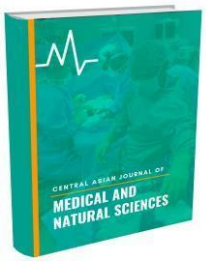

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Article

Fungal Nail Infection

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Abstract: Yeast, mold, and fungus are the usual causes of fungal nail infections. The frequency of onychomycosis tends to differ around the world due of numerous Socioeconomic and cultural aspects. Age roles, smoking, wear artificial nails, Obesity, Weakened immune system, Diabetes, Public swimming pool as well as hereditary disposition all contribute to the various ways that onychomycosis manifests in certain places, including as *Trichophyton spp, Aspergillus spp, Fusarium spp, Candida spp* and yeasts. The impact of genetic and environmental variables on the development of fungal nail infections is covered in this review of the literature and The causes and symptoms of fungal infections of the fingers were also studied.

Keywords: Onychomycosis, *Trichophyton spp, Aspergillus spp, Fusarium spp,* Environmental factors

1. Introduction

Fungal nail infections, also known as tinea unguium or onychomycosis, are chronic fungal infections of the nails that result in onycholysis (separation of the nail from the nail bed), discoloration, and thickening of the nail plate. These infections can affect any portion of the nail unit, including the nail matrix, nail bed, and nail plate, but they are most commonly observed in the toenails.

Approximately 50% of nail diseases are caused by fungal infections, with an estimated frequency of 5.5%.

Causes of Fungal Nail Infection:

1. **Dermatophytes** (more than 75% of cases):
   a. *Trichophyton rubrum* and *T. verrucosum*
   b. *T. soudanense*, *T. tonsurans*, *T. Krajdenii*, *T. violaceum*, *T. equinum*
   c. *Microsporum* species, *Arthoderma* species, and *Epidermophyton floccosum*
2. **Non-Dermatophyte Moulds** (10% of cases):
   a. *Fusarium* species, *Aspergillus* species, *Syncephalastrum* species
   b. *Neoscytalidium* species, *Chaetomium* species, *Onchocola* species, *Acremonium* species, *Scopulariopsis* species, and *Scytalidium* species
3. **Rare Yeasts**:
   a. *Candida albicans* and other Candida species (such as *Candida tropicalis* or *Candida parapsilosis*)

Symptoms of Fungal Nail Infection:

1. Fungal infections can cause deformation of the nails, resulting in an unusual texture or shape.
2. The nails may become brittle, causing them to crumble or break easily.
3. Discoloration of the nails may occur, with yellow, brown, or white patches appearing.
4. Fungal infections may emit a strong, unpleasant odor from the infected nail bed.
5. Infected nails become thicker and more difficult to cut or trim.

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Fig.1 shows a change in the color, shape, and fragmentation or breakage of nails due to fungal growth**. [3,5]**

1. **Age**

Growing older raises the chance of getting a fungal nail infection. It is least prevalent in young children and most common in the elderly. Fungi-related nail infections are uncommon in children under the age of six **[6].**most likely as a result of delayed nail development, insufficient immune function, repetitive nail damage, prolonged exposure to pathogenic fungus, and poor peripheral circulation **[7].**

2. **Smoking**

Possess a heightened susceptibility to fungal nail infections. This may be the result of chronic smoking-related impaired blood circulation in the fingers and toes **[8].**

3. **Wear artificial nails**

When moisture builds up beneath artificial nails, fungus can infect the nails. When nails are left on for three months or more, it occurs more frequently. Additionally, if you reglue the artificial nail before cleaning the gap, this kind of infection may occur **[9].**

4. **Obesity**

Due to its rapid global rise, obesity poses a severe health risk. An increased frequency of inflammatory conditions is linked to obesity. among actuality, the incidence of onychomycosis infection is more than twice as high among those who are statistically obese. In contrast to those who are thin, the study of almost 9 million adults discovered **[7].**

5. **Weakened immune system**

Fungal nail infections can be more likely to affect you if you have a weakened immune system, whether from a medical condition or medication. If research indicates that individuals with weakened immune systems experience protein loss, which in turn causes an antibody deficiency and nail fungal infection **[10].**

6. **Diabetes**

An elevated rate of blood glucose resulting from abnormalities in insulin secretion, action, or both is the hallmark of the endocrine disease known as diabetes. The prevalence of diabetes patients is sharply rising globally **[11].**Among the complications of diabetes are nail fungus and reduced peripheral circulation from peripheral neuropathy. Diabetes raises the risk of harm to diabetic feet due to the resulting reduction in foot feeling. The nail and its nail matrix are more vulnerable to fungal invasion due to this fragility problem **[12].**Prevalence studies indicate that about one-third of diabetes people have onychomycosis**[13].**Despite modest rates indicated by healthy people for the same clinical condition, diabetes is thought to be one of the biggest risk factors for onychomycosis, which in this group amounts to a percentage of 31.5%.Patients with diabetes exhibit a number of clinical traits that promote the growth of onychomycoses. Prolonged diabetes and high glycated hemoglobin (HbA1c) levels cause nails to thicken and accelerate subungual keratinization, which increases the risk of onychomycoses **[14].**

7. Public swimming pool

Swimming is a great way to acquire the health benefits and physical activity required for a healthy life at any age. But it's important to ensure that the water is pure and that it's managed. Because swimming pools are used by a large number of people in a short amount of time, they are a good area for the spread of diseases and are therefore often associated with potentially dangerous health conditions. fungus-ridden nail **[15].**As a result, pollution from swimming pools is becoming a bigger problem. These fungi are the source of the fungal nail infection. A person who has this ailment directly contributes to the spread of illnesses and infections to others if they enter a swimming pool **[16].**The transmission of fungal illnesses can also be caused by heat, humidity, and overheating. Therefore, employing a swimming hat and showering both before and after swimming **[17].**Based on empirical evidence, swimming pools can serve as favorable environments for the growth of harmful fungus if proper management and inspection are not implemented. Pool bottoms and edges, as well as locker rooms and showers, are conducive to the growth of mushrooms. Other high-risk areas include hot tubs, since the dampness in these spaces facilitates the growth of saprophytic fungi **[18].**

4. Materials and Methods

This study on fungal nail infections adopts qualitative review approach to examine the environmental and genetic factors that contribute to the disease condition of the fungal nail infections. It is based on a systematic review of peer reviewed journal articles, clinical studies and scientific reports in order to calculate the prevalence as well as the causes and contributing risk factors for fungal nail infection. Relevance, credibility, recent contributions to the field, and sources were considered by the selection of sources to make sure that the sources are covered in terms of their relevance, credibility and relevance to the field. Data collection was done by reviewing the epidemiological studies, microbiological assessments and clinical studies which shed light on the involvement of the fungi such as Trichophyton, Aspergillus and Candida species in nail infection. Also, among its environmental determinants of disease manifestation were age, smoking, use of artificial nails, obesity, immune deficiencies, diabetes and exposure to public swimming pools. Studies were performed to analyse the genetic predisposition to fungal infections using studies that look into hereditary components, for instance single nucleotide polymorphisms (SNPs) that influence immune response. The findings of the qualitative synthesis of findings were structured to identify patterns and relationships of risk factors and fungal nail infections, both intrinsic and extrinsic. In addition, the study examines the application of the reviewed literature with preventive measures and treatment implications. The research seeks to integrate multiperspectives from clinical dermatology, genetics, and environmental science to better understand fungal nail infection causes, interventions, and their associated symptoms

5. Results

The most important genetic factors causing fungal nail infection

Gene abnormalities, either from mutations or inheritance from parents, are the cause of genetic diseases. Many of these illnesses are uncommon. Genetic differences in the immune system that lead to anomalies in pro- and anti-inflammatory responses may increase the risk of developing fungal infections. Therefore, It makes sense that genetic differences that affect key innate and adaptive immune system mechanisms could have a substantial impact on an individual's susceptibility to fungal nail infections [19,20]. Single-nucleotide polymorphisms (SNPs), for example, are genetic differences that have been found to have a major impact on a host's susceptibility to fungus. Treating these high-risk people would likely be simpler with the early detection and assessment of these genetic risk factors [21].The innate or adaptive immune systems most likely contain a hereditary component that adds to the disease's chronicity. The main indicator of a fungal infection is the innate immune system. Dectin-1, a C-type lectin receptor, is capable of identifying

the fungal cell wall. Beta-glucan carbohydrates found in dermatophytes and yeasts [22].It is expressed on macrophages and dendritic cells, and it plays a role in phagocytosis and the amplification of toll-like receptor (TLR) cytokine production. Dectin-1 boosts the interleukins 11-17, 12-6, and IL-10 on its own and raises the tumor necrosis factor alpha (TNF-alpha) signal, so further invigorating the adaptive immune system. An allele of the Dectin-1 gene with an early stop codon was discovered recently in a family at increased risk of onychomycosis. caused by a single nucleotide polymorphism [2].The ensuing receptor leads to deficiencies in fungus binding as well as the generation levels IL-6 and IL-17, which are less common in the parents' heterozygous generation but more common in homozygous individuals [23].

1. Complications nail fungus

Athlete's foot is a different ailment that can result from untreated toenail fungus spreading to the skin around the nail. Itchy, red, and cracked skin are symptoms of an athlete's foot ailment, which may be quite painful. Jock itch can occasionally be caused by toenail fungus that has traveled to the genitalia. Cellulitis can result from the spread of fungus in extreme situations.When you have cellulitis, your skin swells, becomes red, and hurts to the touch. Cellulitis can become life-threatening for many people if treatment is not received. The infection can spread to the bloodstream. This is the most dangerous outcome of an untreated toenail fungus, which is preventable with medical assistance [24].

2. Prevent nail fungus:-

a. Always remember to keep your nails trimmed Trim your nails neatly, use a cooler to smooth the limbs, and remove any thick patches.After using nail clippers, sanitize them.Long nails might produce more areas where the fungal growth occurs.
b. Always wear dry and clean nails. Wash your feet and hands often. After handling the diseased nail, wash your hands. After thoroughly drying your nails, moisturise them and apply antifungal foot powder. Applying a moisturizer that strengthens nails and surrounding skin could be a good idea.
c. Go for footwear that is permeable to air.
d. Turn up your shoes in the locker rooms and around the pool
e. Get rid of old shoes or use powdered antibacterial or antifungal.
f. Avoid using fake nails and nail paint.
g. You can use an antifungal product to treat athlete's foot[4,5].

3. **Discussion**.

Fungal nail infections, commonly referred to as onychomycosis, represent a significant public health concern due to their prevalence and impact on affected individuals. These infections are caused by dermatophytes, moulds, and yeasts, with *Trichophyton* species being the most common culprits. The frequency and severity of fungal nail infections can be influenced by various environmental and genetic factors, which underscores the complexity of these conditions.

Age is one of the primary environmental risk factors, with the elderly being more susceptible due to age-related changes in the immune system, peripheral circulation, and nail growth. The lower incidence in children, particularly those under six, can be attributed to delayed nail development and a stronger immune defense against pathogens. Smoking also exacerbates the risk by impairing blood circulation, particularly in the fingers and toes, creating an environment conducive to fungal infections.

The use of artificial nails further contributes to the development of fungal nail infections. When artificial nails are left on for extended periods, moisture accumulates beneath them, creating an ideal habitat for fungi. This is especially concerning when nails are reglued before proper cleaning, which can trap fungi and facilitate their growth. Obesity also plays a significant role in increasing the risk, as it is often associated with higher rates of inflammatory conditions, which may impair the immune response and enhance fungal growth.

Moreover, individuals with weakened immune systems, such as those with diabetes or undergoing immunosuppressive treatments, are at heightened risk. Diabetes, in particular, contributes to fungal infections by reducing peripheral circulation and nerve sensitivity in

the feet, making the nails more vulnerable to fungal invasion. Approximately one-third of diabetic patients are affected by onychomycosis, emphasizing the need for careful monitoring and early intervention in this population.

Public swimming pools, often crowded and poorly managed, also pose a significant risk for the spread of fungal infections. The high humidity, coupled with inadequate pool maintenance, creates a breeding ground for fungi. Individuals who frequent public pools should be aware of the potential risks and take preventive measures such as showering before and after swimming and avoiding direct contact with pool surfaces.

Genetic factors also play a crucial role in susceptibility to fungal nail infections. Variations in immune system genes, such as those affecting the Dectin-1 receptor, can make individuals more susceptible to fungal infections. The identification of single nucleotide polymorphisms (SNPs) in these genes offers the potential for early detection and personalized treatment strategies, particularly for those with a family history of onychomycosis.

In conclusion, fungal nail infections are influenced by a combination of environmental exposures and genetic predispositions. By understanding these factors, healthcare providers can better manage and prevent these infections, particularly in high-risk populations. Further research into genetic markers and their relationship to fungal susceptibility may lead to more effective treatments and prevention strategies.

4. Conclusion

Nail fungi are the most common nail disorders, accounting for 50% of nail deformities in adults. This infection occurs due to dermatophytes, molds, and yeasts, and the high incidence of nail fungi can be attributed to environmental and genetic factors. This article will cover the causes, symptoms, some environmental and genetic factors, complications, and prevention of nail fungi.

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