Faculty of Science - University of Benghazi
Libyan Journal of Science & Technology
journal home page: https://journals.uob.edu.ly/LJST

Epidemiological Characterisation and Molecular Identification of Dermatophyte Infections Isolated from Outpatient Clinics of The Dermatology Department at Zliten Medical Center, Libya.

Siham R. Alneebu [a], Mustafa E. Elsharif [a,*], Tarek M. Arshah [b], Amna H. Arltil [c], Minor J. Zeglam [d]

[a] *Department of Microbiology, Faculty of Science, Alasmarya Islamic University, Zliten, Libya*
[b] *Department of Medicine, Faculty of Medicine, Elmergeb University, Libya*
[c] *Department of Microbiology, Laboratory of Zliten Medical Center, Libya*
[d] *Communicable Diseases Centre Zliten, Libya*

Highlights

- ***Trichophyton violaceum* and *Microsporum canis* were identified as the primary etiological agents of dermatophytosis among patients at Zliten Medical Center in Libya.**
- **Real-time PCR targeting ITS1–ITS4 regions provided high molecular diagnostic accuracy, confirming 80% of culture-positive isolates and achieving 100% confirmation for *M. canis*.**
- **Epidemiological findings revealed that children under 10 years old were the most affected demographic group, with *M. canis* infections closely linked to contact with domestic animals.**

ARTICLE INFO

Article history:
Received 12 December 2025
Revised 22 June 2026
Accepted 23 June 2026

Keywords:
Dermatophytes, Fungal skin infection, Molecular Identification, PCR, Trichophyton violaceum, Zliten, Libya.

* Address of correspondence:
Email: melsharif@asmarya.edu.ly
Mustafa E. Elsharif

ABSTRACT

Dermatophytes are keratinophilic fungus causing superficial infections of skin, nail and hair. In recent decades, the prevalence has internationally increased, affecting about 25% of populations in different countries around the World. The aim of this study was to identify different species of dermatophytes causing dermatophytosis in patients infected with fungal skin infections using morphological, microscopic, and molecular diagnostic methods with use of Polymerase Chain Reaction (PCR) techniques. In this study a total of 100 clinical samples from skin, hair, and nails were collected from patients attending Zliten Medical Center over the period of time from 01.01.2022 until 30.5.2022. Samples were examined microscopically using Potassium Hydroxide (KOH) 10%-20% and cultured on Sabouraud Dextrose Agar (SDA), Potato Dextrose Agar (PDA), and Dermatophyte Test Medium (DTM). Fungal isolates from positive Cultures were further investigated with PCR. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Only 22% of total samples show positivity for KOH. A 12 species were identified, with *Trichophyton violaceum* (25%) and *Microsporum canis* (20%) being the most common, followed by *Trichophyton tonsurans* (10%) and several less frequent species. It is worth noting, that *Microsporum canis* was more frequently affecting children under 11 years old und occurred more frequently in People having domestic animals. Molecular confirmation using real-time PCR (ITS1–S4 primers) showed 80% PCR positivity among culture isolates. Eight species were fully PCR-confirmed, while others showed variable detection rates. Overall, PCR has confirmed that *T. violaceum* and *M. canis* were the predominant dermatophytes in this study. The importance of this study lies in its emphasizing of the effectiveness and feasibility of using molecular identification technology for the accurate identification and early diagnosis of dermatophyte infections.

1. Introduction

Dermatophytes are among the most common causes of superficial Fungal Skin infections worldwide, affecting the skin, hair, and nails (Campbell & Johnson, 2013). These infections are generally referred to as Dermatophytosis. Dermatophytes grow in the superficial keratinized layers and are unable to invade deeper tissues due to unfavorable internal conditions for their growth. They belong to three main genera: Trichophyton, Microsporum, and Epidermophyton, and their distribution patterns vary across regions depending on environmental, social, and healthcare factors (Sciortino Jr, 2017). The incidence of dermatophytic infections is higher in warm and humid climates and among individuals in contact with domestic animals. Certain groups, such as children, the elderly, and immunocompromised patients, are more susceptible to infection (Kidd *et al.*, 2016; Magagnin *et al.*, 2011). Superficial fungal skin infections are common health Problem worldwide. In recent decades, the Prevalence of skin, hair and nail fungal infections has increased to affect around 25% of population in different parts of the World (Halvckova, 2008). With advances in diagnostics, molecular techniques, particularly Polymerase Chain Reaction PCR, have become important tools for the rapid and accurate identification of dermatophytes compared to conventional methods (Wisselink *et al.*, 2011). A study by Altayyar (2012) has shown that the major isolated fungi were Aspergillus spp., with 52.47%, Penicillium spp., followed by Candida spp. with 16.3%. A study conducted in Tripoli (Libya) showed that Aspergillus spp., was the dominant clinical manifestation, involving 39.1% of the entire cases of Fungal Skin Infection, and Trichophyton spp. Represented 30.7%, followed by 18.4% of Candida spp. (Atia *et al.*, 2022). Although there was some

 ISSN 2663-1407; National Library of Libya, Legal number: 390/2018

Data about fungal skin Infections in Libya, but they are very limited. The objectives of this study were to isolate and identify dermatophytes from patients attending the dermatology outpatient department of Zliten Medical Center (ZMC) using morphological, microscopic, and molecular (PCR) methods. Additionally, the study aimed to investigate the influence of various factors such as age, gender, and contact with animals on the prevalence of dermatophytic infections. Furthermore, it sought to analyze the relationship between these factors and the distribution of different dermatophyte species among the affected patients. It is very important to find out of Epidemiology and causative species of frequently occurring fungal infections of the skin in this region of northwest Libya, which could be used to prevent and treat them effectively. Using PCR makes the results reliable and trustworthy.

2. Materials and Methods

A total of 100 clinical samples were collected from patients attending the outpatient department of dermatology at ZMC, between 01.01.2022 and 30.05 2022. The samples included skin, hair, and nail specimens from patients of all ages and both genders under the direct supervision of a specialist Dermatologist. Skin scrapings were obtained from skin and nails after cleaning the affected area with 70% ethanol; using a scalpel, and affected hair was plucked using sterile forceps. Each sample was divided for direct microscopic examination and for fungal culture investigation through the inoculation of the samples on different types of culture media, including Sabouraud Dextrose Agar SDA, Potato Dextrose Agar PDA, and Dermatophyte Test Medium DTM were prepared according to standard protocols and then incubated at 25°C for 2–4 weeks (Walsh *et al.,* 2018). Direct microscopic examination was performed using 10% potassium hydroxide (KOH) for skin and 20% KOH for hair and nails (Santhosh *et al*., 2024). Microscopic features were analyzed at 10× and 40× magnifications according to Dismukes *et al.* (2003). Fungal colonies were subcultured on SDA slants for maintenance. Morphological identification was carried out based on colony morphology, including color, texture, reverse pigmentation, and microscopic features of hyphae and the formation of the conidia (Kidd *et al.,* 2016; Sciortino, 2017). The fungal identification was confirmed through the performance of molecular analysis technique. The fungal DNA extraction was carried out using a heat-shock modified method described by Galliano *et al.,* (2021) and then subjected to PCR amplification using HOT FIREPol® Solis Green® qPCR Mix. The PCR products were analyzed under standard cycling conditions. Statistical analysis was conducted using SPSS version 25. Frequencies, percentages, and graphs were used for descriptive analysis. Comparative data analysis between groups employed Eta and Lambda coefficients. *p-value* less than 0.05 was considered statistically significant.

3. Results

This was a cross-sectional descriptive study conducted on 100 patients. The collected samples were assessed to identify the main etiological agents of dermatophytosis; fungal growth was detected in 40% of the cases, whereas 60% showed no growth. The distribution of fungal infections based on KOH test showed that 78% of tested samples showed negative detection for fungal hyphae, whereas the results revealed that 22% of the samples showed fungal hyphae units. Among the culture-negative samples, 54% had a negative KOH result and 6% were positive. Conversely, among the culture-positive samples, 24% were negative by KOH and 16% were positive. This indicates that culture was more sensitive in detecting fungal growth compared to direct KOH examination. (Table 1).

Table 1: Distribution of results according to KOH and culture examinations (P<0.05)

Fungal Culture	KOH Negative (-) %	KOH Positive (+) %	Total%
No Growth	54 %	6%	60
Growth	24%	16%	40
Total	78%	22%	100

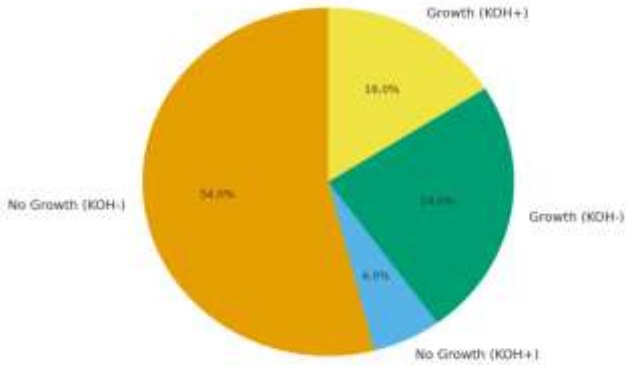

Fig. 1. Distribution of results according to KOH and culture examinations

Fungal species identification through culture examination revealed 12 different species. The most prevalent was *Trichophyton violaceum*, accounting for 25% of the isolates, followed by *Microsporum canis* with 20%. Other species included *Trichophyton tonsurans* (10%), *Trichophyton rubrum* (7.5%), *Trichophyton verrucosum* (7.5%), and *Epidermophyton floccosum* (7.5%), as well as less frequently isolated species of dermatophytes. Also, the fungal culture investigation represented other than dermatophyte species, including *Candida albicans* (2.5%), Table 2.

Table 2: Frequencies and percentage of different isolated fungal species

Fungal Species	Number	Percentage (%)
T. rubrum	3	7.5
T. violaceum	10	25.0
T. soudanense	2	5.0
T. schoenleinii	2	5.0
T. tonsurans	4	10.0
T. mentagrophytes	1	2.5
T. verrucosum	3	7.5
M. canis	8	20.0
M. audouinii	2	5.0
M. gypseum	1	2.5
E. floccosum	3	7.5
C. albicans	1	2.5
Total	40	100

Table 3: Real-time PCR results

Fungal species	PCR Negative (-)	PCR Positive (+)	Total	Positivity (%)
T. rubrum	2	1	3	33
T. violaceum	4	6	10	60
T. soudanense	0	2	2	100
T. schoenleinii	1	1	2	50
T. tonsurans	1	3	4	75
T. mentagrophyt	0	1	1	100
T. verrucosum	0	3	3	100
M. canis	0	8	8	100
M. audouinii	0	2	2	100
M. gypseum	0	1	1	100
E. floccosum	0	3	3	100
C. albicans	0	1	1	100
Total	8	32	40	80

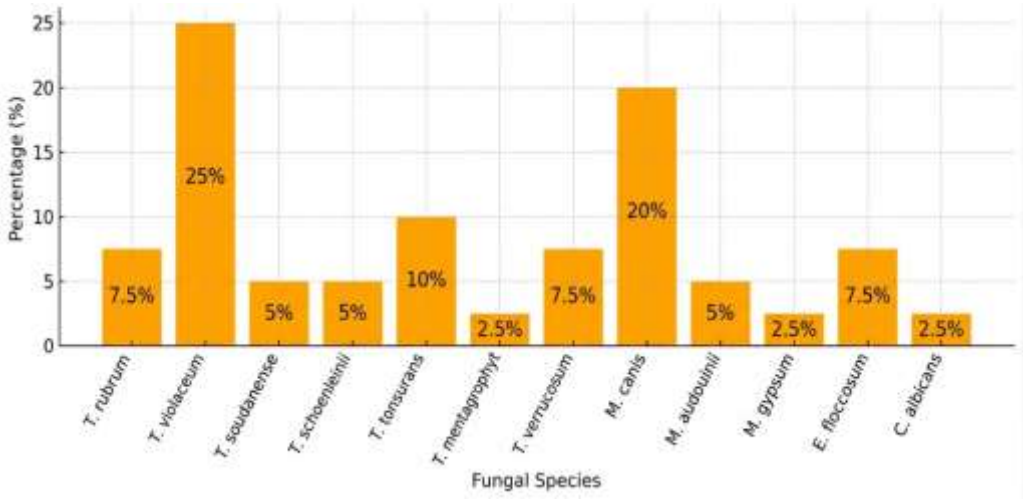

Fig. 2. Percentage of isolated fungi.

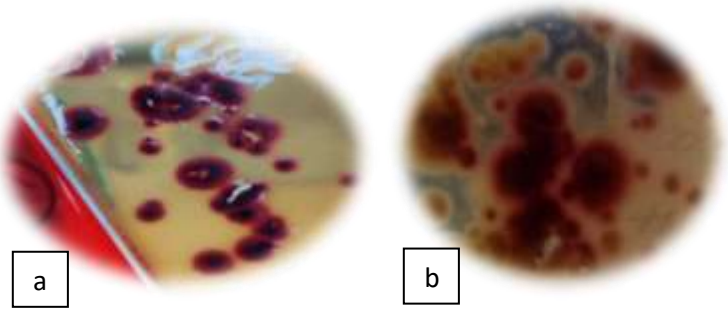

Fig. 3. *Trichophyton violaceum* colonies on SDA**; a)** is the front side view, and **b)** reverse side view.

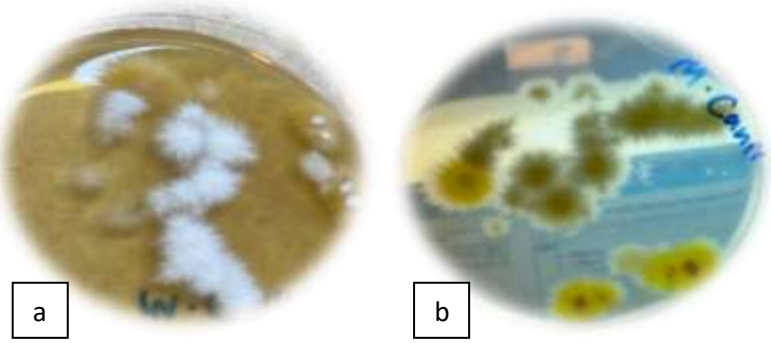

Fig. 4. *Microsporum canis* on SDA**; a)** anterior view, and **b)** posterior view.

Molecular identification using real-time PCR with ITS1–ITS4 primers was applied to confirm the morphological diagnosis of the 40 culture-positive isolates. The results showed that 80% of the isolates were PCR-positive, while 20% were PCR-negative. Among the isolates, eight species (*T. soudanense, T. mentagrophytes, T. verrucosum, M. canis, M. audouinii, M. gypseum, E. floccosum,* and *C. albicans*) were 100% PCR-positive. The remaining species demonstrated variable detection rates: *T. tonsurans* (75%), *T. violaceum* (60%), *T. schoenleinii* (50%), and *T. rubrum* (33%), Table 3.

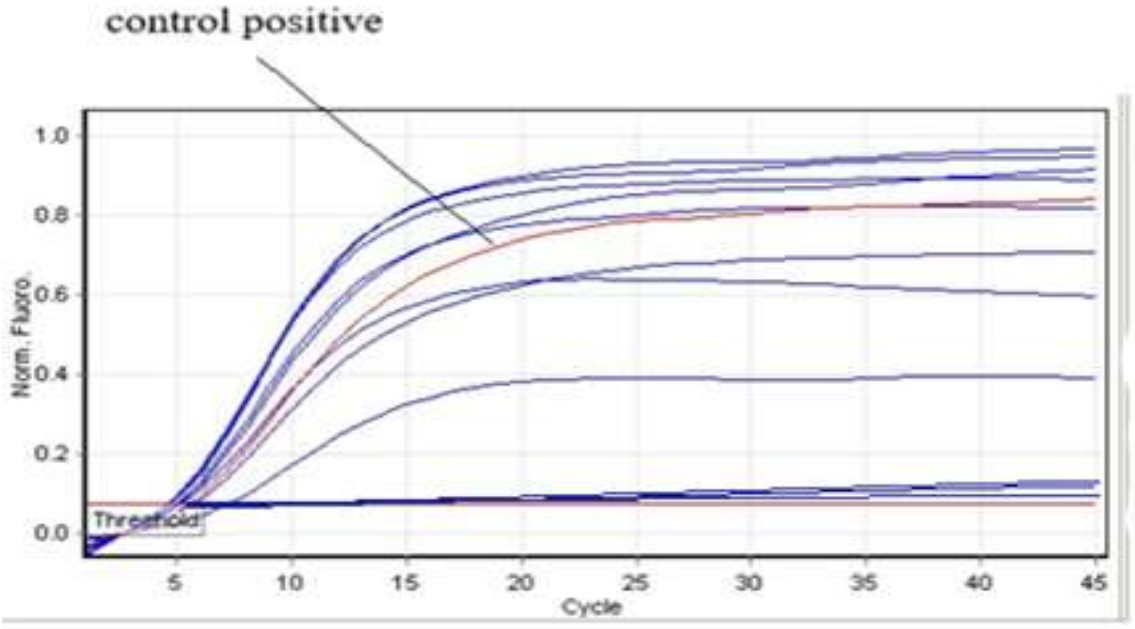

Fig. 5. Real-time PCR results

The PCR technique has confirmed the obtained results of culture. The high prevalence of *T. violaceum* and *M. canis* corresponds with their recognized role as major dermatophytic pathogens in dermatology practice. The variability in PCR positivity among certain species may be attributed to differences in DNA quality, primer efficiency, or intra-species genetic variation, emphasizing the importance of combining morphological and molecular tools for accurate fungal diagnosis.

With the regard to the correlation between fungal species and age, a positive and statistically significant relationship ($p < 0.01$) of 32% was observed, indicating that age is significantly associated with the prevalence of dermatophyte infections. The highest infection rate (45%) occurred among children under ten years of age, while the lowest rate (5%) was observed among young adults aged 21–30 years. It was noted that *M. canis* and *T. violaceum* were the most common species among children under ten years old, Table 4.

Table 4: The distribution of isolated fungal species according to the patient's age groups

	Patient's age groups (years)						
Fungal species	1–10	11–20	21–30	31–40	≥41	Total	%
T. rubrum	0	0	0	3	0	3	7.5
T. violaceum	5	2	0	0	3	10	25
T. soudanense	1	0	0	1	0	2	5
T. schoenleinii	1	0	0	0	1	2	5
T. tonsurans	1	1	1	1	0	4	10
T. mentagrophytes	0	0	0	1	0	1	2.5
T. verrucosum	2	0	0	0	1	3	7.5
M. canis	7	1	0	0	0	8	20
M. audouinii	0	0	1	0	1	2	5
M. gypseum	1	0	0	0	0	1	2.5
E. floccosum	0	1	0	1	1	3	7.5
C. albicans	0	0	0	0	1	1	2.5
Total	18	5	2	7	8	40	100

Correlation coefficient (r) = 0.318; Statistical significance; (p) = 0.004**(Significant at 1% level)

The correlation between fungal species and gender showed a weak, non-significant relationship (r = 0.167, $p > 0.05$). This indicates that gender of patient was not significantly associated with the occurrence of dermatophytic infections, Table 5.

Table 5: The distribution of isolated fungal species according to the patient`s genders

Fungal Species	Male	Female	Total	%
T. rubrum	2	1	3	7.5
T. violaceum	6	4	10	25
T. soudanense	2	0	2	5
T. schoenleinii	1	1	2	5
T. tonsurans	2	2	4	10
T. mentagrophytes	1	0	1	2.5
T. verrucosum	1	2	3	7.5
M. canis	8	0	8	20
M. audouinii	2	0	2	5
M. gypseum	1	0	1	2.5
E. floccosum	2	1	3	7.5
C. albicans	0	1	1	2.5
Total	28	12	40	100

Correlation coefficient (r) = 0.167; p -value = 0.311 (Not significant)

T. violaceum was the most common species among individuals without pets, while *M. canis* predominated among those with pets, Table 6.

Table 6: The distribution of isolated fungal species compared to the domestic animals

Fungal species	No	Yes	Total	%
T. rubrum	3	0	3	7.5
T. violaceum	7	3	10	25
T. soudanense	2	0	2	5
T. schoenleinii	1	1	2	5
T. tonsurans	2	2	4	10
T. mentagrophytes	1	0	1	2.5
T. verrucosum	2	1	3	7.5
M. canis	3	5	8	20
M. audouinii	1	1	2	5
M. gypseum	0	1	1	2.5
E. floccosum	3	0	3	7.5
C. albicans	0	1	1	2.5
Total	25	15	40	100

Correlation coefficient (r) = 0.267; p -value = 0.197 (Not significant)

4. Discussion:

Culture from 100 patients attended Zliten medical center with suspected fungal infections of skin were 40% and this similar to results of Khan *et al* (2021) in Afghanistan 31% and 52% positive culture results in previous study in Tripoli Libya Elabib *et al* (2002), as well as 57.8% in Egypt, Gohar *at el.* (2019). In our study, *T. violaceum* was found to be most prevalent species followed by *M. canis* und was confirmed by PCR technology. Our results were similar to a previous study in Tripoli, Libya, Elabib *et al* (2002) although in our study we found that *M. canis* the second frequent dermatophyte species, this supports the result of a study in Zliten by Arshah (2017) that had found *M. canis* it's the most frequent cause of *T. capitis*. A study in Egypt, Gohar (2019) has found *M. canis* followed with *T. violaceum* the major causative species of fungal skin Infections. On the other hand, in Bangladesh, Khan (2021) has found *T. mentagrophytes* which is zoophilic fungi species, the most frequent cause of *T. corporis* followed by *T. rubrum.* In previous study in Zliten (Arshah, 2017) on patients with *T. capitis* was found that *M. canis* was the cause of *T. capitis* in about 53%. Furthermore, one study in Palestine (Ali-Shtaych, 2015) found that *M. canis* was frequent etiologic agent of skin disease. On the contrary, one study in Iran found that *T. interdigitale* was the commonest Isolate 52.5% Followed by *E. floccosum* 24.4% (Mohammadi, 2015). The relatively low culture positivity; in our Study; may be due to misdiagnosis of non-fungal conditions, self-treatment prior to sampling, or improper collection from lesion centers rather than edges, where fungal elements are more concentrated. Overgrowth of saprophytic fungi may also obscure dermatophytes colonies. In this Study, Direct microscopy (KOH examination) revealed 22% positivity and 78% negativity. Among positive cases, 54% showed no culture growth, while 24% exhibited fungal growth. These findings align with Khan *et al.* (2021) but contradict Bergmans *et al* (2008). False-negative microscopy may be caused by insufficient sample size, central sampling, or inadequate examination time. While KOH is rapid, culture remains more reliable for definitive diagnosis despite its longer turnaround time.

The predominance of *T. violaceum* and *M. canis* may be explained by their zoophilic nature and endemicity in North Africa (Ellabib *et al.,* 2002). In our study, molecular confirmation by using real-time PCR was carried out on 40 isolates, yielding 80% positivity. Notably, *M. canis* was consistently detected (100% positivity). These results are compatible with the study by Li et *al.* (2008), which concluded that ITS sequencing provides a confirmed and reliable method for the recognition of the aetiology of dermatophytes. PCR methodology was used in one study in Spain by Marcos-Tejedor (2021). Polymerase chain reaction is highly sensitive to examine nail fungal infections compared to the classic culture method, 84.3% versus 76.5%. Our study reported that the age distribution analysis revealed that children aged 1–10 years were the most affected, followed by individuals over 40 years and those aged 31–40 years. This is in line with Al-Aryan *et al.* (2022) and Sjahril *et al.* (2017), but differs from Mohammadi *et al.* (2015) and Khan *et al.* (2021). The high prevalence in children may be explained by close contact with pets, poor hygiene, and environmental factors such as heat and humidity. Additionally, the lack of protective Fatty acids in children's sebum predisposes them to infection, whereas hormonal changes after puberty increase sebaceous secretions and yeast colonization, offering natural protection (Ndiaye *et al.,* 2021; Kromer *et al.,* 2021).

The study also found that the infection rate was higher in males (70%) than females (30%), though this difference was not statistically significant. Similar patterns were reported by Sjahril *et al.* (2017), Arshah *et al.* (2019), and Al-Aryan *et al.* (2022). The higher prevalence among males may be due to shorter hair, barber-related transmission, and greater exposure to contaminated tools. Lower prevalence among females may be related to reduced healthcare-seeking behavior. This study showed a weak, non-significant correlation ($r = 0.27$, $p > 0.05$) between pet ownership and fungal species distribution, indicating that having pets did not significantly influence the occurrence of dermatophytic infections. Most infections (63%) occurred among individuals without pets, suggesting that other factors, such as hygiene or environmental exposure, may play a larger role. *T. violaceum* was predominant among those without pets, while *M. canis* a known zoonotic species was more common among pet owners. Finally, the statistical analysis showed that the occurrence of fungal infection is not related to the presence of accompanying chronic diseases in the patient. The study indicated that 88% of the patients surveyed do not suffer from chronic diseases. Furthermore, the lowest prevalence was found among those with diabetes and hypertension (combined), at a very low rate of only 3% of the patients.

5. Conclusion

This study found that *T. violaceum* and *M. canis* being the predominant etiological agents for fungal skin, nail, and hair infections in patients attended Zliten medical center. Children and people having domestic Animals were more susceptible to *M. canis*, reflecting the influence of host, environmental, and behavioral factors. Although culture and microscopy remain essential diagnostic tools, molecular methods such as real-time PCR provide fast and more accurate confirmation of species identity, strengthening diagnostic capacity, improving the efficacy of diagnostic and therapeutic management of dermatophytosis in the region.

6. Limitations

This study has several limitations. First, the sample size was relatively small and limited to a single medical center, which may not fully represent the broader population in Libya. Second, not all negative culture or KOH samples were confirmed by PCR due to financial and technical constraints, which may have underestimated the true prevalence of dermatophytosis. Third, environmental and behavioral risk factors such as contact with animals, personal hygiene, and socioeconomic status were not systematically assessed. Finally, the study relied on conventional phenotypic identification methods, which are subject to observer variability and may not detect cryptic species.

References:

Al-Aryan, A., Al-Sabah, H. Y., Al Obaid, K. A. (2022) '*Epidemiology of dermatophytes related infections in Kuwait: a retrospective study'*, Medical Mycology, 60(1), pp.76-76.

Ali-Shtayeh, M., Yaish, S., Jamous, R. M., Arda, H., & Husein, E. (2015) 'Updating the epidemiology of dermatophyte infections in Palestine with special reference to concomitant dermatophytosis', *Journal de Mycologie Médicale, 25*(2), pp. 116-122.

Arshah,T.M., Al Dwibe, H and Al-Bakosh, A. (2017) '*Tinea capitis* in Patients Attending Zliten Teaching Hospital (North West of Libya)', *International Journal of Tropical Diseases & Health,* 26(2), pp. 1-7

Arshah, T. M., Arshah, A. M., Alrtail, A., Elzurghany, A. (2019) 'The Sensitivity and Role of Mycology Laboratory in Management of Superficial Fungal Infections in Zliten Teaching Hospital', *Asian Journal of Research in Dermatological Science*, 2(1), pp.1-6

Altayyar I. (2012) 'Opportunistic pathogenic fungi from the dust in Sebha Medical Centre, Libya', *Sebha Med. J*; 11, pp. 87-93.

Atia, A., Ashour, A., & Elyounsi, N. (2019) 'Trends in skin fungal infection in Tripoli, Libya, during 2007–2015', *Ibnosina Journal of Medicine and Biomedical Sciences, 11*(03), pp. 116-119.

Bergmans, A., Schouls, L., Van Der ENT, M., Klaassen, A., Böhm, N., & Wintermans, R. (2008) 'Validation of PCR–reverse line blot, a method for rapid detection and identification of nine dermatophyte species in nail, skin and hair samples', *Clinical microbiology and infection, 14*(8), pp. 778-788.

Campbell, C. K., & Johnson, E. M. (2013) *Identification of pathogenic fungi*: John Wiley & Sons. 31-79.

Dismukes, W. E., Pappas, P. G., Sobel, J. D. (2003) Clinical mycology. Oxford University Press, 7-15,370-384

Ellabib, M., Khalifa, Z., & Kavanagh, K. (2002) 'Dermatophytes and other fungi associated with skin mycoses in Tripoli, Libya', *Mycoses, 45*(3-4), pp. 101-104.

Galliano, I., Dapra, V., Zaniol, E., Alliaudi, C., Graziano, E., Montanari, P., Bergallo, M. (2021) 'Comparison of methods for isolating fungal DNA', *Practical Laboratory Medicine, 25*, 1-5.

Gohar, N., El-Batal, H., Elawady, B., & Samir, N. (2019) 'Phenotypic methods versus PCR-RFLP for the identification of dermatophyte species isolated from patients with dermatophytosis in Egypt', *African Journal of Clinical and Experimental Microbiology, 20*(2), pp. 117-126.

Havlickova, B., Czaika, V., Friedric, M. (2008) 'Epidemiological trends in skin mycoses worldwide', Mycoses, 51(4), pp. 2-15.

Khan, S., Shamsuzzaman, S., Rahman, A., Ashekin, N., Mahmud, R., Sharmin, R., Haque, F. (2021) 'Isolation and Identification of Dermatophytes Causing Dermatophytosis at a Tertiary Care Hospital in Bangladesh', *Archives of Clinical and Biomedical Research, 5*(3), pp. 437-451.

Kidd, S., Halliday, C., Alexiou, H., & Ellis, D. (2016) Descriptions of medical fungi (Vol. 3). *David Ellis*.195-218.

Kromer, C., Celis, D., Hipler, U. C., Zampeli, V. A., Mößner, R., & Lippert, U. (2021) 'Dermatophyte infections in children compared to adults in Germany: a retrospective multicenter study in Germany. *JDDG', Journal Der Deutschen Dermatologischen Gesellschaft, 19*(7), pp. 993-1001.

Li, H. C., Bouchara, J.-P., Hsu, M. M.-L., Barton, R., Su, S., & Chang, T. C. (2008) 'Identification of dermatophytes by sequence analysis of the rRNA gene internal transcribed spacer regions', *Journal of medical microbiology, 57*(5), pp. 592-600.

Magagnin, C. M., Stopiglia, C. D. O., Vieira, F. J., Heidrich, D., Machado, M., Vetoratto, G., Scroferneker, M. L. (2011) 'Antifungal susceptibility of dermatophytes isolated from patients with chronic renal failure', *Anais brasileiros de dermatologia, 86*, pp. 694-701.

Marcos-Tejedor, F., Mota, M., Iglesias-Sánchez, M. J., Mayordomo, R., & Gonçalves, T. (2021) 'Identification of fungi involved in onychomycosis in patients of a Spanish rural area', *Journal of Fungi, 7*(8), pp. 623.1-8.

Mohammadi, R., Abastabar, M., Mirhendi, H., Badali, H., Shadzi, S., Chadeganipour, M., Haghani, I. (2015) 'Use of restriction fragment length polymorphism to rapidly identify dermatophyte species related to dermatophytosis', *Jundishapur journal of microbiology, 8*(6), pp. 1-6.

Ndiaye, M., Sacheli, R., Diongue, K., Adjetey, C., Darfouf, R., Seck, M. C., Hayette, M.-P. (2021) 'Evaluation of the multiplex real-time PCR DermaGenius® assay for the detection of dermatophytes in hair samples from Senegal', *Journal of Fungi, 8*(1), pp. 11.1-13.

Santhosh, P., George, M and Nandakumar, G. (2024) 'Demonstration of fungi in superficial mycosis: Skin scraping and potassium hydroxide mount', *Journal of Skin and Sexually Transmitted Diseases*, 6(1), pp. 77-79

Sciortino J.r., C. V. (2017) *Atlas of clinically important fungi*: John Wiley & Sons. 135-166.

Sjahril, R., Hamid, F., Yulianingsih, A., Prastiwi, N., Awaluddin, A., Nuryanti, S., Bahar, B. (2017) 'Identification of Dermatophytes by Multiplex-Polymerase Chain Reaction, Polymerase Chain Reaction-Restriction Fragment Length Polymorphism ITS1-ITS4 Primers and MvaI, and Polymerase Chain Reaction (GACA) 4 Primer', *UNEJ e-Proceeding*, pp. 132-135.

Walsh, T. J., Hayden, R. T., & Larone, D. H. (2018) *Larone's medically important fungi: A guide to identification*: John Wiley & Sons. 257-282.

Wisselink, G., Van Zanten, E., & Kooistra-Smid, A. (2011) 'Trapped in keratin; a comparison of dermatophyte detection in nail, skin and hair samples directly from clinical samples using culture and real-time PCR', *Journal of microbiological methods, 85*(1), pp. 62-66.