UMYU Scientifica, Vol. 2 NO. 3, September 2023, Pp 121 – 127
https://doi.org/10.56919/usci.2323.018
ISSN: 2955 – 1145 (print); 2955 – 1153 (online)
A periodical of the Faculty of Natural and Applied Sciences, UMYU, Katsina

ORIGINAL RESEARCH ARTICLE

Prevalence of Dandruff among the Pupils and Staff of some Selected Public Schools in Katsina State.

Nawaf A.[1], Junaidu S.[2], Ibrahim S.[2], Babangida I.[2] and Liadi S.[1].
[1]Department of Biological Science, Federal University Lokoja, Kogi State.
[2]Department of Biology, Isa Kaita College of Education, Dutsin-Ma, Katsina State.

ABSTRACT
Dandruff is characterized by patches of loosely attached flakes on the scalp, which are generally accompanied by irritation. *malassezia* species of the genus *restricta* and globossa, Staphylococcus species of the genus aureus, and Bacteria of the genus Propiobacterium are components of human skin microflora and etiological agents of dandruff. The purpose of this study was to investigate the prevalence of dandruff, Isolation and identification of the pathogens causing the dandruff infection among secondary school students in Katsina State. The study was a cross-sectional survey conducted with the permission of seven local government areas, namely: Katsina, Funtua, Mani, Kankia, Malunfashi, Dutsin-ma, and Daura. According to the prevalence studies of the selected LGAs, Kankia and Mani Local Governments had the highest prevalence rates of 14.81% and 14.65%, respectively, followed by Daura, Malunfashi, and Funtua with 14.49%, 14.33%, and 14.01%. Dutsinma and Katsina had the lowest prevalence rates, of 13.85% and 13.85%, respectively. Males (51%) were more affected than females (49%), out of the 420 people polled. The prevalence by age shows that the age group 11-20 years has the highest incidence of dandruff infection, with 58.83%, followed by the age groups 1-10 years, with 21.88%, and 21-30 years, with 8.27%. The socioeconomic position of the individuals studied was found to be a risk factor for the occurrence of this disease. The prevalence of dandruff was highest in villages, followed by towns, with 58% and 42%, respectively. To prevent the spread of this disease, the researchers recommend sterilizing barbing and weaving materials.

ARTICLE HISTORY
Received June 25, 2023.
Accepted September 28, 2023.
Published September 30, 2023.

KEYWORDS
Dandruff, Prevalence, Scalp.

INTRODUCTION
Dandruff is one of the most frequent scalp problems in adults and adolescents, characterized by excessive shedding of dead skin cells. The scalp flaking is defined by regions of loosely adherent flakes, which are generally accompanied by irritation (Schwartz *et al.*, 2010). Dandruff is distinguished clinically by microscopic white or gray flakes that gather in scattered regions on the scalp. It is restricted to the scalp and does not appear to be inflamed. Seborrheic dermatitis is defined by the formation of red patches with yellow-gray scales that appear most frequently on the face, scalp, upper chest, and back (Schwartz *et al.*, 2010). About 50% of humans are impacted to some extent, with start during puberty and peaking around the age of 20 and becoming less common after the age of 50 (Baroni *et al.*, 2008). The etiology of dandruff and Seborrheic dermatitis appears to be based on three elements, according to the most recent evidence: sebaceous gland secretions, micro-floral metabolism, and individual sensitivity (Deangelis *et al.*, 2005). Dandruff is caused by the fungus *Malassezia restricta* and *M. globosa*, as well as bacteria *Propionibacterium acnes* and *Staphylococcus epidermidis* (Zhijue, 2016). The genus *Malassezia,* formerly called *Pityrosporum*, causes infection of skin and scalp (Rippon, 2000). Warm and humid atmosphere, overcrowding and poor personal hygiene are ideally suited for the growth of *Malassezia* (Rippon, 2000).

Dandruff infection is unpleasant and can result in an uncomfortable scenario (Rippon, 2010). Although not communicable; the fungi has the potential to infect everyone in a population at some point, particularly during early adulthood. Over the last few years, over 200 million people have been presumed to have Dandruff, with at least 50 million people in the United States spending over $300 million each year on over-the-counter medications to cure scalp irritation and flaking. Although there is inadequate evidence to assess the occurrence of the infection in various parts of the World, recent research have showed that the prevalence of dandruff in South Asia

Correspondence: SANUSI, Junaidu. Department of Biology, Isa Kaita College of Education, Dutsin-Ma, Katsina State. ✉ ismailjunaid63@gmail.com. Phone Number: +234 816 328 6669.
How to cite: Nawaf A., Sanusi, J., Ibrahim S., Babangida I., & Liadi S. (2023). Prevalence of Dandruff among the Pupuls and Staff of some Selected Public School in Katsina State. *UMYU Scientifica*, 2(3), 121 – 127. https://doi.org/10.56919/usci.2323.018

is 60.1%, which is higher than the global estimate (50%) (Rippon, 2010). According to recent data, the prevalence in Africa, particularly Sub-Saharan Africa, could be substantial (81-95%). Africans and Americans are infected at a rate of 66-82% of Caucasians and 30-42% of Chinese in the American population (Rippon, 2010). This might significantly provide a hint on the incidence in Africa especially when socioeconomic and environmental factors are taken into consideration.

Available evidences indicate the rising of dandruff infection burden. Despite the potential significant burden of dandruff in Nigeria, there is lack of reliable data on its prevalence in the Northern part particularly Katsina State. Conducting this research would provide valuable insights into the extent and distribution of dandruff in the selected local government areas.

This study aimed to investigate the prevalence of dandruff among the pupils of some selected public schools of Katsina State with the following specific objectives:

i. Determine the prevalence of dandruff among people in some selected Local Government Areas of Katsina State.
ii. Isolate and identify the pathogens causing the dandruff infection

MATERIALS AND METHODS

Study Area

The prevalence of dandruff studies was carried out in some selected local government areas in Katsina State. A sample were collected in Katsina State, Northwestern Nigeria. Katsina State covers an area 23,938 sq.km, located between latitudes 11Â°08'N and 13Â°22'N and longitudes 6Â°52'E and 9Â°20'E. The State is bounded by Niger Republic to the North, Jigawa and Kano States to the East, Kaduna State to the South and Zamfara State to the West (Figure 1). As of 2006, Katsina's estimated population was 5,801,584 with total annual rainfall ranging from 600 to 700mm and 1000mm. The city is the center of an agricultural region producing groundnuts, cotton, hides, millet and guinea corn, and also has mills for producing peanut oil and steel (Canback, 2008).Some of the major rivers which originate in or transverse the State contain water in their channels only during the rainy season and have little or no water in the dry season. A cool dry (harmattan) season from December to February; a hot dry season from March to May; a warm wet season from June to September and a less marked season after rains during the months of October to November, characterized by decreasing rainfall and a gradual lowering of temperature. The southern half of the state belongs to the Northern Guinea Savannah Zone, while the north belongs to the Sudan Savannah Zone (Canback, 2008).

Figure 1 Map of Katsina State showing study area

Determination of sample size

Prevalence rate of 50 % (Baroni *et al.,* 2008) on Dandruff in the world, the sample size was estimated using a formula (equation 1) developed by Hassard (1963).

$n=Z^2Pq/d^2$ - ---------- eqn (1)

Where; n = sample size, Z = abscissa of normal curve at 95% confidence level of 1.96. P = prevalence obtained from previous report = 0.50, q = 1-P, d = allowable error = 0.05.

Therefore, $n=1.96^2\times0.50(0.50)/0.05^2$, n=384.16 approximately 384

Ethical permit

The permission was based on commitments that participants anonymity would be preserved; ethical clearance was obtained from State Ministry of Education Katsina, Katsina State. Excellent laboratory practice quality control would be achieved, and this research would be used solely for this reason.

Sample collection site

The study was a cross sectional survey and was done with the consent of seven local government areas namely: Dutsin-ma, Daura,Funtua, Kankia, Malunfashi, Mani,Katsina. A total of 420 from the student of primary schools, secondary schools and staff were used in this study using a Cluster sampling techniques as described by Kreyce and Morgan (1971) in a random selection of 60 students and staff from each primary and a secondary school in the selected local government areas. All the schools used in this study were public schools with crowded class rooms and inadequate facilities. Majority of

the children hailed from low-income socio-economic class. The participants were selected from the grades (classes 1-6) in both selected primary and secondary schools. Children were compensated with writing materials after the sample collection.

Questionnaire was also administered to the students and the staff of the selected schools. The questionnaire was made up of two parts. First part requiring background information of the respondents, which sought information on their age, sex, social status, while the second part (disease and behavior of respondents), sought information on previous knowledge of dandruff, scalp itching and discomfort, and their causes. The second part also sought to know the types of curative method(s) being used in treating dandruff and method used in preventing and controlling dandruff generally.

Collection and Preparation of Dandruff Samples

Four hundred and twenty (420) samples from the scalp of the staff and students from the selected primary schools and secondary schools within the study area were collected through the help of volunteers which are registered heath personnel (medical laboratory personnel). Sharp and sterile epilation forceps were used to detach the small hair and scalp samples from the infected persons. The infected region was first washed with 70% ethanol followed by scraping with the sterile epilation forceps which was held at an angle of 90^{o} with the head. The specimen was then transferred into a dark sampling paper to prevent exposure to sunlight to prevent the denaturing of the dandruff infection pathogens. Each sample was labeled. The samples were taken to the laboratory for analysis (Cheesbrough, 2006).

RESULTS

The frequency of dandruff among secondary school students was studied in seven Local Government Areas (LGAs) of Katsina State (Katsina, Funtua, Mani, Kankia, Malunfashi, Dutsin-ma and Daura.), with a total study population of 420 subjects. The overall incidence of the infection was 47.86% of the study population. The prevalence from the selected LGAs showed that Kankia and Mani Local Governments had the highest prevalence rate of 14.81% and 14.65% each, followed by Daura, Malunfashi and Funtua with 14.49%, 14.33% and 14.01% respectively. The lower prevalence rate was recorded in Dutsin-ma and Katsina with 13.85% each as shown in Table 4.1. Out of sampled population, males (51%) were more affected than females (49%) as shown in Table 2. The prevalence by age shows that the age group 11-20 years had more incidences of dandruff infection, having 58.83% followed by age group 1-10 years, with 21.88% and 21-30 years with 8.27%. The low incidence of dandruff infection was recorded in 31-40, 41-50, and 51-60 age groups with 6.97%, 3.40% and 0.65%, respectively (Table 4). The prevalence by socioeconomic status shows high incidence of dandruff in villages followed by towns with prevalence of 58% and 42%, respectively (Table 3).

Table 1: Prevalence of Dandruff by Local Government

Local governments	Number of sample	Number Infected	Prevalence (%)
Katsina	60	26	13.85
Funtua	60	27	14.01
Malumfashi	60	29	14.33
Daura	60	30	14.49
Dutsin-ma	60	26	13.85
Mani	60	31	14.65
Kankia	60	32	14.81
Overaall prevalence	420	201	47.86

P value = 0.9911, Chi-square statistic = 0.8341, Degrees of Freedom = 6. Not significantly associated.

Table 2: Prevalence of Dandruff by Gender

Gender	Number of samples	Number infected	Prevalence (%)
Female	210	97	49
Male	210	104	51
Total	420	201	100

P value = 0.7487, Chi-square = 0.1026, Degrees of freedom = 1. Not significantly associated.

Table 3: Prevalence of Dandruff by Socioeconomic Status

Socioeconomic status	Number of samples	Number infected	Prevalence (%)
Village	245	115	58
Town	175	82	42
Total	420	197	100

P value = 0.9921, Chi-square statistic = 9.873. Degrees of freedom = 1. Not significantly associated.

Table 4: Prevalence of Dandruff by Age

Age group	Number of sample	Number Infected	Prevalence (%)
1-10	103	32	21.88
11-20	236	127	58.83
21-30	32	19	8.27
31-40	30	13	6.97
41-50	16	05	3.40
51-60	03	01	0.65
Total	420	197	100

P value = 0.1214. n=420, Chi-square= 8.706, Degrees of Freedom= 5. Not significantly associated.

Identification of Fungi and Bacteria Associated with Dandruff

Fungal Isolates

Four distinct fungal isolates were found from the 420 dandruff samples obtained from this study for fungal presence as *Malassezia* spp. (*Malassezia restricta*, *Malassezia*

globossa,Malassezia furfur and *Malassezia pachydermatis*) were identified based on colonial, microscopic and biochemical properties as presented in Table 5. Among the identified isolates, *M. restricta* and *M. globossa* were the most prevalent isolates with 52.3%and 40.4% occurrence rate respectively. This was followed by *M. furfur* (4.07%) and *M. pachydermatis* (3.2%) as shown in Figure 2.

Table 5: Microscopic description and biochemical characterization of fungal isolates

Isolates	Colonial and Microscopic Description of Test isolates	Catalase Test	Urease Test	Identified Species
1	Colonies are small, flat to somewhat raised, dull, pale yellowish- brown, hard and brittle, smooth and somewhat ridged near the edge, and with loborate margin. The cells are avoid to globose with monopolar, percurrent budding on a relatively narrow base.	+	-	*M. restricta*
2	Colonies are raised, wrinkle to cerebriform, rough and brittle, pale yellowish shiny or dull, and with hypae margin slightly lobotate. In primary cultures, colonies are surrounded by abundant precipitate. Cells are spherical, and budding is monopolar on a narrow base.	-	-	*M. globossa*
3	Colony morphology ; White colored, finely folded surface, smooth and shiny surface, the cells are Spherical or ovoid in shape Narrow based budding	NA	+	*M. pachydermatis*
4	The colony is White Cream or Buff colored , convex, shiny smooth surface, cells are cylindrical Oval in shape with a Broad based budding	+	+	*M. furfur*

KEY: + = presence of growth - = absence of growth, NA= Not applicable

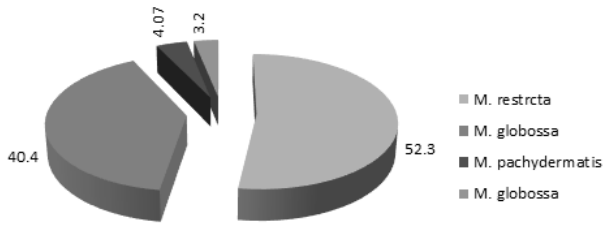

Figure 2: Occurrence rate of fungal isolates identified from Dandruff sample

Bacterial Isolates

Similarly, out of 420 dandruff samples collected from the study subjects the samples were also screened for the presence of bacterial pathogenes. A total of 4 different bacterial isolates were identified, 3 of the species were belonging to the same genera, *Staphylococcus* and the remaining belonging to genera *Propionibacterium*, as shown in Table 6. Majority (54.8%) of the identified isolates were *Propionibacterium acne*, followed by *Staphylococcus epidermidis*(41.3%), *S. aureus* (2.33%) and *S. capitis* with 1.5% incidence rate as shown in Figure 3.

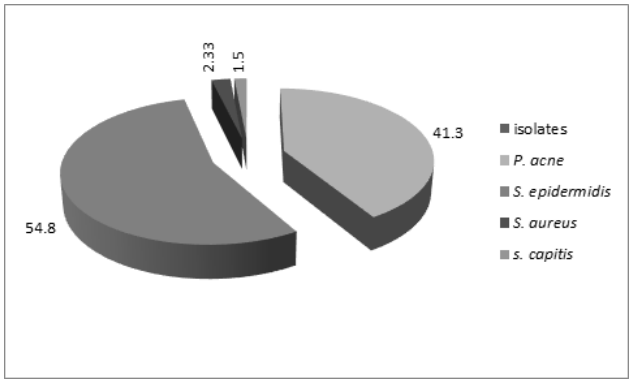

Figure 3: Percentage of Occurrence of Bacterial Isolates from Dandruff

Table 6: Microscopic Description and Biochemical Characterization of Bacterial Isolates

Isolate	Gram Stain			Biochemical Characteristics									TSI						Probable Identity
	GR	Shape	Type	COA	CAT	OXI	MR	VP	UR	IND	CIT	Starch	GLU	LAC	SUC	H_2S	GAS	MOT	
1	+	R	L	NA	+	+	-	+	+	-	+	+	+	-	-	+	-	-	*Propionibacterium acne*
2	+	C	C	-	+	-	-	+	+	-	-	-	+	+	+	+	+	-	*Staphylococcus epidermidis*
3	+	C	C	+	+	-	+	+	+	-	+	-	+	+	+	-	-	-	*Staphylococcus Aureus*
4	+	C	C	-	+	+	-	+	-	-	+	-	+	+	+	-	+	-	*Staphylococcus capitis*

Key - GR:Gram reaction. **COA:** Coagulase test. CAT: Catalase. OXI: oxidase. MR: methylred. VR: voges prokauer. UR: urease.IND: indole test. CIT: Citrate. TSI: Triple sugar ion GUL: glucose. LAC: lactose. SUC: sucrose. H2S: hydrogen sulfide production.GAS: gas production .MOT: motility. L: long. R: Rod. Cluster, cocci. Starch: starch hydrolysis

DISCUSSION

Dandruff is a common, unpleasant scalp disorder that is one of the major concerns for the health-conscious people over the world. This study showed that there is 47.86% prevalence of the infection among the sampled population. Results from the selected LGAs showed that Kankia and Mani had the highest prevalence rate of 14.81% and 14.65% respectively. The prevalence in these local governments could be as a result of occupation of the people dwelling in that area, as farming and rearing of animals are their major occupation of the people. These findings are in conformity with the findings of Nweze *et al.* (2005) and that of Adefemi *et al.* (2011). It is known that contact with animals and soil is the important factors for transmission of Dandruff. Lower prevalence of the infection was recorded in Katsina and Dutsin-ma with 13.85% each. Though, the prevalence was not significant ($p>0.05$), it is however not unprecedented. It could be attributed to the fact that people dwelling in that areas are mostly civil servants, have access to medical facilities, free from contact with animals, less crowded, and have good information about the causes of the dandruff.

In the present study, dandruff was found to be more prevalent in males than females with prevalence rate of 51% and 49% respectively. Similar findings with male predominance were reported in studies conducted by Priyam *et al.* (2019), who reported prevalence rates of 20.7% and 12.8% for males and female respectively. In a similar vein, Roopa and Biradar (2015) reported prevalence of 62.3% and 37.7% among males and females respectively. Most of the affected patients belonged to the age group of 11-20 years with prevalence of 58.83%, followed by 1-10 years (22%) and 21-30 (8.27%). However, there was low occurrence of the disease in Subjects above 50years which had the lowest prevalence of 0.65 %. Similar findings have been noted in studies by Laurent *et al.* (2013) and Priyam *et al.* (2019). High occurrence of dandruff in such age groups might be due to sweating from strenuous outdoor physical activity, exposure to infected animals, soil, and lack of awareness about the disease. Males in second decades of their life are generally engaged in active physical activities such as farming, Animal rearing and other stereceous activities , especially if they belong to low socioeconomic status. A study reported by Ghosh *et al.* (2014) is also in support of these findings. The incidence in the age group 1-10years could be attributed to their poor personal hygiene, especially in children from rural areas. This is in line with the findings of Aliero *et al.* (2013).

The results futher revealed that about 58% of the affected patients were from villages and belonged to low socioeconomic status, involved in active physical work. However, statistical analysis showed that there was no significant association between the prevalence of dandruff and demographic factors in the study area ($P>0.05$).

Malassezia restricta, M. globossa, Propionibacterium acne and *Staphylococcus epidermidis* were identified as the etiologic agents in the dandruff samples with the percentage frequency of occurrence of 52.3%, 40.04%, 54.8% and 41.3% respectively. This result is consistent with the findings of Cecile (2013), who identified *Malassezia restricta, M. globossa, P.acne* and *S. epidermidis* as the most prevalent microorganisms in the dandruff samples, with propotions of 49% and 40% respectively. On the other hand, *M. restricta* and *M. globossa* accounted for97%and1% respectively. This finding is in consonance with that of Zhiju *et al.* (2016) who reported that the severity of dandruff was closely associated with the interactions between the host and microorganisms and these microorganisms included; *M. restricta, M. globossa, P. acne* and *S. epidermidis*. The result also agrees with that of Surbhi *et al* (2018) who isolated *M. globossa*and *S. Aureus* as the prevalent organisms in dandruff sample. The result is also in line with the findings of Shuaibu *et al.* (2013), who identified*M. restricta, M. globossa* as the most prevalent fungi in dandruff suspected individual. Kohinu *et al.* (2019) reported that *M. globosa, M. restricta, M. sloofiae, M. sympodialis, M. furfur* and *M. pachydermatis* were responsible for causing dandruff. However accordance to the epidemiological data, different *Malassezia species* were

isolated in dandruff patients due to geographical variations (Hedayati *et al.,* 2010).

CONCLUSION AND RECOMMENDATION

This study isolated dandruff causing pathogens, from volunteers and found that dandruff infections were more prevalent in the local government areas with poor standard of living and poor personal hygiene. Molecular identification implicated the isolated bacterial strains, *P. acne* and *S. epidermidis* and fungal strain, *M. restricta* and *M. globossa* as the major pathogens associated with dandruff pathogenesis. The findings of this study recommend the following:

1. That there is need for creating awareness among the public for improvement in their personal hygiene.
2. The public should be enlightened on the disinfecting of barbing and weaving material, replacing the old ones with new one time to time
3. People should encourage to use some antiseptic agent in cleaning the barbing and weaving materials

REFERENCES

Acero, F., Aharonian, F., Akhperjanian, A. G., Anton, G., De Almeida, U. B., Bazer-Bachi, A. R., and Shalchi, A. (2010). First detection of VHE γ-rays from SN 1006 by HESS. *Astronomy & Astrophysics*, *516*, A62. **[Crossref]**

Adefemi A., Odeigah O., Alabi K. (2011). Prevalence of dermatophytois among primary school children in Oke-oyi community of Kwara State.*Niger. J. Clin. Practice***14**(1):23-27. **[Crossref]**

Akroum S, Satta D, Lalaoui K (2009). Antimicrobial, antioxidant, cytotoxic activities and phytochemical screening of some Algerian medicinal plants. *European Journal of Science. Research*. **2**:289-295

Aliero, A. A., Shehu, K., Manga, S. S. and Bagudo, A. I. (2013). Prevalence of dermatophytosis among school children in kebbi state, nigeria. Equity *Journal of Science and Technology* **1**(1):1-5

Baroni, A., De, R.R, and Donnarumma, G. (2008). New Strategies in Dandruff Treatment: Growth Control of Malasseziaovalis. *Dermatol.,* 201: 332-336. **[Crossref]**

Canback. Retrieved 2008-08C-GIDD (Canback Global Income Distribution Database)".http://www.onlinenigeria.com/map.gif

Cecile C, Jourdain R, Bar-Hen A, Tichit M, Bouchier C. (2013). Dandruff Is Associated with Disequilibrium in the Proportion of the Major Bacterial and Fungal Populations Colonizing the Scalp. Bangladesh *Pharmaceutical Journal***22**(2): 146-152

Cheesebrough M. (2006). District Laboratory Practice In Tropical Countries, part 2, second edition Cambridge University press, The Edinburgh Building, Cambridge, United Kingdom, 38, 62–69.

Deangelis ,Y.M., Gemmer, C.M, and Kaczvinsky, J.R.. (2005). Three etiologic facets of dandruff and seborrheic dermatitis: *Malassezia* fungi, sebaceous lipids, and individual sensitivity. *J Investig Dermatol Symp Proc.* **10**(3):295–297. **[Crossref]**

Ghosh R., Ray R., Ghosh T., Ghosh P. (2014) Clinicomycological profile of dermatophytoses in a tertiary care centre hospital in West Bengal- An Indian Scenario. *Int J Curr Microbiol App Sci.;* **3**(9):655-6.

Hassard H. and Whelan W. (1963). Classification of the informed Consent rule. California medicine.

Hedayati M., Kachap S.K., Rosmus N., Collis S.J., Kortenhorst M.S.Q., Wissing, M.D., and Carducci M. A. (2010). Dawnregulation of homologous Recombination DNA repair gene by HDAC inhibition in prostate cancer in mediated through the E2F1Transcription factor. PLoS ONE, 5(6). **[Crossref]**

Kohinur B., Farjahan N. and Mashmum S. (2019) Isolation and Characterization of Malasezzia Species from Dandruff Samples and Determination of its Sensitivity Towards Antifungal Agents. *Bangladesh Pharmaceutical Journal***22**(2): 146-152, **[Crossref]**

Kreyce, R. V., & Morgan, D. W. (1971). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610. **[Crossref]**

Laurent M., Nora R., Antoine D., and Charles T. (2013) Epidemiology of Dandruff, Scalp Pruritus and Associated Symptoms *Acta Derm Venereol***93**(2): 234-239

Nweze, E. L., and Okafor, J. I., (2005). Prevalence of dermatophytic fungal infection in children: A recent study in Anambra state, Nigeria, *Mycopathologia,* **160**(1):239-243

Priyam B., Bandana M and Swetalona P. (2019).Prevalence of dermatophytic infections including antifungal susceptibility pattern of dermatophytes in a tertiary care hospital.*International Journal of Research in Medical Science* **14**(3):2320-607

Rippon, JW. (2000). Superficial Mycoses.Med Mycol., 2nd Ed.Pp140-53.

Roopa C and Biradar S. (2015). Incidence and Identification of Dermatophytes in a Tertiary Care Hospital in North Karnataka.*India. Int J Curr Microbiol App Sci.* **4**(9):986-90. 17

Schwartz, JR., Cardin, C.W., DeAngelis, Y.M., and Dawson, TL. (2010) Textbook of Cosmetic Dermatology pp 230-241. **[Crossref]**

Shu'aibu I., Hauwa S., Fatima U and Muhd M. (2013). Isolation and Identification of Malassezia globosa, Associated with Dandruff among Female Students of Gombe State University. *Greener Journal of Microbiology and Antimicrobials* ***8****(2):*2354-2284. **[Crossref]**

Surbhi R., Kshama M and Anita C. (2018). Antimicrobial activity of natural herbal products against dandruff causing fungus and bacteria.*World Journal of Pharmaceutical Research.***5**(2):334-338

Zhijue X., Zongxiu W., Chao Y., Xiaoping L., Fang Y., Ting W., Junling W., Kenji M, Ou Q., Xuemin W., Yan Z., and Menghui Z. (2016) Dandruff is associated with the conjoined interactions between host and microorganisms. *scientific reporters*