Tinea Capitis in an Immigrant Pediatric Community; A Clinical Signs-Based Treatment Approach

Riad Kassem
Sheba Medical Center at Tel Hashomer: Sheba Medical Center
Yahel Shmase
Poriya Medical Center: Baruch Padeh Medical Center Poriya
Orna Nitzan
Poriya Medical Center: Baruch Padeh Medical Center Poriya
Maya Azrad
Poriya Medical Center: Baruch Padeh Medical Center Poriya
Avi Peretz (aperetz@poria.health.gov.il)
Poriya Medical Center: Baruch Padeh Medical Center Poriya

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Abstract

Tinea capitis is a common cutaneous infection of the scalp and hair follicles, typically diagnosed by direct examination and culture. Treatment with oral antifungals is usually withheld until mycology results are available. In Israel, African refugee children demonstrate higher susceptibility to Tinea capitis and generally fail to undergo follow-up evaluations. This study aimed to identify the clinical characteristics and treatment response of refugee children in Israel with Tinea capitis, in order to formulate a treatment plan, for primary care physicians. To this end, demographic, clinical and laboratory data were extracted from the electronic medical records of 76 refugee children presenting with Tinea capitis during 2016-2017. Scaling was the most common clinical finding. Cultures were positive in 64 (84%) and direct examination in 65 (85%) cases, with a positive correlation between the tests in 75% of cases. The most common fungal strain was T. violaceum. Fluconazole treatment failed in 27% of cases. Griseofulvin 50 mg/kg/day was administered to 74 (97%) of the children, and induced clinical responses. No side effects were reported. In African refugee children with suspected Tinea capitis, a culture, direct examination and empiric treatment with griseofulvin 50 mg/kg/day are recommended to prevent outbreak of an epidemic.

Introduction

Tinea capitis is an infection of the scalp and hair follicles, caused by dermatophytes [1]. Dermatophytes is a common name of three genera of fungi – *Trichophyton*, *Microsporum* and *Epidermophyton*, with the first two species being most dominant. Dermatophytes are also classified by host preference and natural habitat, with anthropophilic dermatophytes affecting human, zoophilic dermatophytes affecting animals, and geophilic dermatophytes mainly affecting the soil, the latter two of which are relatively rare [2–3]. All dermatophytes can exploit keratin (hair, skin, and nails) for growth and their clinical manifestations are named after the affected area of the body (Tinea manum, Tinea pedis, Tinea capitis, etc.) [4]. Tinea capitis is one of the most common cutaneous infections in pre-pubertal children [1, 5–8], mainly from 6 months to 10–12 years of age [6]. The epidemiology of Tinea capitis varies across geographical regions throughout the world and changes over time [8–9]. The infection spreads among family members and classmates[1].

The clinical manifestations of Tinea capitis are variable, depending on the type of hair invasion, the level of host resistance, the immune system and the degree of inflammatory host response [6–7], but can grossly be classified as alopecic or inflammatory. Inflammatory Tinea capitis includes kerion, which manifests as a tender mass with pustules, purulent discharge, lymphadenopathy, malaise and fever, and favus, with yellow cup-shaped crusts around the hair, with inflammation and scarring [3, 10].

Tinea capitis is often misdiagnosed, thus delaying appropriate treatment and enabling spread of infection [7]. The diagnosis can be made in several ways. First and foremost, anamnesis and physical examination are crucial. Recently, the dermatoscope is more commonly used for close inspection of the scalp [11]. Confirmation of diagnosis can be made by direct microscopy, with use of standard potassium hydroxide (KOH) preparations. Its disadvantages include the time-consuming process, requirement of an expert and equipment not necessarily available in every clinic, and a false negative rate of up to 40% [12]. In addition, culture of scalp scrapings and hair fragments from the affected area can be performed, but can involve up to 3 weeks until results are provided [6, 12]. Molecular techniques such as polymerase chain reaction (PCR), provide for faster and more accurate identification of dermatophyte infections [6].

Systemic antifungal agents are indicated for all cases of Tinea capitis. Topical agents are used as adjuncts because they do not penetrate the hair shaft [7, 13], but may, however, reduce the risk of transmission to others [1]. The common drugs in use are griseofulvin, terbinafine, itraconazole and fluconazole. The type and duration of treatment, as well as the dosage are determined by the dermatophyte strain [1–2, 6, 14].

Refugee communities are generally of a low socioeconomic status and are associated with dense living conditions, which facilitate the spread of Tinea infections. In Israel, although refugees are medically insured up to the age of 18, and receive sufficient general medical treatment, they often receive suboptimal care in this specific field, partly due to the low availability of dermatologists in the southern part of Tel-Aviv where most of the refugees reside. Instead, such cases are most often treated by pediatricians or family doctors, who generally have minimal expertise with this indication. As a result, the infection is frequently misdiagnosed, and when properly diagnosed, topical treatments are prescribed, which are rarely effective.

Treatment of Tinea capitis in refugee children poses a dilemma, since, on the one hand, optimal treatment demands repeated lab exams, but on the other hand, compliance with such measures is very low because most parents work long hours and cannot afford to miss workdays. In addition, in order to prevent transmission and ensuing epidemics, a child diagnosed with Tinea capitis is forbidden to return to his daycare facility for several weeks, which requires that a parent stay at home and miss more workdays. Thus, our aim was to simplify the diagnosis of Tinea capitis by primary physicians in this population and speed initiation of appropriate treatment, by developing tools to accurately identify and treat the disease based on clinical finding and on physical examination. To this end, the clinical and demographic characteristics of 76 Tinea capitis-infected pediatric refugees living in the southern district of Tel Aviv, Israel, were analyzed and compared to the current knowledge in the field.

Materials And Methods

Study design

This was a retrospective study, conducted in the district of Tel-Aviv, Israel. The study analyzed the records of children aged 0–8 years (2 months – 7.7 years) with a clinical manifestation or positive culture of Tinea capitis, who were referred to a dermatologist in a secondary referral clinic of the Meuhedet sick fund and treated by the same dermatologist between January 2016 and December 2017. Data extracted from patient electronic records included: age, gender, country of birth, origin of parents, duration of lesion until contact with the dermatologist, infected family member (yes/no), high IgE level (yes/no) and eosinophil blood count, history of immunosuppression, medical history, lesion description (alopecia, scaling, pruritus) and morphology, presence of kerion and lymphadenopathy, culture results, microscopic examination of skin scrapings and hair fragments (KOH exam), topical treatment (yes/no) and type and duration of systemic treatment.

Statistical analysis

All measured variables and derived parameters are presented using descriptive statistics. The correlation between background clinical and demographic data and Tinea capitis diagnosis was assessed using the chi-squared and Wilcoxon tests Correlations between demographic/clinical/laboratory characteristics and other types of fungi or other important findings were performed using a T-test.

All tests were two-tailed, and a *p*-value of 5% or less was considered statistically significant. The data were analyzed using SAS® version 9.1 (SAS Institute, Cary, North Carolina).

Results

The medical records of 74 children fulfilling the eligibility criteria were reviwed (Table 1). Out of 76 cases, 55 (72.4%) were boys and 21 (27.6%) girls. The average age was 3.1 years (range 0–8 years). In total, 30 children (39.9%; 9 girls (30%) and 21 boys (70%)) had a family member infected with Tinea capitis. The average weight of the affected children was 14.5 kg (5.5–21.5). All children were born in Israel to parents who emigrated from Eritrea. The average time from the initial appearance of the lesion until contact with a dermatologist was 4.3 months (3 days – 24 month).

Table 1
Demographic and baseline characteristics

Criteria	All cases	Culture		Direct examination	
	n (%)	Positive n (%)	Negative[a] n (%)	Positive n (%)	Negative n (%)
Gender	**76**	**64 (84)**	**12 (16)**	**65 (85)**	**11 (15)**
Male	55 (72.4)	46 (84)	9 (16)	49 (89)	6 (11)
Female	21 (27.6)	18 (86)	3 (14)	16 (76)	5 (24)
Age	**3.3**				
0–2	13 (17.1)	10 (77)	3 (23)	12 (92)	1 (8)
2.1-4	38 (50)	31 (81)	7 (9)	33 (87)	5 (13)
4.1-6	24 (31.6)	22 (92)	2 (8)	19 (79)	5 (21)
6.1-8	1 (1.3)	1 (100)	0	1 (100)	0
Eosinophilia	23 (30)	21 (91)	2 (9)	21 (91)	2 (9)
High IgE levels	8 (10)	8 (100)	0	8 (100)	0

[a] Contaminated culture was considered negative

Out of 76 cases, 64 had a positive culture, 18 of which were collected from girls (28%) and 46 from boys (72%); 12 cultures were contaminated. In parallel, 65 cases had a positive direct examination, 8 of which showed negative cultures (Table 1). Thus, 57 cases had both a positive culture and direct examination, while 72 patients have at least one positive test.

The most common clinical manifestation among patients with a positive culture or a positive direct examination was scaling, and the least common was kerion with lymphadenopathy (Table 2). Kerion with lymphadenopathy provided the highest diagnostic specificity, while scaling was associated with the lowest diagnostic specificity. No single or combination of symptoms provided both high diagnostic sensitivity and specificity (Tables 2 and 3). Pruritus, as well as kerion with lymphadenopathy had a high diagnostic sensitivity but low specificity.

Table 2
Single symptoms at enrollment: relationship to positive dermatophyte culture (DC) and to positive direct examination (PDA) [a]

Symptom	Number		Sensitivity (%)		Specificity (%)		PPV (%)		NPV (%)	
	DC	PDA	DC	PDA	DC	PDA	DC	PDA	DC	PDA
Scaling	58/64	63/65	90.63	96.92	8.33	45.45	84.06	91.3	14.29	71.43
Alopecia	25/64	28/65	39.06	43.08	33.33	54.55	75.76	84	9.30	13
Pruritus	5/64	8/65	7.81	12.31	66.67	90.91	55.56	88.89	11.94	14.93
Kerion with lymphadenopathy	5–64	5/65	4.69	7.69	83.33	100	60	15.49	14.08	21.05

[a] Contaminated culture was considered negative

Table 3
Multiple symptoms at enrollment: relationship to positive dermatophyte culture (DC) and to relationship to positive direct examination (PDA) [a]

Symptom	Number		Sensitivity (%)		Specificity (%)		PPV (%)		NPV (%)	
	DC	PDA	DC	PDA	DC	PDA	DC	PDA	DC	PDA
No symptoms	3/64	0/65	4.69	0	100	72.73	100	0	16.44	10.96
Any 1 symptom	34/64	31/65	53.13	47.69	88.33	54.55	94.44	86	25	15
Any 2 symptoms	24/64	29/65	37.50	44.62	41.67	81.82	77.42	20	11.11	50
Any 3 symptoms	3/64	5/65	4.69	7.69	75	90.91	50	83.33	15.79	14.29

Out of the 64 children with a positive culture, 13% and 33% had high level of IgE and eosinophilia, respectively (Fig. 2a); 9% of these children had both high level of IgE and high eosinophilic count. Similar percentages were seen among the children with a positive direct examination (Fig. 2b). Among children with both a positive culture and a positive direct examination, fewer children (17%) had eosinophilia as compared to children with only one positive test (Fig. 2c).

The most common cultured dermatophyte species was *Trichophyton violaceum*, which was found in 25 (39%) samples. Out of the positive cultures taken from girls, *T. violaceum* was found in 33%, versus 41% of the samples collected from boys. The fungal distribution is shown in Fig. 3a. Distribution by host preference is described in Fig. 3b.

Observations of Tinea capitis cases in children in this community prior to this study period, found griseofulvin as first line therapy at a maximum dose of 25 mg/kg/day for 6–8 weeks, to induce a minimal response, if any. In order to eradicate and prevent spread of the infection, the recommended drug dose was gradually elevated until a dose (50 mg/kg/day, for 6–8 weeks) that efficiently eradicated the infection was achieved. Only after initiation of this high-dose regimen, a clinical response was observed. Eventually, all children suspected to have Tinea capitis

were treated with griseofulvin at this doubled dose. Bhanusali et al. reported on the effectiveness of a similar dose elevation for treating Tinea capitis in skin of the color needed to eradicate the same fungi from the 1970s, tell nowadays [15].

During the study period, due to unavailability of griseofulvin for some time, 21 patients were treated with fluconazole, at a maximum dose of 7.5 mg/kg/day, for 4 weeks. None of these children showed a clinical response, even when the dose was raised to 10 mg/kg/day for 6 weeks. After the return of griseofulvin to the market, these children were treated with griseofulvin as second line, at 50 mg/kg/day; clearance was achieved within 6 weeks in most cases, except for 3 children who required 8 weeks of treatment until the condition fully resolved.

Five children presented with kerion. In addition to antifungal treatment, they were treated with antibiotics and steroids. None required surgical intervention. Two children with negative culture and direct examination and suspected of having seborrheic dermatitis were not treated empirically for Tinea capitis. Two other children with uncertainty regarding the possibility of Tinea capitis or seborrheic dermatitis diagnosis, were given empirical treatment, which was discontinued after receiving negative results.

Four children who showed no response to griseofulvin, had *Rhodotorula Mucilaginosa*-positive culture and were treated appropriately.

All children received topical treatment as adjunct therapy, as recommended, in order to reduce contagion. Blood test abnormalities were not observed in the participants during treatment. Treatments and responses are summarized in Table 4.

Table 4
Anti-mycotic treatment dosage and duration

Participants	Line	Drug	Dose	Duration (week)	Eradication	Therapy replacement	Therapy stopped
53	1	Griseofulvin	50 mg/kg/day	8	49	4	1
18	2[a]			6	18	0	0
3				8	3	0	0
21	1	Fluconazole	7.5–10 mg/kg/day	10	0	20	1
5		Steroids	-	-	-	-	-
5		Antibiotic	-	-	-	-	-

[a] Griseofulvin as second line was given after therapeutic failure with fluconazole

Discussion

Since 2006, more than 60,000 people illegally emigrated from Africa to Israel through the border with Egypt. Most of the refugees came from Eritrea, while others arrived from the Republic of Sudan and other African countries. This phenomenon has increased considerably between 2007 and the end of 2012. A significant portion of this population has settled in the southern Tel Aviv area. As mentioned, this population, generally of a low

socioeconomic status and residing in dense living conditions, and less likely to visit a tertiary clinic with expert dermatology services, is susceptible to Tinea capitis epidemics. Due to a focal outbreak of Tinea capitis among children of refugees from Africa that immigrated to Israel, and in order to prevent epidemics and in other communities, this work attempted to characterize the clinical manifestations and provide primary physicians with appropriate diagnostic and management guidelines, to minimize the need for referral to dermatology services.

In accordance with the literature, and as shown in Fig. 3a, T. *violaceum* was the most common cause of Tinea capitis, in refugee children as in refugee in the US, Europe and Israel of African descent [5, 8, 16–17]. Furthermore, 75% of positive cultures showed that the source of infection was an anthropophilic fungus, strengthening the conclusion that patients infect each other at day care facilities and at home, due to the dense living conditions and lack of sufficient hygiene.

The most common clinical finding in children with either positive culture or positive direct examination was scaling, observed in 91 % and 97% respectively, aligning with a previously published report [12]. However, in contrast to this earlier report, that dealt with urban hospital-based general pediatric practice, which introduced a significantly higher chance of having a positive culture, as there are more signs on physical examination, in the present study, the majority of children with positive culture or positive direct exam had one positive sign, which was scales (53% and 48%, respectively). Moreover, the previous work found a high association between lymphadenopathy and positive Tinea capitis cultures, which stands in contrast with our results, in which only 4.7% of the children with positive culture and 7.7% of those with positive signs on direct examination, presented with lymphadenopathy. A different immune response to the same infection may underlie these conflicting observations, which would require adoption a different approach right from the start.

In the current study population, many parents who visited a dermatologist with their infected child stopped the follow up at various stages, some even after only one visit, due to long queues, distant clinics, loss of workdays and more. Some of the parents returned to the dermatologist only because the teacher refused to take the child back to the day care center until he healed or due to development of infection and fever, as in cases of kerion, which necessitated a visit to the dermatologist. Thus, treatment should be given to ensure suitable and efficient management from the initial and possibly only encounter with the patient.

In previously reported cases of Tinea capitis, insufficient response of tinea capitis in skin of the color population to treatment was not solely due to lack of compliance, but rather, to a reduced clinical response of the fungi to the conventional griseofulvin doses [15]. As a result, over the past few decades, dosage elevations have been necessary to achieve clearance. This might be due to suboptimal absorption of the drugs, different host response patterns to the same fungi or evolution of resistance of the fungi to the drugs [15].

No specific association was observed between eosinophilia or IgE levels and susceptibility to Tinea capitis infection. However, this lack of correlation may have been the result of the small sample size, or maybe because systemic signs in these children are subtle when compared to the regular pediatric population, that can be pertained to a different immunologic response of this population to fungi or parasites expect in cases of Kerion.

The four children who had no clinical response to griseofulvin, turned out to have a *Rhodotorula mucilaginosa*-positive culture. Although rare, in particular in immunocompetent patients, scalp infection due to these unicellular pigmented yeasts that mimic Tinea capitis, has been observed in refugee population before [18]. Several

therapeutic approaches have been described, including amphotericin B, ketoconazole, fluconazole, itraconazole and flucytosine, however, there is no consensus on the preferred treatment for such infections [18].

For a refugee patient, considered a part of a high-risk population, a full physical examination should be performed. If findings like scaling, alopecia or pruritis are identified, the physician must rely on his clinical index of suspicion and should treat in accordance with the highest degree of suspicion, by providing empirical treatment, from the first encounter [19], as culture results may only be provided after 2–4 weeks and advanced test, such as PCR, may not be available in most outpatient clinics. Prescriptions for the entire treatment period should be given in advance, because it might be the only encounter with the patient.

Despite the challenges of follow up in this population, and in accordance with the literature, in any case of suspected Tinea capitis, the scalp should be cultured prior to treatment [2], at least for epidemiological investigation. If opportunity arises, follow-up with a repeat mycology culture is recommended at the end of treatment as a definitive diagnosis of eradication [1].

Due to the relative resistance to traditional dosages of griseofulvin observed in this population and failure to regularly follow up, these patients should be treated at a higher dosage than usual. Although treatment decisions rely on the identity of the fungus [14, 19–20], griseofulvin at a dosage of up to 50 mg/kg/day is recommended for first-line treatment, since it provides a sufficient clinical response. In addition, years of experience with the drug have demonstrated its long-term safety[13]; it has the fewest known drug interactions [15], a favorable adverse-effect profile[21] and rarely induces serious adverse-reactions [2]. Griseofulvin treatment has been associated with a small number of minor adverse effects mainly gastrointestinal symptoms (vomiting, abdominal pain, diarrhea). Furthermore, it is the cheapest antifungal drug [13], a critical criterion in the population of interest, for maintaining long-term compliance. When considering these benefits against the potential damage, empiric treatment prior to culture results is recommended [22]. As shown in Table 4, the study population seemed to be resistant to fluconazole. It is therefore not recommended to treat them with this drug, as it may result in lower compliance. Topical treatment alone, yielded no clinical resolution, particularly in this population, and therefore should not be given as a single treatment, but only as adjunct therapy. In case of an inflammatory lesion, such as kerion, additional treatment with steroids and antibiotic is needed. All the medications should be given together, thus increasing compliance.

Eradication is worthless in cases of cycles of reinfection. It is therefore critical that the physician attempt to establish a relationship of trust with the parents in order to achieve whole-family care. It is also recommended to sterilize all shared hygiene instruments and wash bedding frequently. There might be a need for multidisciplinary collaborations (social worker, medical specialists) so that treatment plans and appointments can be coordinated with parents, and perhaps go as far as to hold mass testing in the neighborhood/schools to hopefully eradicate this fungal infection plaguing the immigrant community and to prevent its spread to other communities.

The key aim of this study was to emphasize the importance of diagnosis and treatment of these immigrant children by their primary pediatric doctor since it takes, as mentioned, an average of 4.3 months until they visit a dermatologist. During this critical time period, the scalp can become seriously and permanently damaged, and the infection can become systemic or cause an outbreak within the entire community. In conclusion, we recommend to relate to scaly scalp in high-risk populations as tinea capitis, and to treat with griseofulvin at a dosage of up to 50 mg/kg/day, starting from the first presentation to the pediatrician.

Declarations

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Conflicts of interest/Competing interests: There were no conflicts of interest

Ethics approval The study protocol was approved by the institutional review board of the Health Maintenance Organization Meuhedet (03-29-10-18).

Consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and material: Not applicable

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Authors' contributions: Data collection: RK, YS and AP; Data analysis: ON, MA, AP; Drafting of the manuscript: RK. Approval of the final manuscript: AP and RK.

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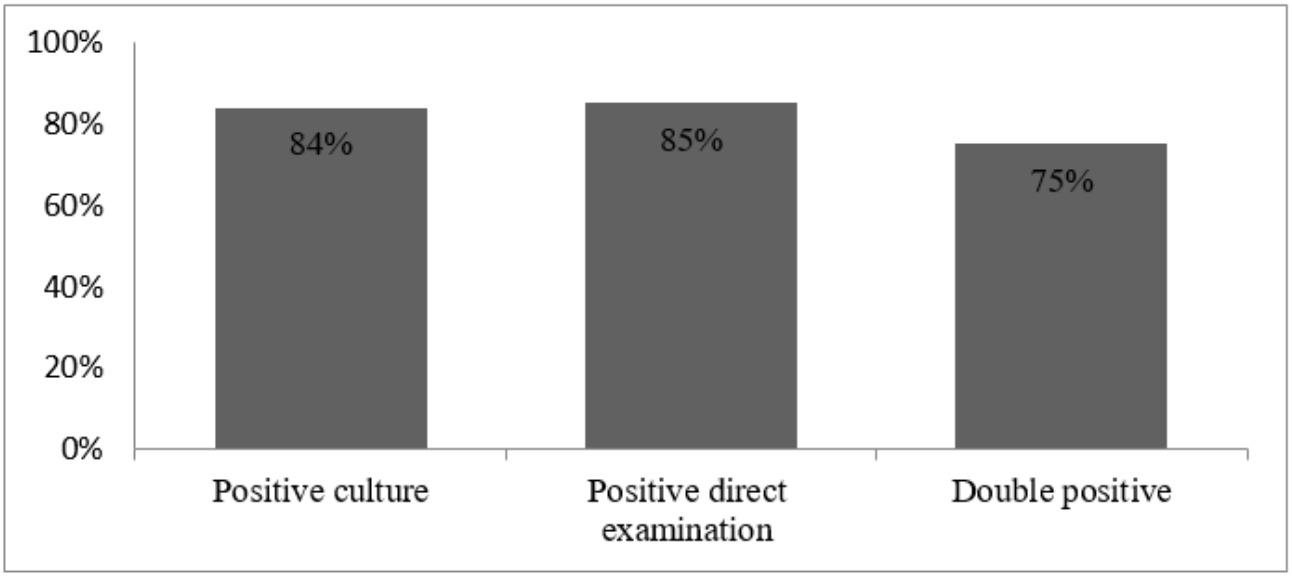
Figures



* Contaminated culture was considered negative

Figure 1

Percentage of positive tests for Tinea capitis out of all cases: 57 cases (75%) had both a positive culture and direct examination, while 72 cases had at least one positive test

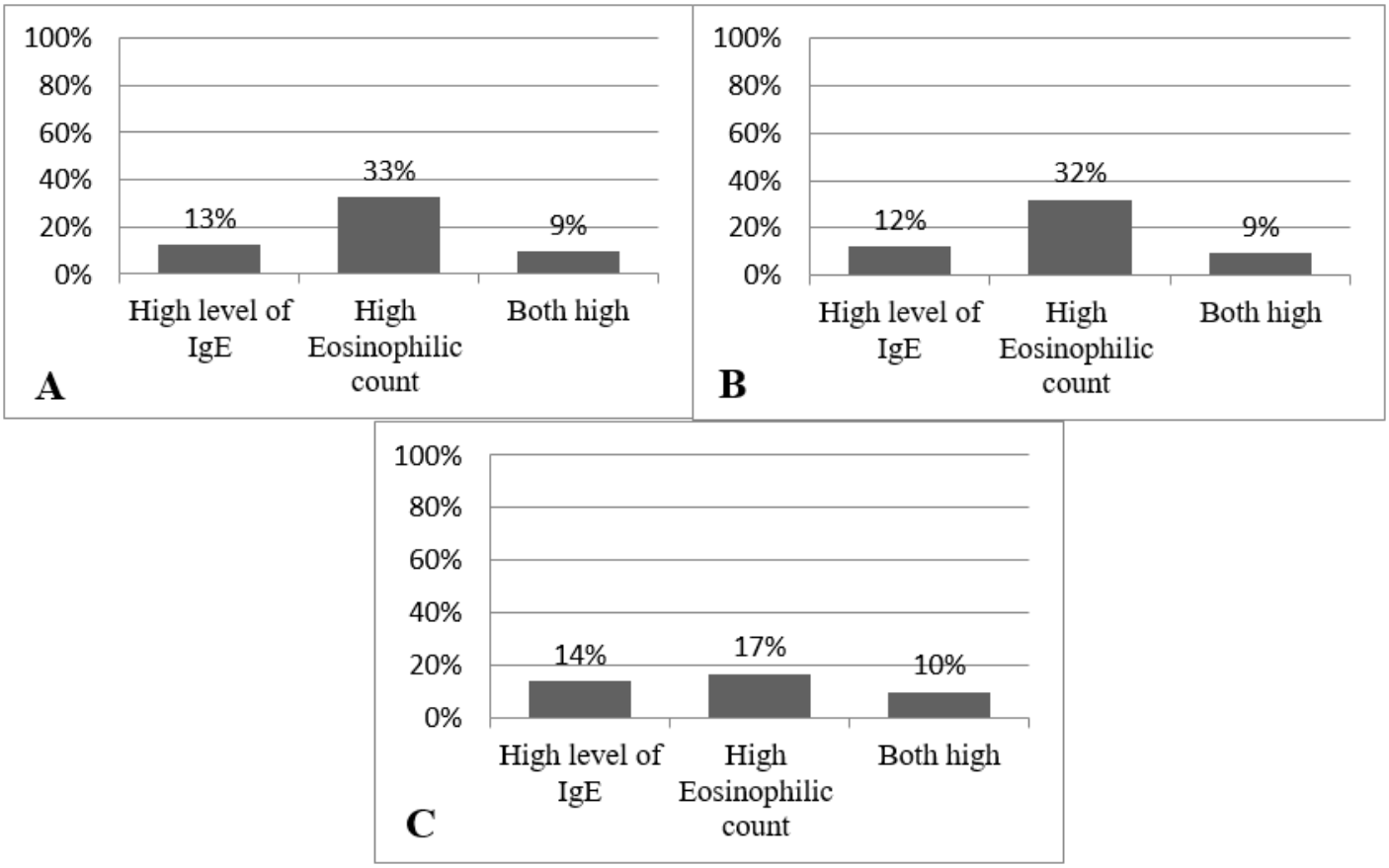


Figure 2

Percentage of children with high levels of IgE and/or eosinophilia out of all cases with positive A. Culture B. Direct examination C. Culture and direct examination

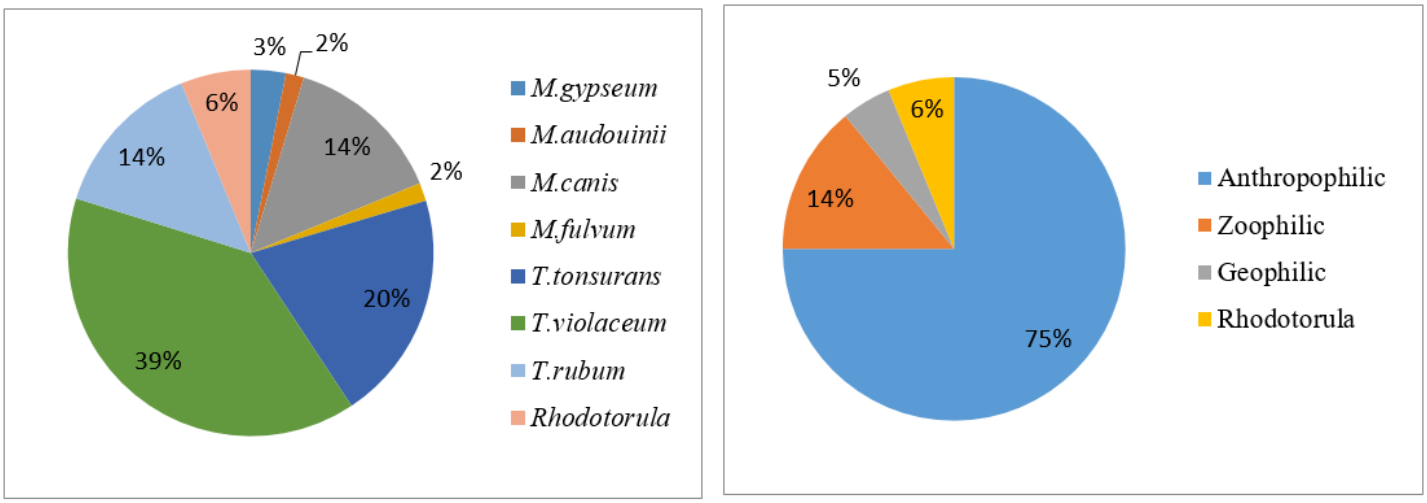


Figure 3

A. Percentage of the different types of dermatophyte fungi in culture. B. Percentage of the different types of dermatophyte fungi by host preference.