International Journal of Life Science Research Archive

ISSN: 0799-6640 (Online)

Journal homepage: https://sciresjournals.com/ijlsra/

(RESEARCH ARTICLE)

Tinea capitis due to *Microsporum canis* in the university hospital Hassan II of fez: Epidemiological and mycological profile

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International Journal of Life Science Research Archive, 2024, 07(01), 004–012

Publication history: Received on 10 April 2024; revised on 12 July 2024; accepted on 15 July 2024

Article DOI: https://doi.org/10.53771/ijlsra.2024.7.1.0054

Abstract

Microsporum canis (M. canis) is a widespread zoophilic dermatophyte worldwide and is identified as the primary causative agent of scalp ringworm in prepubescent children. The objective of this study is to describe the epidemiological and mycological profile of scalp tinea due to *M. canis* diagnosed at the Hassan II University Hospital in Fes. This was a descriptive cross-sectional study conducted from January 1, 2016, to December 31, 2023, involving all patients referred to our parasitology-mycology laboratory for scalp mycological sampling, excluding those already under antifungal treatment. Out of a total of 251 patients, 72 patients were confirmed to have scalp ringworm based on fungal culture (28.68%). Among the positive samples, 33 cases were confirmed as *M. canis* positive (45.83%). The mean age of patients with *M. canis* scalp ringworm was 8.75 years, with a predominance (63.63%) in children aged 5 to 10 years. The male-to-female sex ratio was 1.35. A history of contact with animals was found in 60.6% of cases, and immunosuppression was noted in 3.03% of cases. The tinea capitis presenting as large alopecic patches was exclusive to the 33 patients. Direct examination was positive in 66.66% of cases, showing an endo-ectothrix pattern of hair parasitism in all cases. Our study confirmed the predominance of *M. canis* scalp ringworm in school-aged male children and its rarity in adults, consistent with the literature, particularly studies from Tunisia, Cameroon, and Germany.

Keywords: Tinea capitis; *Microsporum canis*; Epidemiology; Mycological diagnosis; Griseofulvin

1 Introduction

Tinea capitis (TC) is a fungal disease caused by microscopic keratinophilic and keratinolytic filamentous fungi known as dermatophytes, which colonize and invade the epidermal layer of the scalp, spreading downwards to the bulb.

M. canis is one of the main dermatophytes responsible for TC, particularly in prepubertal children, with quite high frequencies of up to 59% [1]. A cosmopolitan fungus widely distributed in developed and developing countries, it belongs to the zoophilic dermatophytes [2] and, as a result, domestic animals, notably *cats* and *dogs*, often serve as sources of contamination for humans, either through direct contact or indirect transmission from spore-contaminated objects [3]. Human-to-human infections with *M. canis* are exceptional, although transmission diminishes spontaneously after only a few transmission events.

TC due to *M. canis* is one of the most recalcitrant superficial mycoses, with an increasing incidence over the last decade[2]. The aim of our work is to describe the epidemiological and mycological profiles of *M. canis* TC through a descriptive cross-sectional study of 33 cases recorded in the parasitology-mycology department of the central laboratory for biological medical analyses at CHU HASSAN II in Fez.

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2 Material and methods

2.1 Study type and population

This is a monocentric descriptive cross-sectional study of *M. canis* TC cases diagnosed among 251 patients referred to the parasitology-mycology department at the central laboratory for biological medical analyses of CHU HASSAN II in Fez for mycological sampling of the scalp, over an 8-year period from January 1, 2016 to December 31, 2023. Patients under 16 years of age were considered to be children, while other patients were defined as adults.

2.2 Data collection

The following data were collected from the laboratory registers for each patient included: age, sex, age of the scalp lesion, its clinical appearance (one or more large or small alopecic plaques, with or without desquamation) and notion of contact with animals and/or associated immunosuppression. Biological data were also collected from registers and the ILab computer system, and then entered into a Microsoft EXCEL database.

2.3 Mycological analysis

Sampling is the most critical stage in mycological examination, as its quality determines the isolation of the pathogen. It must be taken at a distance from any antifungal treatment, with a therapeutic window of 2 weeks for local treatment and at least one month for general treatment. Broken hairs were removed with tweezers and scales or crusts were scraped off with a scalpel blade and collected in sterile Petri dishes. In the case of suppurated inflammatory lesions, serosities are collected using a sterile swab. A portion of the collected product is immediately examined under a light microscope, at low magnifications (x10 and x40), between slide and coverslip in 30% KOH aqueous potash to determine the type of hair parasitism. The remainder of the sample was inoculated onto three agar media: Sabouraud simple, Sabouraud-chloramphenicol and Sabouraud-chloramphenicol-actidione, using a platinum loop on slanted agar. Tubes were incubated at 27°c ± 2°C and examined daily. Cultures were kept for at least three weeks before returning a negative result. In the event of a positive culture, identification of *M. canis* was based on growth time, macroscopic appearance of colonies on the front and back, and microscopic appearance after mounting in lactophenol blue using the flag method. 2 Cultures with no colony growth for up to 4 weeks were considered negative. The mycological diagnosis of TC was based on a positive direct examination and/or culture.

3 Results

3.1 On the epidemiological front

During the study period, 251 patients were referred to our parasitology-mycology laboratory on suspicion of TC. The diagnosis was confirmed in 72 patients by mycological examination, i.e. a prevalence of 28.68%. Five dermatophyte species were isolated: *Microsporum canis* in 33 patients (45.83%), followed by *Trichophyton violaceum* in 27 patients (37.5%), *Trichophyton mentagrophytes* in 6 patients (8.33%), *Trichophyton verrucosum* in 5 patients (6.94%) and *Trichophyton gypseum* in just 1 patient (1.38%) (figure 1). Thus, *M. canis* occupied first place in TC during our study period with 45.83% of cases.

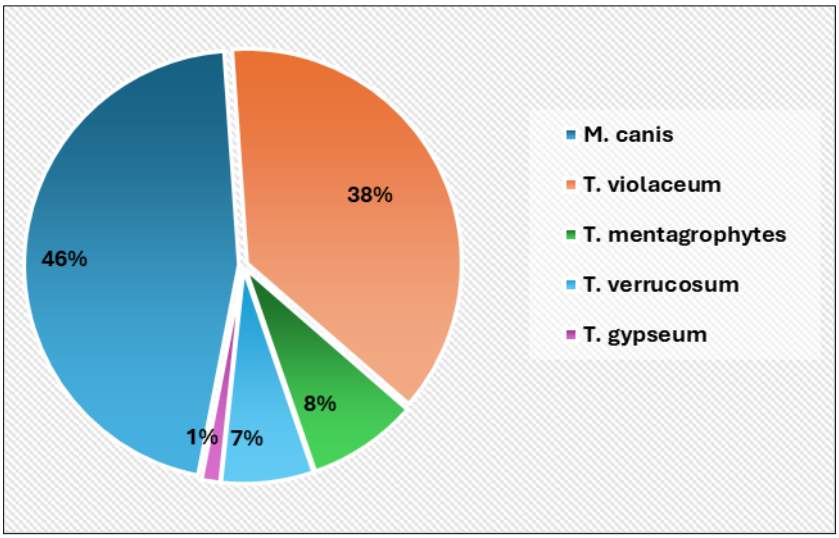

Figure 1 Distribution of different species of dermatophytes isolated in the culture

The annual distribution of *M. canis* TC was heterogeneous, with a maximum of 11 cases (33.3%) in 2018 and a minimum of 1 case (3.03%) in 2020 and 2021 respectively, with an average of 4.12 cases/year. The number of *M. canis* TC cases increased significantly between 2018 and 2019, before declining between 2020 and 2021 and increasing again between 2022 and 2023 (Figure 2).

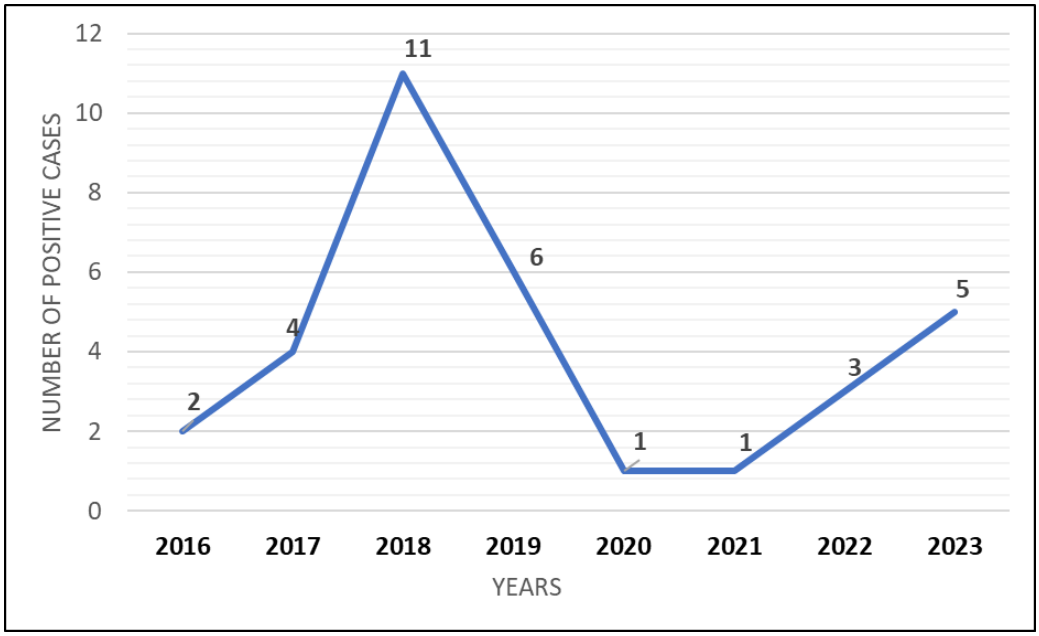

Figure 2 Annual incidence of scalp ringworm caused by *M. canis* between 2016 and 2023

The average age of patients was 8.75 years, with extremes ranging from 1 year to 57 years. The age group most affected was that between 5 and 10 years (63.63%, n=21), followed by less than 5 years with 24.24% (n=8), but from age 11 onwards, cases of *M. canis* TC decreased significantly (12.12%, n=4), with only 2 cases of *M. canis* TC in the elderly (figure3).

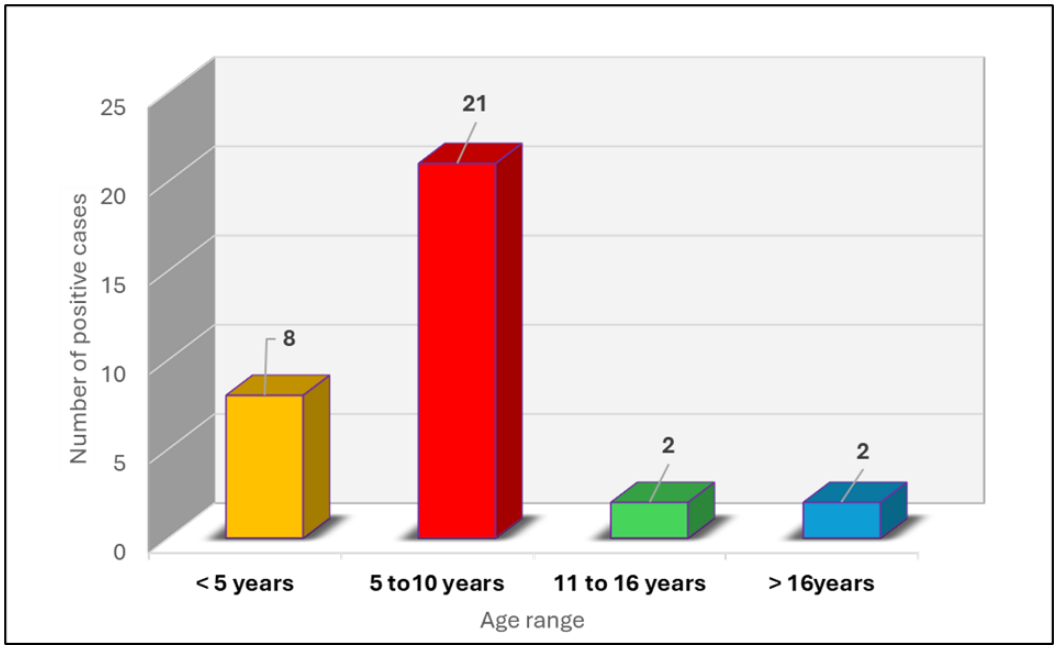

Figure 3 Distribution of scalp ringworm caused by *M. canis* according to age group

We noted a male predominance in 57.6% of cases (n=19) versus 42.4% of cases (n=14) for females, with a M/F sex ratio of 1.35. The notion of contact with domestic animals, mainly *cats* and dogs, was encountered in 60.6% of cases, i.e. 20 patients.

3.2 Clinical aspects

Ringworm with large patches of alopecia was the exclusive clinical form in all 33 patients, i.e. in 100% of cases, with broken hairs 2 to 3 mm from emergence. Only one case of *M. canis* TC in our series was found to be immunosuppressed, representing a prevalence of 3.03% of all confirmed cases. This case involved a 43-year-old woman with type 2 diabetes on insulin.

3.3 On the mycological front

The sensitivity of direct examination (DE) was 66.66% (n=22). The parasitism was microsporic hair parasitism of the endo-ectothrix type in all cases, with numerous spores found around the hair (Figure 4).

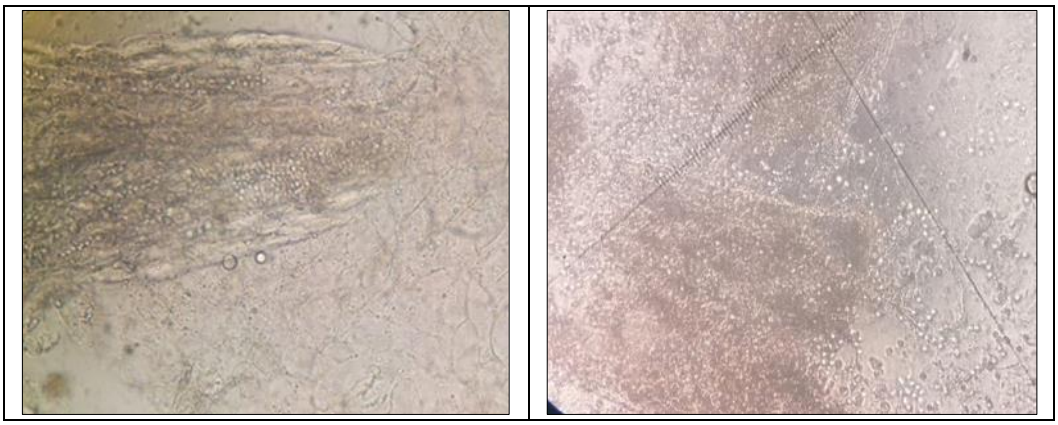

Figure 4 Hair parasitism of the endo-ectothrix type (objective x40) collection of the parasitology-mycology laboratory CHU Hassan II of Fez

Culture was positive in 33 cases, i.e. a prevalence of 100%, with good concordance between direct examination and culture results. Colony growth rate was rapid after 4-5 days. Macroscopic appearance was in favor of small, star-shaped colonies, white to cream in color, consisting of mycelial filaments immersed in agar and centered by a thick tuft of down.

Microscopically, we noted the presence of mycelial filaments compartmentalized in a snowshoe pattern with thick-walled spindle-shaped macroconidia with pointed ends (Figure 5).

Figure 5 Macroscopic and microscopic appearance of *Microsporum canis* (objective x40) Collection of the parasitology-mycology service CHU Hassan II of Fez

3.4 Therapeutic aspects

All our patients had been treated with oral Griseofulvin at a dose of 20 mg/kg/day, combined with local treatment (2 applications/day) for 8 weeks, with good clinical and biological evolution.

4 Discussion

Scalp tinea is a common public health problem throughout the world, particularly in developing countries such as Morocco [4,5], where it is still a considerable and very frequent reason for consultation in routine medical practice. It is also highly prevalent in Africa, Southeast Europe, Asia and the United States [2], whereas it accounts for only a small percentage of dermatomycoses in certain Western industrialized countries, including Germany and Poland [6,7]. In our study, TC was diagnosed, after mycological analysis, in 72 patients, giving a prevalence of 28.68%. These results differ from those reported in other national studies (57.4% in Rabat in 2010 and 64.67% in Marrakech in 2016) [4,5] and in Maghreb studies carried out in Mauritania in 2021 [8] and Tunis in 2022 [9], where the prevalence was 52.5% and 44.3% respectively. However, they were comparable with those recorded by the Moroccan study carried out by Tligui et al in 2019 in Rabat, where the prevalence was 25.4%[10] and by other African publications: Algeria in 2017 (33.48%)[11], Senegal in 2015 (34.51%)[12] and Cameroon (21.48%)[13]. During our study period, the zoophilic dermatophyte *M. canis* was the most frequently isolated in TC, accounting for 45.83% of cases (n = 33), which is in line with several studies carried out in various Maghreb countries, including Morocco, and in many countries around the Mediterranean [14, 15]. Indeed, *M. canis* is no longer confined to a specific geographic region, but has become an emerging threat in several countries, due to the increasing mobility of populations across borders. Among others, a study carried out at the Parasitology-Mycology Laboratory of the CHU Mustapha in Algiers revealed a predominance of *M. canis* in 60.5% of cases[16]. Komba et al, in Tanzania, noted a predominance of *M. canis* with 46.7%[17]. Studies by Huilin Zhi et al [18] and Dongyan Zheng et al, in China, [19] confirmed that *M. canis* was the most isolated dermatophyte, with a prevalence of 38.5% and 62% respectively. Another study carried out in Italy showed that *M. canis* ranked first, with a prevalence of 90.5%[20]. This marked increase in *M. canis* is probably linked, on the one hand, to socio-economic development and growing urbanization in these regions, where human-pet cohabitation, particularly with *cats* as the main reservoir of *M. canis*, is becoming increasingly common. On the other hand, better management of anthropophilic ringworm in schools and improved hygiene, such as shaving for young boys, have contributed to a significant reduction in cases of *T. violaceum* trichophytic ringworm [4, 5]. However, other national surveys carried out in the cities of Meknes and Rabat, and another in the Sousse region of Tunisia, showed that the anthropophilic dermatophyte *T. violaceum* ranked first, accounting for 70%, 55.6% and 66.7% of cases respectively, followed by *M. canis* in 20%, 32.5% and 29.3%

of cases respectively [21, 22, 3]. In our series, *M. canis* TC predilection was for school-age children between 5 and 10 years of age (63.63%, n=21), while adult involvement was rare, with only 2 cases out of a total of 33 (6.06%). This predominance in children has been reported in several studies carried out in different countries around the world, notably Morocco, Tunisia, Austria and China [5, 22, 9, 23, 24]. The protection of adults against ringworm is probably linked to sex hormones, mainly testosterone, and to the secretion of sebum, which contains triglycerides characterized by fungistatic properties against dermatophytes, and whose role in the regression of sebaceous glands at the site of infection has been revealed indirectly by anatomopathological examination. In children, on the other hand, this secretion does not begin until puberty, which explains the spontaneous recovery of patients at this time. However, a single-center study carried out in Korea [25] showed an exceptionally high percentage of adults with *M. canis* ringworm (56.5%), as did a publication by Hillary and Suys describing an epidemic of *M. canis* ringworm in adults [26]. The mean age of our patients was 8.75 years, with extremes ranging from 1 to 57 years. K. Elandaloussi et al in Morocco [22] and Latifa Mtibaa et al in Tunisia [9] respectively found a mean age more or less close to this (9.6 and 6.2 years). A recent study carried out in Guangxi province, China[19], also reported a similar result, where the mean age was 8.18 years. In contrast, a study carried out in Senegal [12] in 2015 found an average age of 27.33 years. The male sex was more affected, with 19 cases (57.6%) versus 14 cases (42.4%) for the female sex. This male predominance noted in our series was in line with the literature, and is reported in numerous Moroccan studies [4, 22] and other studies carried out in Africa [9, 11, 13], Germany [27] and China [24]. This may be explained by the fact that boys have shorter hair, making it easier for them to be contaminated by spores, and by the fact that boys have more contact than girls with domestic animals, which are often asymptomatic carriers. Although other studies have shown a predominance of females [5, 28], this could be due to the exchange of scarves and hairdressing tools [9]. In general, the gender spectrum of TC varies considerably between studies and countries. In our study, the notion of close contact with animals was reported in 60.6% of patients. This finding was similar to those reported in surveys carried out by L. Boumhil et al in Rabat [4] and by Dongyan Zheng et al in Guangxi province, China [19] in 56.7% and 44.2% of patients respectively. The notion of immunodepression was found in a 43-year-old patient diagnosed with *M. canis* TC in our series, representing a prevalence of 50% of confirmed cases in adults. Indeed, this *M. canis* fungal infection of the scalp is frequently found in immunocompromised adults, according to several surveys [29, 30]. On the other hand, other studies have reported an increase in the incidence of ringworm in immunocompetent adult patients of up to 72% [31, 32, 33], underscoring the need to raise awareness among clinicians. Ringworm with large patches of alopecia was the clinical appearance observed exclusively in the *M. canis* TC cases in our series (100%, n=33), with hair breakage a few millimeters from the scalp. According to the literature, clinical manifestations of *M. canis* ringworm can range from circular alopecia and mild desquamation associated with hair breakage 2 to 3 mm from the emergence of the scalp [29, 34], which is superposable with our results, to an intense inflammatory reaction, notably pustules and invasion of the dermis through the hair follicles, which can evolve into Majocchi granuloma with permanent hair loss and persistent cosmetic scars [29, 35, 36, 37] . Consequently, *M. canis* infections can be a serious burden on society, affecting patients' quality of life both physically and psychologically [35]. Mycological identification of our strains was based on standard phenotypic methods, including direct examination and macroscopic and microscopic aspects of colonies. In our study, direct examination was positive in 66.66% of cases (n=22), with microsporic hair parasitism of the endo-ectothrix type in 100% of these cases. A similar result was reported in the Korean study conducted by Zhihui Yang et al in 2021 [30], where the type of parasitism during *M. canis* ringworm was ectothrix. A positive DE allows instant confirmation of the diagnosis of TC, helping the clinician to rapidly institute appropriate treatment without waiting for culture results, and minimizing the risk of contamination of the surrounding community [38]. The sensitivity of culture was 100% (n=33), although this percentage varies between authors in different countries, notably Tunisia, Cameroon and Malaysia [9, 13, 39]. In 11 cases in our series, culture enabled the diagnosis of TC to be made. It represents an essential complementary examination to DE [38] and enables the isolation and identification of incriminating dermatophytes, which is essential for any epidemiological study.

Although dermatophytosis can heal spontaneously in humans within three months, treatment is necessary in most cases. In addition to local antifungal treatment, systemic therapy and hygiene measures are recommended.

Griseofulvin and terbinafine are the 2 molecules commonly used in the treatment of TC [40]. In a meta-analysis comparing the efficacy of griseofulvin and terbinafine in the treatment of ringworm, griseofulvin was found to be more effective than terbinafine for *Microsporum canis* [41]. This efficacy was demonstrated in our study, where griseofulvin treatment showed a clear clinical and biological improvement.

5 Conclusion

This study highlights the predominance of *Microsporum canis* scalp tinea in male schoolchildren. The study of the current epidemiological profile of *M. canis* TC found in the Fez region and that of previous surveys in Morocco and the Maghreb, has made it possible to appreciate the recrudescence of microsporic *M.canis* ringworm compared with

trichophytic *T.violaceum* ringworm, hence the importance of raising awareness of the hygiene and health of pets, as well as of preventive measures to reduce the risk of transmission of *Microsporum canis* to man. Mycological examination plays a vital role in confirming the diagnosis, identifying the dermatophytes involved, monitoring their epidemiology according to region, and providing therapeutic management. Given the constant increase in globalization, tourism and migration, the epidemiological and mycological profile of TC will continue to change in the future.

Compliance with ethical standards

Acknowledgments

This research was supported by the parasitology and mycology laboratory at the Hassan II University Hospital in Fez, Morocco.

Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of ethical approval

Ethical approval for this research was obtained from the Ethics Committee of the Department of Parasitology and Mycology at the Hassan II University Hospital in Fez. All procedures followed complied with the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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