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RESEARCH ARTICLE

FUNGAL INFECTIONS IN DANDRUFF AFFLICTED SCALPS ON MEDICAL STUDENTS

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ABSTRACT

Skin mycoses are caused mainly by dermatophytes, which are fungal species that primarily infect areas rich in keratin such as hair, nails and skin. In most of the dandruff sufferers, hair fall is a very common problem. In our study, we detected the fungal infections associated with dandruff on the Medical students scalp using staining technique and cultura media. Moreover, the preliminary study was planned to identify only fungal infections present in dandruff scalps. Altogether 4 different types of fungi were encountered from 50 samples. The most dominant fungus was *Candida albicans* (50%), followed by *Aspergillus niger* (24%), *Cryptococcus spp* (16%) and *Penicillium spp* (10 %) from the dandruff scalp. Our study provides useful information for the prevention of fungal infections. Dandruff is a common disorder affecting the scalp condition. Dandruff cannot be completely eliminated but can only be managed and effectively controlled by proper antifungal agents.

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INTRODUCTION

Dandruff is a non-inflammatory condition of the scalp that is characterized by scaling and is considered to be a form of mild seborrheic dermatitis. Dandruff is a common scalp disorder affecting almost half of the post pubertal population regardless of ethnicity and gender has several putative causes including non-microbial and microbial factors. (Pierard-Franchimont *et al*., 2006; Ranganathan Franchimont *et al*., 2010) The potential non-microbial causes for dandruff are excessive exposure to sunlight, minimal irritation of the scalp due to over zealous of shampooing, frequent combing, use of certain cosmetic products, and exposure to dust and filthy areas, although experimental evidence is lacking. (Pierard-Franchimont *et al*., 2006) Dandruff is a major cosmetic problem that causes great public health concern both in developed and developing countries. It is characterized by slight to moderate scaling of the scalp with varying degrees of irritation or erythema associated with the sensations of dryth. The characteristic flaking and scaling of the scalp suggest impairment in the desquamation process. In most of the dandruff sufferers, hair fall is a very common problem. (Balakrishnan *et al*., 2011) Dandruff is a condition characterized by scaling of skin (most commonly scalp skin) resulting from rapid turnover and release of skin cells.

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Dandruff is reliant on three factors that favour its survival and reproduction of the yeasts, they are: sebum production, microbial metabolism and susceptibility of individual. (Shu'aibu Isa *et al*., 2013)

The visual perception of individually distinguishable flakes on the scalp, in the hair, or on the clothing is considered an abnormal condition frequently referred to as dandruff, seborrheic dermatitis, or multiple other names. (Gupta *et al*., 2003) especially in the public domain of non- technical literature and advertisement. In the medical literature, the same disorder, though often in a more severe form, is most commonly referred to as seborrheic dermatitis.

Historically, there have been multiple other descriptive names reflecting the fungal cause of this condition, such as *pityriasis simplex* and *pityriasis capitis* (referring to Pityrosporum) and furfuracea (referring to *Malassezia furfur*). (Gupta *et al*., 2003;Pierard Franchimont *et al*., 2000) Dandruff has the clinical feature of small white or gray flakes that accumulate diffusely on the scalp in localized patches. It does not exhibit apparent inflammation and is confined to the scalp. (Schwartz *et al*., 2010)

Fungal organisms are widely associated with human hosts and are often ignored as they do not harm healthy humans. However they are potential enough in causing diseases in immunocompromised patients which can even be fatal. *Aspergillus sp*. is long known to cause aspergillosis in lungs of

AIDS patients. Their toxic effect is also well studied along with their detrimental effects. *Aspergillus flavus* is more potent in the genus due to its ability to produce mycotoxin, aflatoxin B(B1 and B2) and aflatoxin G (G1 and G2). (Amadi and Adeniyi, 2009; Denning and Hope, 2010; Woloshuk *et al*., 1991)

The epidermis is made up of dense, heavily keratinised cell layers that are constantly undergoing a process of renewal. Three major groups of filament-forming fungi commonly infect the keratinised and cornified layers of skin, nails, and hair by *Candida albicans*, the dermatophytes and the lipophilic *Malassezia spp*. (Xu *et al*., 2007). The present study depicts the mycological examination of the dandruff afflicted scalp of Medical students and targeting the awareness for the control of dandruff.

MATERIALS AND METHODS

Collection of sample

By using sterile blunt scalpel, we scrapped dandruff flakes from the scalp of 50 different individual, collected in clean dry petridish in biosafety Hood cabinet. The flakes were obtained from different areas of the head of Medical students.

Plating on media

Flakes or scales were collected by partitioning the hair with a sterile comb and scrapping approximately one inch area using blunt scalpel. Thus total fifty samples were collected from each Medical student. The samples were inoculated as per the standard protocols over the surface of SDA (Sabouraud Dextrose Agar) which was incorporated with chloramphenicol to avoid bacterial contaminants. The plates were incubated at room temperature (25^{o}C) for three days and then, up to a week. (Kindo *et al*., 2004) The microscopic examination of fungal growth was observed with wet mount preparation, lactophenol cotton blue stain (LPCB), Grams stain, Indian ink preparation. Nature of mycelium and conidia formation (macro and micro conidia) helped to differentiate various genera and species. (Summera rafiq *et al*., 2014)

RESULTS

In the present study a total of 50 samples were collected from the scalp of the individuals with dandruff. The age group of the participants was in the age range of 18-25 years. A total of 50 plates plated with dandruff flakes, this plates were found to have growth. These included 50% *Candida albicans* followed by 24% *Aspergillus niger*, 16% *Cryptococcus spp* and 10% *Penicillium spp*. as shown in the Table 1, Figure 1,2,3,4,5,6, 7 & 8.

Dandruff is a common embarrassing scalp disorder affecting the large chunk of population. It affects half of the post pubertal of any ethnicity of both genders. (Saint, 1990) Dandruff, the visible desquamation of scalp, is the mildest manifestation of seborrheic dermatitis combined with multiple host factors. When the level of sebaceous activity is at its peak, androgenic influence may be responsible for its onset. Dandruff is commonly aggravated by changes in humidity, trauma, season and emotional stress. (Vyjayanthi *et al*., 2004)

In this fast growing, competitive and modernized world, people are more conscious of their personality in terms of facial beauty which reflects through hair styles for which many cosmetics are used, which leads to dandruff formation. The severity of dandruff may lead to loss of hair thus projecting their facial appearance. Therefore they are running after cosmetic products to enhance their beauty. There is a long standing use of Ketoconazole as an anti-dandruff agent. Ketoconazole is reported to be effective in the treatment of severe dandruff. (Pierard-Franchinont *et al*., 2001)

Hence significant consideration should be given for treating the mycotic infection by this fungus and presence of these fungi should be pre- screened to prevent fungal infections to develop and proceed at later stage. Drugs like amphotericin B, itraconazole, voriconazole and posaconazole show significant activity against fungal infections. Thus these drugs can be employed for treating the fungal infections. (Abhinaba Ghosh *et al*., 2012)

In the current scenario, a wide variety of antifungal agents are available for the treatment of dandruff by controlling the abundance of fungi on the scalp. Therefore, regular treatment is necessary for the people suffering from dandruff. We have demonstrated by our study that dandruff caused by different fungal species can be controlled and prevented by using proper antifungal agents.

Table 1. Prevalence of fungal isolates on dandruff affected scalp

S.No	Fungal isolated	Total numbers	Percentage
1	*Candida albicans*	25	50%
2	*Aspergillus niger*	12	24%
3	*Cryptococcus species*	8	16%
4	*Penicillium species*	5	10%

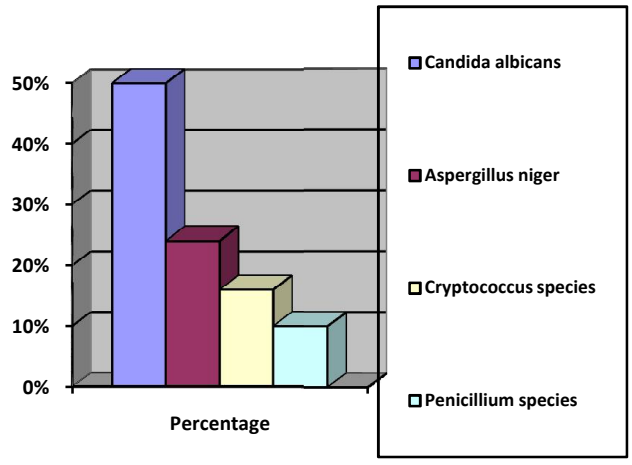

Figure 1. Percentage of fungal isolates on dandruff affected scalp

Fig. 2. *Candida albicans* on SDA

Fig. 3. *Aspergillus niger* on SDA

Fig. 4. *Cryptococcus* on SDA

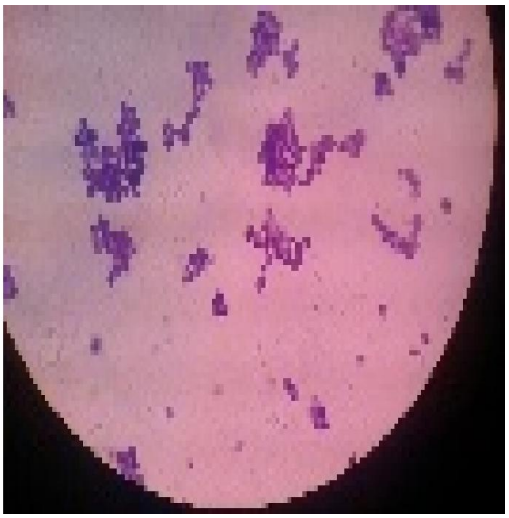

Fig. 5. Direct microscopy of dandruff from scalp of students showing *Candida albicans*

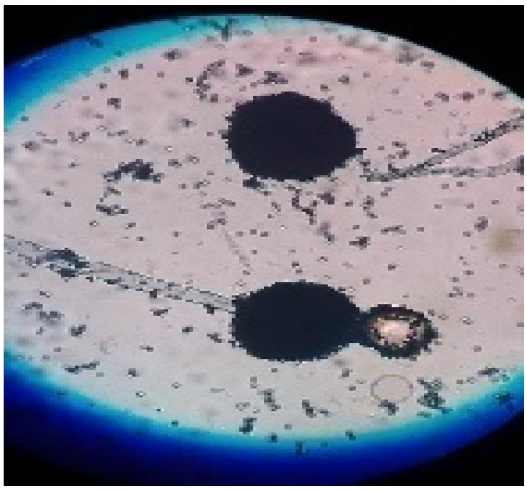

Fig. 6. Direct microscopy of dandruff from scalp of students showing *Aspergillus niger*

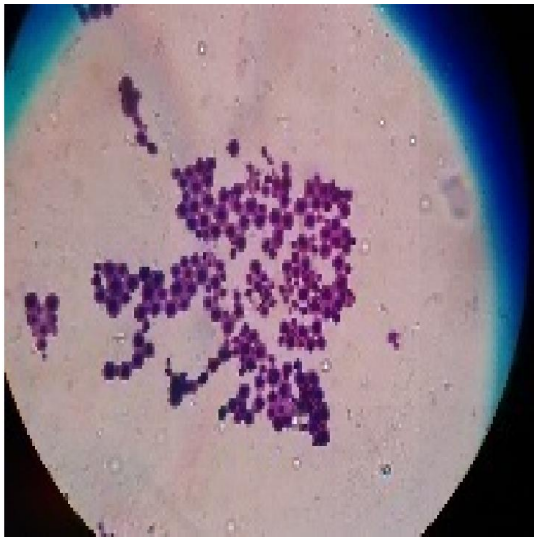

Fig. 7. Direct microscopy of dandruff From scalp of students Showing *Cryptococcus spp*

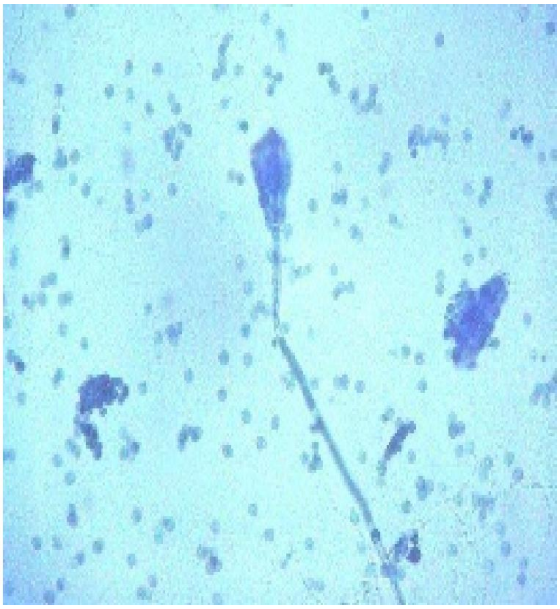

Fig. 8. Direct microscopy of dandruff from scalp of students Showing *Penicillium spp*

DISCUSSION

Dandruff is the most common scalp disorder in adolescence (post-pubescence) and adulthood which is rare and mild in children. Historically, it was thought that about 50% of humans were affected with onset of puberty and progressed with severity at the age of 20 years and becoming less frequent after the age of 50. (Dawber, 1995)

A more recent study of 1,408 Caucasians, African Americans and Chinese from the states of Minnesota and Georgia in the United States, Beijing, Shanghai, and Guangzhou, China, suggests that severity and prevalence of noticeable dandruff and seborrheic dermatitis is much higher in adults than first thought, at 81-95% in African Americans, 66-82% in Caucasians, and 30-42% in Chinese. Additionally, the prevalence of dandruff was as high in US teens as their adult counterparts with prevalence at 75-95% in Caucasian and African American teens. (Hickman *et al*., 2009) our finding correlates with previous studies by showing the prevalence of dandruff in adults especially teen aged Medical students.

We investigated the fungal species of dandruff afflicted Medical students scalps using wet mount preparation, LPCB, Grams stain ,Indian ink preparation and SDA. Recently, human fungal disease has been recognized as a serious problem and the most common human fungal pathogens belong to the phyla *Basidiomycota* and *Ascomycota*, including the major pathogens ***Candida albicans, Cryptococcus neoformans***, and ***Aspergillus fumigatus***. (Heitman *et al*., 2006) Human fungal pathogens are associated with diseases ranging from dandruff and skin colonization to invasive bloodstream infections, which increase morbidity and mortality. (Butler, 2010) This present study showed 50% *Candida albicans* predominate in the fungal species followed by 24% *Aspergillus niger*, 16% *Cryptococcus species* and 10% *Penicillium species* on dandruff afflicted Medical students scalps.

Like our study, in another study (Hee Kuk Park *et al*., 2012) suggested that ***Penicillium*** is a genus of ascomycetous fungi, and ***P. chrysogenum*** (***P.notatum***), specifically, produces the antibiotic penicillin. Based on this, ***Penicillium*** may have increased on the dandruff afflicted scalps because other microbes that cause dandruff, such as ***Staphylococcus***, might have increased under the severe condition. It is possible that these genera increased to supply the moisture lost when the dandruff became severe and the scalp became too dry. J. McGrath, GM. Murphy reported "Ketoconazole" is an imidazole antimycotic agent and has been used orally for the treatment of multiple mycoses. Several large antidandruff efficacy studies have demonstrated efficacy against *pityriasis capitis* and seborrheic dermatitis. Ketoconazole has been approved for topical over the counter use at 1% in shampoos and for prescription use at 2%. Twice-weekly treatments are currently recommended for ketoconazole containing shampoos. To achieve efficacy, these products are recommended to be left on the scalp for 5 to 10 minutes before rinsing, thereby requiring a change in shampooing habits and practices. As an antifungal, ketoconazole is a member of the imidazole family and blocks fungal synthesis of ergosterol. Ergosterol is an essential constituent of fungal cell membranes. Ketoconazole binds and inhibits cytochrome P450 14-alpha-demethylase. This enzyme is required in fungal thesterol biosynthesis for the formation of ergosterol from lanosterol. (McGrath and Murphy, 1991; Shuster, 1984; Dandruff, 1991)

(Warner *et al*., 2001) reported that the treatments to control dandruff can be divided into three main classes on the basis of their mechanisms of action; these include keratolytic, antimicrobial and antiproliferative agents. Simple shampooing and keratolytic treatments (e.g., salicylic acid) will remove a considerable proportion of flakes in patients with milder conditions. The majority of commercially available treatments for dandruff and seborrheic dermatitis contain antifungal agents. These treatments (e.g., pyrithione zinc, selenium sulfide, ketoconazole, and ciclopirox) have been shown to improve the visible symptom of flaking and restore the underlying skin condition.

(Schwartz *et al*., 2004) proved that antiproliferatives (e.g., coal tar) decrease epidermal proliferation and dermal infiltrates. Adjunctive treatment with topical steroids may also be helpful in patients whose condition includes evidence of an inflammatory component. Given that many dandruff patients may require regular, long term use of therapeutic agents, it is important that the treatments be formulated so as to be aesthetically and cosmetically acceptable to the patient.

Conclusion

Dandruff is characterized by adherent or loose white or gray flakes that accumulate on the scalp, in the hair, and on clothing. It is accompanied by pruritis and carries a significant social stigma in most developed countries. Today, dandruff can be successfully treated by multiple antifungal or topical steroidal anti-eczemic agents. Due to the cost, poor cosmeticity, and adverse effects of steroidal agents, they should be confined to severe or refractory cases. When considering treatment options, one must consider long term chronic

therapy. This necessitates that patients are highly compliant to any therapy. As hair is a significant driver of cosmetic appeal, for any subject to remain compliant to long term therapy, the treatment must be cosmetically appealing as well as effective. Effective treatment as well as prevention of hair dandruff is necessary which includes self hygiene such as washing hair frequently especially with antidandruff shampoos (ketoconozole) and prevention of dust exposure and air pollutants from the environment.

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