UDC: 616-002.828:[616-097.3:577.112.82]
Professional paper

STUDY OF THE LEVEL OF TOTAL IMMUNOGLOBULIN E (IGE) IN MYCOTIC SKIN DISEASES

Artizana DUSHI, Dance VASILEVA, Sotirija DUVLIS[1]

[1] Faculty of Medical Sciences, Goce Delcev University, Štip, North Macedonia,*
Corresponding author: Artizana Dushi, PhD Student at Faculty of Medical Sciences, Goce Delcev University, Štip, North Macedonia
[*]Corresponding author e-mail: artizane.311119@student.ugd.edu.mk

Abstract

This dermatological study aims to analyze fungal skin diseases caused by dermatophytes. There is a large body of scientific data that scientifically indicates that dermatophytes represent a significant public health concern worldwide. Although the clinical manifestations of these infections are well documented, the mechanisms of the immune response, especially the role of total immunoglobulin E (IgE), are not fully understood.This conceptual study scientifically analyzes the immune profile of 60 patients with dermatomycosis, focusing on the level of total IgE as an indicator of systemic sensitization. The results demonstrate a strong correlation between male gender and high IgE levels ($p < 0.001$), confirming at the same time that the immune response is independent of the magnitude of the clinical change. Our conclusions will ultimately show the need for a personalized therapeutic approach based on the gender and immune profile of the patient. Before examining the role and importance of IgE in dermatomycoses, we will first scientifically analyze a brief scientific and theoretical overview of dermatomycoses.Dermatophytosis is a superficial fungal infection of the skin, hair and nails caused by dermatophytes, yeasts or molds. Dermatophytosis is a prototype of mycotic infections of the skin and its adnexa, but also includes non-dermatophyte infections (P. versicolor), as well as candidiasis. These species colonize the skin, specifically the stratum corneum, on which they feed and create their habitat. The most invasive genera for humans are Trichophyton, Microsporum and Epidermophyton. Of all of them, Trichophyton rubrum stands out as the most common cause of dermatophytosis.

Keywords: *dermatophite, mycotiv diseases, statistics, analyzes. Immunologu, dematology*

Introduction

According to data from the World Health Organization (WHO), dermatophytosis affects about 25% of the world's population [1], and 30 to 70% of adults are asymptomatic carriers of these types of diseases.In Western countries, 80 to 90% of onychomycosis cases are caused mainly by dermatophytes, 5–17% by yeasts, and 2–3% by non-dermatophyte molds. In Southern European countries, dermatophytes are responsible for 40 to 68% of cases, while 21–55% are due to yeasts. In Asian and Middle Eastern countries, dermatophytes account for 40–48% of cases, 43–46% of infections are caused by yeasts, and 8–11% by non-dermatophyte molds. In Africa, infections associated with onychomycosis are most commonly caused by yeasts [2]. The high prevalence of nail infections in North America is largely due to the immigration of dermatophytes from other regions of the world, such as West Africa and Southeast Asia. The global prevalence of *tinea pedis* is estimated to be 5.5%, accounting for 50% of all cases of nail disease [3].

Recent scientific literature shows a significant global increase in dermatomycoses (superficial fungal infections of the skin, hair, and nails), with approximately 1.73 billion cases reported globally in 2021. The prevalence is particularly increasing due to the emergence of antifungal-resistant species, such as Trichophyton indotineae, as well as changing environmental conditions, such as increasing global temperature and humidity. It is estimated that up to 1 in 5 people will experience a dermatophyte infection (commonly called tinea infection) during their lifetime [4].Historically, dermatophyte infections were considered relatively mild conditions

that were usually treated with short-term topical antifungal therapy [5]. Oral antifungals were required mainly in patients with nail or hair shaft infections, as well as in extensive fungal skin infections, which most often occurred in immunocompromised patients [5].However, the situation is rapidly changing due to the global emergence of severe dermatophyte infections that are often resistant to first-line antifungals. [6-8]

Source of infection and method of spread

According to their natural reservoir, dermatophytes can be classified as anthropophilic, zoophilic, and geophilic species, primarily infecting humans, animals, and soil, respectively [4,5].This group of pathogens is thought to have been initially geophilic and gradually adapted to infect vertebrates over time, through contact with soil and transmission via animal fur. **[6].** Transmission occurs through direct or indirect contact, as well as through contaminated fomites (objects). **[7].** In recent decades, conventional pets, mainly dogs and cats, have become increasingly important in the domestic environment and can facilitate the transmission of infections. Globally, a total of 37 regions have reported dermatophyte infections in humans associated with contact with animals, especially on the European continent. **[8].** In addition, fungal spores are known to survive in the environment for years, under optimal conditions of temperature and humidity. **[7].** In general, children and young animals are more predisposed to ringworm, as are other vulnerable individuals with weakened immune systems (e.g., HIV, cancer, pregnancy, etc.). **[7 , 9].** Dermatophytes are the most common fungal pathogens worldwide, responsible for the majority of skin and nail infections [11, 12, 13]. Globally, the estimated lifetime risk of developing dermatophytosis is 10–20%, with foot infections being the most common [14, 15]. Given the high incidence of infection, the global cost of treating dermatophytes is estimated at $500 million per year [16]. Accurate diagnosis is essential for patient management and the application of appropriate therapies. Many forms of dermatophytosis can be clinically difficult to distinguish from other skin diseases, as the clinical picture overlaps between different diseases [17]. In addition, a significant proportion of dermatophyte infections occur in developing countries, where the population lacks adequate access to health care [18, 19]. Misdiagnosis can have serious consequences, especially in immunocompromised patients, as the disease can progress to deeper invasion, leading to disseminated dermatophytosis and invasive dermatitis [20, 21, 22, 23]. Misdiagnosis can also occur due to misidentification of the dermatophyte responsible for the infection. As in other areas of mycology, medical mycology has recently experienced a reclassification of different species as the use of genetics has become more widespread in species determination [24, 25].The change in nomenclature has affected many dermatophyte genera, which may have implications for clinical databases and certain diagnostic techniques. This review discusses: (1) the classification of dermatophytes associated with infections in humans and animals, (2) the diagnostic techniques currently used to detect dermatophytes in the clinical setting, (3) possible future directions in the diagnosis of dermatophytosis, and (4) a comprehensive clinical review of the dominant zoophilic species *Microsporum canis* . This species frequently infects both humans and animals, making it one of the most commonly encountered dermatophytes in clinical practice [26, 27].

Inventory of dermatophytes

These fungi are septate, hyaline, filamentous forms that can produce spores (conidia) and are mainly composed of mycelium [28]. Mycelium structures are formed by the fusion of tubular fungal structures known as hyphae [28]. The mycelium performs the physiological functions of nutrient absorption, spore production, and sensitivity to environmental factors such as light,

temperature, and nutrients [28, 29, 30, 31]. Different types of conidia are formed depending on the dermatophyte species and environmental conditions [28]. For example, asexual spores can be formed as macroconidia (large conidia with multiple septa), microconidia (small, unicellular conidia), and arthroconidia (infectious fragments of hyphae) [28].The onset of dermatophyte infection begins when the infectious parts of the dermatophyte, called arthroconidia, attach to keratinized tissue [32, 33, 34] (Figure 1). Arthroconidia initially adhere to the epidermis within 2 to 6 hours of contact and begin to germinate in the stratum corneum [32, 33, 34] (Figure 1). As the arthroconidia begin to germinate, these spores develop germ tubes that can penetrate the first layer of the epidermis— *the stratum corneum* [34] (Figure 1).The pH at the site of infection becomes more basic as the dermatophyte degrades keratin, facilitating further action of fungal proteases [35]. Fungal hyphae continue to grow and invade keratinized tissues and begin to produce arthroconidia within 7 days of infection, allowing the fungus to spread to other anatomical sites within the same host, to other hosts, or to contaminate the environment [36].

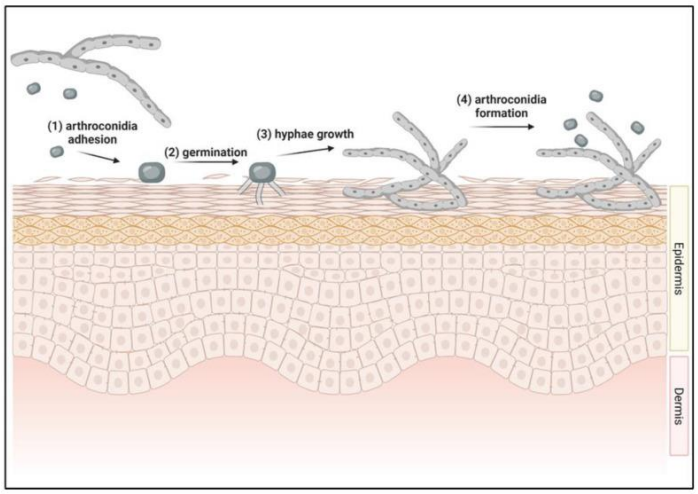


Figure 1.

Onset of dermatophyte skin infection

(1) Arthroconidia from the environment or another infected host come into contact with the skin of a new host. Attachment to the skin occurs within 2–6 hours of contact. (2) Arthroconidia begin to germinate in the superficial layer of the epidermis, forming germ tubes. (3) Hyphae continue to grow within the epidermis. (4) New arthroconidia are formed within 7 days of infection, allowing the cycle to repeat. Arthroconidia cannot invade healthy tissues because the host immune system prevents the fungi from infecting healthy epidermal skin [2, 18, 47, 48, 49]. Therefore, predisposing factors are usually present for infection to develop. The most common predisposing factors are young age, immunosuppression, nutritional deficiency, skin trauma, and high temperature and/or humidity [2, 16, 18, 48, 49]. One study showed that cats experimentally exposed to dermatophyte spores remained uninfected unless a predisposing factor was present; in this study, occlusive dressings and limited cleaning [50]. The unique metabolic pathways of dermatophytes that allow invasion and degradation of keratin represent potential targets for the development of new therapeutic approaches.

Factors that favor infection with dermatophytosis in humans

1. External factors

- High temperature and humidity of the environment;
- Poor personal hygiene;

• Socio-epidemiological living conditions;
• Overpopulation, i.e. high population density in residential areas.

A more detailed explanation of these factors:

• **High temperature and humidity:** Tropical and subtropical climates provide optimal conditions for the growth of dermatophytes, increasing the prevalence of infections.
• **Closed clothing and footwear, especially workwear:** Tight and closed clothing and footwear create a warm and humid environment (intertriginous regions), which leads to sweat accumulation, friction and maceration of the skin.
• **Exposure to contaminated sources:** Contact with contaminated surfaces (e.g., locker rooms in fitness centers, public swimming pools) and objects (towels, combs) can act as a vector of transmission.
• **Contact with soil and animals:** Geophilic fungi are transmitted through soil, while zoophilic fungi are transmitted through contact with domestic animals or livestock.
• **Professions with increased exposure:** Veterinarians, farmers and other professions with a higher risk of contact with the causative agents.

2. Host-related and physiological factors

• **Compromised immunity:** Conditions such as HIV/AIDS, diabetes mellitus, lymphoma, and leukemia increase susceptibility.
• **Skin damage and trauma:** Disruption of the skin barrier (scratches, atopy, ichthyosis) allows fungi to penetrate more easily.
• **Age and gender:** Infections can occur at any age, but are more common in children (tinea capitis) and older adults. Some studies show a higher prevalence in men, especially for tinea pedis and tinea cruris.
• **Thickness:** Increased skin folds create localized and retained moisture.
• **Use of topical steroids:** Inappropriate or excessive use suppresses local immunity and allows for faster growth of fungi.
• **Use of antimicrobial drugs:** Broad-spectrum antibiotics can disrupt the normal microflora and encourage the growth of opportunistic fungi.

Localization of dermatomycoses in body regions

The preferences of dermatophytes for colonization of humans are site-specific. Certain dermatophyte species inhabit specific anatomical regions. Infection of the feet is called *tinea pedis* (“athlete’s foot”) [24, 78]. Other forms of localized dermatophytosis include *tinea capitis* (infection of the scalp), *tinea unguium* (infection of the nails), *tinea barbae* (infection of the beard), *tinea faciei* (infection of the face), *tinea corporis* (infection of the body), *tinea manuum* (infection of the hands), and *tinea cruris* (infection of the groin) [18] (Figure 2).
T. rubrum is the most common dermatophyte infecting humans worldwide and is responsible for the majority of cases of *tinea pedis* [1, 24, 25]. *T. interdigitale* also causes *tinea pedis* and is a clonal branch of *T. mentagrophytes* [15, 74]. *T. tonsurans is one of the major causes of tinea capitis* infections worldwide [24, 79] (Figure 2, Table 1). A rare form of *tinea capitis* , known as *tinea capitis favosa* , is caused by *Trichophyton schoenleinii* and occurs most commonly in children and adolescents [74, 80, 81].

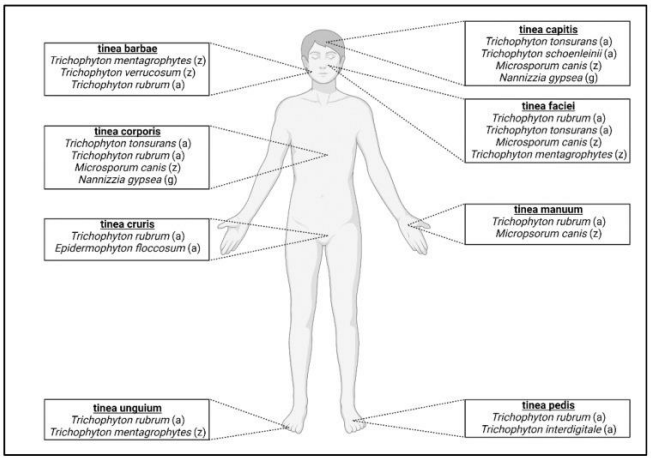


Figure 2.

Diagnosis

Accurate diagnosis is essential in dermatophytosis to allow early treatment and reduce transmission to humans or other animals. When diagnosing dermatophytosis in animals, fomite transmission should also be considered, especially in cases without clinical signs, as they may be positive for dermatophytosis [16]. Given the similarities in clinical presentation between dermatophytosis and other skin diseases, accurate diagnosis is also important before initiating treatment [110]. Previous treatment can interfere with many diagnostic tests, which can lead to inaccurate results [16].Proper clinical specimen collection significantly increases diagnostic accuracy. Specimens should be collected from the periphery of well-defined skin lesions, as the center of the lesion may contain little or no material [18]. In skin infections with poorly defined lesions, specimens are obtained by scraping the skin, covering a representative area of the infection [18]. Hair samples can be collected by plucking or using the Mackenzie brush technique [111]. In this technique, the patient is combed for 2–3 minutes or until the brush collects a sufficient amount of hair [16]. Whole nail clippings or scrapings can also be taken, depending on the location and severity of the infection [18]. The type of clinical specimen influences the diagnostic approaches that can be used, as the sensitivity and specificity of the assays depend on the type of specimen.

Direct review

Dermoscopy involves the use of a handheld magnifying device to examine skin lesions, including those involving hair and nails [112]. Direct examination of the patient with dermoscopy is common in clinical practice, especially in human medicine [112]. Because the method is noninvasive, dermoscopy can be used both for diagnosis and for monitoring infection during treatment [112, 113, 114].
Modern advances in dermoscopy include the use of polarized light sources and the connection of the device to mobile devices for better observation of dermatological features [115]. In veterinary medicine, dermoscopy is most commonly used to examine hair follicles and skin [116, 117]. A disadvantage of veterinary dermoscopy is the need for the patient to remain still long enough for digital imaging [118] (Table 2). Therefore, the accuracy of this technique is largely dependent on the skills and expertise of the examiner [118] (Table 2).

Table 2. Comparison of diagnostic methods for detecting dermatophytes.

Diagnostic method	Advantages	Disadvantages	Time for Results	Reference
Direct examination	Non-invasive Low cost	Inability to determine species	Minutes	[116 , 117]
Wood lamp	Non-invasive Low cost	Not all species fluoresce	Minutes	[119 , 120]
microscopy	Can reveal unique traits of species Low cost	Inability to distinguish dead from live mushrooms	Minutes	[38 , 121]
Culture	Low cost Easy to perform Can distinguish between species	Requires expertise to determine species Can be contaminated by saprophytes	Day–Week	[122 , 123 , 124]
PCR	Very sensitive Can distinguish between species	Inability to distinguish dead from live mushrooms	Hours–Days	[16 , 125 , 126]
ELISA	Very specific	False positives due to past infections	Hours–Days	[127 , 128 , 129]
MALDI-ToF	Very sensitive Can distinguish between species	Discover only species in the library	Minutes–Hours	[130 , 131 , 132 , 133]
Genetic analysis	Can distinguish between species Very sensitive	Inability to distinguish dead from live mushrooms	Hours–Days	[30 , 31 , 134]

The role and significance of IgE in dermatomycosis

Immunoglobulin E (IgE) plays a significant, and often detrimental, role in the pathogenesis of chronic or severe dermatomycoses (fungal skin infections), particularly those caused by dermatophytes such as *Trichophyton rubrum* . While a cell-mediated immune response (Th1)

is essential for the elimination of fungal infections, an exaggerated humoral immune response characterized by elevated total and specific IgE levels is associated with chronic, resistant, and widespread infections.

1. The role of IgE in chronic dermatophytosis

- **Marker of chronicity:** Studies show that patients with chronic or recurrent dermatophytosis often have elevated levels of total IgE in serum.
- **Pathogenetic mechanism (Th1/Th2 imbalance):** Chronic infections are characterized by a shift towards a Th2-type immune response (which produces IgE), rather than the protective Th1 response. This imbalance leads to the inability to completely eliminate the fungus.
- **Immediate hypersensitivity:** Chronic and disseminated dermatophyte infections are associated with type I hypersensitivity reactions to trichophyton, mediated through IgE.
- **Correlation with disease severity:** Serum IgE levels show a significant positive correlation with disease duration and degree of body surface area involvement.

2. IgE-mediated inflammation and dermatophytes

- **Tissue damage:** IgE bound to FcεRI receptors on mast cells and basophils, upon contact with fungal antigens, causes degranulation and release of inflammatory mediators (e.g. histamine), leading to inflammation.
- **Antigenic components:** *T. rubrum* produces antigens (mannans, glycoproteins) that, in addition to inhibiting cell-mediated immunity (CMI), stimulate increased production of IgE and IgG4, contributing to a chronic inflammatory state.

Clinical significance

Increased IgE values may indicate:
• activation of a Th2 immune response; • sensitization to fungal antigens; • chronic or recurrent form of infection.
However, total IgE **is not a specific marker** for dermatomycoses and should be interpreted in a clinical context, as it may be influenced by atopy, parasitosis, and other immunological factors.

Immunological explanation of the role of IgE in dermatomycoses

Dermatomycoses are superficial fungal infections where the immune response involves both cellular and humoral immunity. Although the main protection is based on Th1-immunity, in certain patients a Th2 response is activated, leading to increased IgE production.

Immune mechanism

Fungal antigens of dermatophytes and *Candida* can act as chronic allergens and:

- stimulate Th2 lymphocytes;
- increase the production of cytokines IL-4, IL-5 and IL-13; • activate B-lymphocytes for IgE synthesis.

IgE binds to receptors on mast cells and basophils, increasing local inflammatory reactivity and contributing to hypersensitivity processes.

When IgE increases in dermatomycoses

Elevated values are most often observed in:
• chronic or recurrent dermatophytosis; • widespread or deeper infections;
• patients with atopic predisposition;
• hypersensitivity to fungal antigens.
In these cases, dermatophytes act not only as infectious pathogens, but also as chronic allergic stimulants.IgE in dermatomycoses is an indicator of the humoral and allergic component of the immune response to fungal antigens. Its increase is most often associated with chronic, widespread forms or atopic predisposition, while in many patients with simple fungal infections, the level of IgE may remain within normal limits.Our work was considered in several phases: a phase of collecting material over a period of two years and further processing of the data in accordance with the topic, specifically the analysis of the significance of IgE in dermatomycoses.
During this period, 60 patients with dermatomycosis were treated at **QKUK** , Pristina Kosovo. The diagnosis of the **60 included patients** was based on a combination of clinical examination and laboratory confirmation. First, a clinical assessment of the lesions was performed to determine the type of infection, which showed that **Kerion Celsi** was the most common form (31.7%).
To confirm the diagnosis, the following were used:

- clinical picture,
- examination with **WOOD lamp** ,
- dermoscopy,
- direct microscopic examination with **potassium hydroxide (KOH)** to identify fungal elements in the structure of the skin, hair and nails.

mycotic culture on Sabouraud Dextrose Agar (SDA) was performed to identify the fungal species.
total IgE (Immunoglobulin E) in serum is measured by **ELISA (Enzyme-Linked Immunosorbent Assay)** to assess the systemic immune response.
The infected area was calculated as a percentage to analyze the correlation with the severity of sensitization.

Table 1: This table shows the statistical data on the validity of the patients included in the study, which were analyzed according to three variables: **Gender** , **Fungus** , and **IgE_Category** .

Statistics

		Gender	Fungus	IgE_Category
N	Valid	60	60	60
	Missing	0	0	0

The size of the patient group is indicated by **N** , and the table shows full validity without loss of information during the data processing process.
This means that data for all three variables are available for all 60 patients, which allows for reliable statistical analyses and correlations between gender, type of fungus, and IgE level/category.

Table 2: Distribution by Gender

Gender

		Frequency	Percent	Valid Percentage	Cumulative Percentage
Valid	Male	43	71.7	71.7	71.7
	Female	17	28.3	28.3	100.0
	Total	60	100.0	100.0	

From the statistics shown in the previous table, a dominance of one gender is observed in the sample of 60 patients:
Men constitute the majority with **43 patients (71.6%)** of the total.
Women make up the remainder with **17 patients (28.3%)** .
This result was taken into account when interpreting the results and during the entire clinical analysis process, as antibody levels or the body's response to fungal infections can vary between men and women.

Table 3: Fungal frequencies

Fungus

		Frequency	Percent	Valid Percentage	Cumulative Percentage
Valid	Onychomycosis	12	20.0	20.0	20.0
	Kerion Chelsea	19	31.7	31.7	51.7
	Tinea Superficialis	4	6.7	6.7	58.3
	Tinea Pedis	7	11.7	11.7	70.0
	Tinea Manii	7	11.7	11.7	81.7
	Tinea Capitis	5	8.3	8.3	90.0
	Tinea Corporis	6	10.0	10.0	100.0
	Total	60	100.0	100.0	

This table provides a clear overview of the distribution of fungal species in the sample of 60 patients:
Kerion Celsi is the most common diagnosis with **19 cases (31.7%)** .
Onychomycosis follows with **12 cases (20%)** .
This distribution shows that **Kerion Celsi dominates in patients** , which is clinically significant because this type of infection causes **a strong inflammatory response** compared to other more superficial forms of dermatomycoses.

Conclusion

This research confirms that **dermatomycoses cause a significant systemic immune reaction** , expressed through high levels of total IgE in 80% of patients.
Key findings:Gender has a critical impact on the intensity of sensitization: men show significantly higher mean IgE levels (1107.36 IU/mL) compared to women (255.51 IU/mL), with high statistical significance ($p < 0.001$).**The intensity of the allergic reaction does not depend on the visible affected area** ($r = -0.113$), but on **the inflammatory nature of the fungal pathogen** .This suggests that **therapy of dermatomycoses should also include the systemic immune aspect** , especially in men with a predisposition to high systemic reactions.In addition to the statistical data, the study clearly highlights the need for **a reevaluation of the**

current treatment of dermatomycoses . The non-correlation between high IgE levels and the affected area suggests that **the intensity of the immune reaction depends more on the nature of the dermatophytosis and the susceptibility of the patient** , than on the visible clinical expansion.

Recommendation: Personalized therapy, especially in men with a predisposition to strong systemic reactions, is **critically important for effective long-term treatment** .

References

[1]. Sai BS, Tejashree A., Veeranna S., Krishna Karthik M. Speciation and In Vitro Activity of Four Antifungal Drugs Against Clinical Isolates of Dermatophytes By E-Test Method. Int. J. Sci. Res. 2019; 8 doi: 10.36106/ijsr. [DOI] [Google Scholar]

[2]. Gupta AK, Stec N. New drugs for the treatment of onychomycosis. Expert Opinion. Emergency Medicine. 2019;24:213–220. doi: 10.1080/14728214.2019.1685493. [DOI] [PubMed] [Google Scholar]

[3]. Gupta AK, Versteeg SG, Shear NH Onychomycosis in the 21st century: An update on diagnosis, epidemiology, and treatment. J. Cutan. Med. Surg. 2017;21:525–539. doi: 10.1177/1203475417716362. [DOI] [PubMed] [Google Scholar]

[4]. *Noble SL, Forbes RC, Stamm PL. Diagnosis and management of common tinea infections. Am Fam Physician. 1998;58:163–174, 177–168.* [PubMed] [Google Scholar]

[5]. *Ely JW, Rosenfeld S, Seabury Stone M. Diagnosis and management of tinea infections. Am Fam Physician. 2014;90:702–710.* [PMC free article] [PubMed] [Google Scholar]

[6]. *Uhrlaß S, Verma SB, Gräser Y, et al. Trichophyton indotineae—an emerging pathogen causing recalcitrant dermatophytoses in India and worldwide—a multidimensional perspective. J Fungi (Basel). 2022;8:757. doi: 10.3390/jof8070757* [DOI] [PMC free article] [PubMed] [Google Scholar]

[7]. *Verma SB, Panda S, Nenoff P, et al. The unprecedented epidemic-like scenario of dermatophytosis in India: I. epidemiology, risk factors and clinical features. Indian J Dermatol Venereol Leprol. 2021;87:154–175.* [DOI] [PubMed] [Google Scholar]

[8]. *Chen E, Ghannoum M, Elewski BE. Treatment-resistant tinea corporis, a potential public health issue. Br J Dermatol. 2021;184:164–165.* [DOI] [PubMed] [Google Scholar]

[9]. *Verma SB, Panda S, Nenoff P, et al. The unprecedented epidemic-like scenario of dermatophytosis in India: I. epidemiology, risk factors and clinical features. Indian J Dermatol Venereol Leprol. 2021;87:154–175.* [DOI] [PubMed] [Google Scholar]

[10]. *Chen E, Ghannoum M, Elewski BE. Treatment-resistant tinea corporis, a potential public health issue. Br J Dermatol. 2021;184:164–165.* [DOI] [PubMed] [Google Scholar]

[11]. Seebacher C., Bouchara J.P., Mignon B. Updates on the Epidemiology of Dermatophyte Infections. Mycopathologia. 2008;166:335–352. doi: 10.1007/s11046-008-9100-9. [DOI] [PubMed] [Google Scholar]

[12]. Havlickova B., Czaika V.A., Friedrich M. Epidemiological trends in skin mycoses worldwide. Mycoses. 2008;51:2–15. doi: 10.1111/j.1439-0507.2008.01606.x. [DOI] [PubMed] [Google Scholar]

[13]. Hay R.J. Tinea Capitis: Current Status. Mycopathol. Et Mycol. Appl. 2017;182:87–93. doi: 10.1007/s11046-016-0058-8. [DOI] [PMC free article] [PubMed] [Google Scholar]