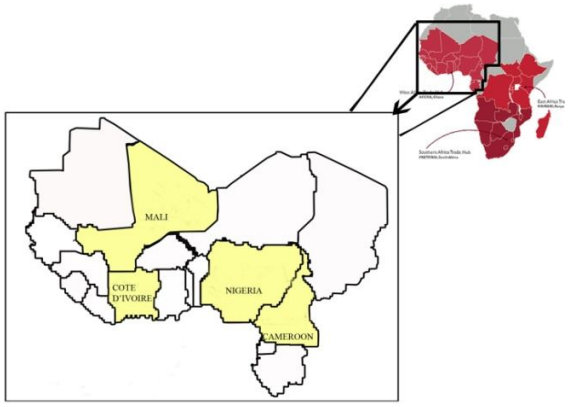

Fig. 3. A Map showing the selected countries from which the data were collected

DISCUSSION

This survey showed that the children age group 6–10 years followed by 11–15 years are mostly affected by Tinea capitis which is similar to the report of Ayanbimpe *et al.*[21]. There is a general belief that children of this age group constitute the most active population who are explorative and engage in playful activities on the playgrounds that allow for a high degree of body contact and are more likely to be in closer contact with sources of a fungal pathogen like soil. Large family sizes, close family contact (overcrowding) and sharing of personal items like combs, towels, and pillows together account for the high incidence of Tinea capitis in children[22]. Similarly, poor standard of living and poor hygiene could also be predisposing factors encouraging the high rate of dermatophyte infections among children. Also, pre-puberty and puberty years have been identified as a high infection period for dermatophytosis[23].

In addition, Tinea capitis primarily affects children in developing countries while Tinea pedis and Tinea unguium pose the greatest burden to adults and the elderly in developed countries[24]. The results of this survey corroborate similar studies in the United States, which have recognized Tinea capitis as an increasingly common pediatric infection with the highest incidence occurring mostly in black children[25]. According to Onubogu*et al.*[26], daily hair care with soap is even a risk factor for Tinea capitis, because acid soaps fight against bacterial proliferation contrary to fungus, and alkaline soaps increase the pH of the skin, making it more vulnerable to infections. The high incidence of this infection in this group may be due to low fungistatic fatty acid levels which imply the absence of saturated fatty acids that provide a natural protective mechanism against fungal infections[27].

The frequency of occurrence of dermatophytosis was higher in males than females. The susceptibility of boys to scalp infection has been attributed to their low haircut, and frequent sharing of caps, combs and hair brushes. Also, the sex has greater contact with soil than the opposite gender as reported by Ayanbimpe *et al.*[21],Popoola *et al.*[28], George and Altraide[29], Ndako *et al.*[30] and Adesiji *et al.*[31].

This survey has confirmed the overall prevalence rate of different dermatophytes comprised of 12 species of *Trichophyton*, 6 species of *Microsporum*, 2 species of *Epidermophyton* and seven genera of non-dermatophytic fungi. Of the genera, *Trichophyton*; *Trichophyton mentagrophytes* recorded the highest prevalence (19.40%) followed by *T. rubrum* (16.42%) and *T. tonsurans* (14.93%) this follows earlier reports by Adesiji *et al*[31].Several studies reported species of *Trichophyton* as the main causative agent of Tinea capitis[32-35].Oyekaand Eze[27] and Fulgence *et al.*[33] in Ivory Coast, Nweze and Okafor[36], Ngwogu and Otokunefor[37], and Ayanbimpe *et al.*[21] in Nigeria, Kechia *et al.*[38] in Cameroun, and Davide*t al.*[39] in Nigeria earlier documented the finding. The organism has been reported to predominate in most of Sub-Saharan West Africa[21,39,40].

Most of the species isolated were anthropophilic in nature, there were also some species of zoophilic origin which could be due to contact with some animals such as cats, fowls and dogs which are domesticated in some homes. However, the dominance of anthropophilic dermatophytes may reflect important risk factors involved in the spread of Tinea capitis in the community such as direct contact with infected humans or indirect contact with infected fomites[41-44]. In other words, these animals could serve as reservoirs for some of these organisms and hence a means of transmission. *Trichophyton* species are more prevalent compared to *Microsporum* species. Among the non-dermatophytic species *Aspergillus* spp. and *Penicillium* spp. recorded the highest occurrence. This has been attributed to the abundant nature of their spores in our environment[45,46]. Studies by Ayanbimpe *et al.*[21] and Ndako *et al.*[30] also reported some non-dermatophytes to be associated with human skin infections.

Conclusion

Improve hygiene should be encouraged and another predisposing factors like sharing of combs, towels and foot wears should be discouraged. Since the climatic condition of West Africa naturally encourages the growth of pathogens, parents and school-age children should be educated on the spread of the disease and its control.

Acknowledgements

We appreciate Dr. Oluwole Olusola Adeoye for assisting in sourcing for articles.

Funding Details

The author received no funding for this work.

Conflict of interest

The authors declare that there are no conflicts of interest to the present work.

References

1. Macha M.E.; Makange, M.R.; Misinzo, G. *Afr. J. Med. Health Sci.*, **2020,** *19(7),* 103-109. DOI: 10.3390/jof8070757
2. Vennewald, I.; Wollina, U. *Clin. Dermatol.*, **2005,** *23(6),* 565–571. DOI: 10.3923/ajava.2010.180.192
3. Boualem, B.; Shahar, H.K.; Abdulrahman, H. *Mal. J. Med. Health Sci.*, **2022,** *18(1),* 206-213.
4. Aaron, U.U.; Onoja, U. *Curr. Stud. Comparat. Educ. Sci. Technol.*, **2017,** *4(1),* 40-49.
5. Terrell, C.L. Antifungal agents. Part 11. The azoles. *Mayo Clinic Proc*., **1999,** *74* 78–100. DOI: 10.4065/74.1.78
6. Rolston, K. Overview of systemic fungal infections. *Oncol.,* **2001,** *15(11),* 11–14. DOI: 10.1093/jac/dki218.
7. Odeigah, L.; Rotifa, S.; Shittu, R.; Mutalub, Y. *Annals Afr. Med. Res.*, **2020,** *3,* 23-27. DOI: 10.4081/aamr.2020.100.
8. Gugnani, H.C. *Nig. J. Microbiol.*, **1982,** *2,* 47–451. DOI: 10.12691/ajidm-1-6-1.
9. Shenoi, S.D.; Davis, S.V.; Rao, S.; Rao, G.; Nair, S. *Ind. J. Dermatol. Venereol. Leprol.*, **2005,** *71(4),* 254–258. DOI: 10.4103/0378-6323.16617.
10. Moskaluk, A.E.; VandeWoude, S. *Pathogens*, **2022,** *11,* 957. DOI: 10.3390/ pathogens 11090957.
11. Nweze, E.I.; Eke, I.E. *Med. Mycol.*, **2018,** *56(1),* 13–28. DOI: 10.1093/mmy/myx025
12. Oyeka, C.A.; Okoli, I. *Mycoses,* **2003,** *46(8),* 336–338. DOI: 10.1046/j.1439-0507.2003.00899.x
13. Efuntoye, M.O.; Sobowale, A.A.; Mabakoje, O.O.; Agu, G.C. *Egyp. Dermatol. Onlinase J.*, **2011,** *7(1),* 4.
14. Uhrlab, S.; Verma, S.B.; Graser, Y.; Rezaei-Matehkolaei, A.; Hatami, M.; Schaller, M.; Nenoff, P. *J. Fungi*, **2022,** *8,* 757. DOI: 10.3390/jof8070757
15. Shathele, M.S.; Fadlelmula, A. *Asian J. Animal Veter. Adv.*, **2010,** *5(3),* 180–192. DOI: 10.3923/ajava.2010.180.192
16. Macura, A.B. *Inter. J. Dermatol.*, **1993,** *32,* 313–323. DOI: 10.1111/j.1365-4362.1993.tb01464.x
17. Coloe, J.R.; Diab, M.; Moennich, J. *Mycoses,* **2010,** *53(2),* 158–162. DOI: 10.1111/j.1439-0507.2008.01665.x
18. Shy, R. *Pediatr Rev.*, **2007,** *28(5):* 164–174. DOI: 10.1542/pir.28-5-164.
19. Patro, N.; Panda, M.; Jena, K. I*ndian Dermatol. Online J.*, **2019,** *10,* 262–266. DOI: 10.4103/idoj.IDOJ_342_18.
20. Ayanbimpe, G.M.; Taghir, H.; Diya, A.; Wapwera, S. *Mycoses.*, **2008,** *51(4),* 336–340. DOI: 10.1111/j.1439-0507.2007.01476.x
21. Ayanbimpe, G.M.; Enweani, I.B.; Solomon, E.C. *Afr. J. Clin. Exper. Microbiol.*, **2003,** *4,* 2–10. DOI: 10.4314/ajcem.v4i2.7302
22. Gugnani, H.C.; Njoku-Obi,A.N.; Okoro, A.N.. *West Afr. Med. J.*, **1975,** *23*, 111–115.
23. Giarni, C.; Betti, R.; Perotta, E.; Crosti, C. *Mycoses,* **1995,** *38,* 329–331. DOI: 10.1111/j.1439-0507.1995.tb00417.x

24. Achterman, R.R.; White, T.C.*PLoS Path.*, **2012,** *8(3),* e1002564. DOI: 10.1371/journal.ppat. 1002564
25. Chepchirchir, A.; Bii, C.; Ndinya-Achola, J. *East Afr. Medical J.*, **2009,** *86*, 59-68. DOI: 10.4314/eamj.v86i2.46934
26. Onubogu, C.U.; Ushie, S.N.; Aghanya, I.N.; Ugochukwu, A.F. *Asian J. Res. Infect. Dis.*, **2022,** *11(2),* 22-32. DOI: 10.9734/AJRID/2022/ v11i2214
27. Oyeka, C.A.; Eze, I.I. *Mycoses*, **2008,** *51(1),* 50–54. DOI: 10.1111/j.1439-0507.2007.01408.x
28. Popoola, T.O.S.; Ojo, D.A.; Alabi, R.O. *Mycoses*, **2006,** *49*, 499–503.DOI:10.1111/j.1439-0507.2006.01279.x
29. George, I.O.; Altraide, D.D. *Nig. Health J.*, **2008,** *8*, 3-4.
30. Ndako, J.A.; Osemwegie, O.O.; Spencer, T.H.; Olopade, B.K.; Yunusa, G.A.; Banda, J.*Global Adv. Res. J. Med. Medical Sci.*, **2012,** *1(3),* 049-056. https://garj.org/garjmms/index.htm
31. Adesiji, Y.O.; Omolade, B.F.; Aderibigbe, I.A.; Ogungbe, O.V.; Adefioye, O.A.; Adedokun, S.A.; Adekanle, M.A.; Ojedele, R.O. *Diseases*, **2019,** *7*, 13. DOI: 10.3390/diseases7010013
32. Soyinka, F. *Mycopathol.*, **1978,** *63(2),* 99–103. DOI: 10.1007/BF00441255.
33. Fulgence, K.K.; Abibatou, K.; Vincent, D.; Henriette, V.; Etienne, A.K.; Kiki-Barro, P.C.; Yavo, W.; Kone, M.; Ignace, M.E. *Inter. J. Dermatol.*, **2013,** *52*, 456–460. DOI:10.1111/j.1365-4632.2012.05733.x
34. Monan, E.I.H.; Zongo-Bonou, O.; Rouet, F. *Inter. J. Dermatol.*, **2002,** *41*, 204–207. DOI:10.1046/j.1365-4362.2002.01456.x.
35. Adefemi, S.A.; Odeigah, L.O.; Alabi, K.M. *Nig. J. Clin. Practice*, **2011,** *14(1),* 23–28. DOI: 10.4103/1119-3077.79235.
36. Nweze, E.I.; Okafor, J.I.*Mycopathol.*, **2005,** *160*, 239–243. DOI: 10.1007/s11046-005-0124-0.
37. Ngwogu, A.C.; Otokunefor, V.T. *Mycopathol.*, **2007,** *164*, 149-158. DOI: 10.1007/s11046-007-9038-3
38. Kechia, F.A.; Kouoto, E.A.; Nkoa, T.; Nweze, E.I.; Fokoua, D.C.; Fosso, S.; Somo, M.R. *J. Mycol. Med.*, **2014,** *24(2),* 129-134. DOI:10.1016/j.mycmed.2013.12.002
39. David, O.M.; Ajayi, Y.O.; Babalola, T.O. *Egypt. Acad. J. Biolog. Sci.*, **2020,** *12(2),* 1-8.
40. Anosike, J.C.; Keke, I.R.; Uwaezuoke, J.C.; Anoeiz, J.; Obiukwu, C.; Nwoke, B. *J. Appl. Sci. Environ. Manag.*, **2005,** *9*, 21-25. DOI: 10.4314/jasem.v9i3.17347.
41. Johnson L. *Mycologist.*, **2003,** *17(4),* 147–149. DOI: 10.1017/S0269915X04004185.
42. Rabinowitz, P.M.; Gordon, Z.; Odofn, L. *Amer. Fam. Physician.*, **2007,** *76(9),* 1314–1322.
43. Michaels, B.D.; Del Rosso, J.Q. *J. Clin. Aesthetic Dermatol.*, **2012,** *5(2),* 49–59.
44. Segal, E.; Elad, D. *Frontiers Microbiol.*, **2021,** *12*, 1-10. DOI: 10.3389/fmicb.2021.713532
45. Nweze, E.I.*Rev. Iberoam. Micol.*, **2010,** *27(4),* 191–194. DOI: 10.1016/j.riam.2010.06.003
46. Gnat, S.; Nowakiewicz, A.; Lagowski, D.; Zieba, P. *J. Med. Microbiol.*, **2019,** *68*, 823–836. DOI: 10.1099/jmm.0.000982.