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# Asymptomatic groin dermatophyte carriage detected during routine gynaecologic examinations

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## Summary

We investigated the epidemiological characteristics of both symptomatic and asymptomatic dermatophytic groin infections in 1970 women (age: 36.2 ± 12.5) during routine gynaecologic examinations. Bilateral groin samples were collected with sterile cotton swabs premoistened with sterile physiological saline. The samples were then separately inoculated onto Sabouraud glucose agar. Fungi were identified by sequencing the rDNA internal transcribed spacer region. Dermatophytes were recovered from five patients (four *Trichophyton rubrum* and one *Arthroderma vanbreuseghemii*, 0.25%) with a diagnosis of asymptomatic carriers (four) and tinea inguinalis (one). In one case, groin carriage converted into tinea inguinalis after 3 weeks. Analysis of risk factors indicated that patients of at least 49 years were more likely to be positive for dermatophyte isolation ($P = 0.002$). In conclusion, groin dermatophyte carriage is more common than tinea inguinalis and can potentially convert into a symptomatic infection.

**Key words:** Anthropophilic, carrier state, dermatophytes, terbinafine, tinea inguinalis, *Trichophyton rubrum*.

## Introduction

Tinea cruris (eczema marginatum or 'jock itch') is an infection typically involving the groin, perianal and perineal areas, and the upper thighs. Lesions are erythematous and scaly, exhibiting raised and inflamed borders, often with pustules.[1,2] Groin ringworm is frequently caused by anthropophilic fungi such as *Trichophyton rubrum*, *T. interdigitale* and *Epidermophyton floccosum*.[1–3] Tinea cruris is more common in adult men than in women.[2,3] The preponderance of tinea inguinalis in men may be because of the following factors: (i) the presence of a warm and moist scrotal environment and (ii) frequent auto-inoculation of fungal elements from elsewhere in the body, especially from the foot or nails, to the groin.[4–8] Once infected, scales may be transmitted through direct contact between individuals or indirectly through contact with objects that carry the infected scales (e.g. arthroconidia).[1]

Tinea inguinalis may also present as a minimal infection, termed as a carrier state. An asymptomatic carrier state is used to describe an individual who exhibits no signs or symptoms of tinea inguinalis but has a dermatophyte-positive culture.[8,9] To the best of our knowledge, the earliest case of tinea inguinalis in women was reported by Fox[10] in 1878 in the daughter of a family outbreak. In 1957, English and La Touche[4] highlighted this relatively uncommon entity in women in a literature review and reported three cases of tinea inguinalis accompanied by tinea pedis caused by *T. rubrum* in women aged 44–57 years. However, asymptomatic groin dermatophyte carriage status in women has not been investigated. In this study, we analysed the risk factors for groin ringworm and determined the

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prevalence and related fungi of groin dermatophyte carriage and tinea inguinalis in women visiting a gynaecology clinic in Adana, Turkey.

## Materials and methods

### Data collection

Between September 2011 and December 2011, 1970 women visited the outpatient gynaecologic clinic at the Department of Obstetrics and Gynecology, Faculty of Medicine, University of Çukurova, Adana, Turkey. The mean age was 36.2 ± 12.5 years (range: 11–90). All patients consented to participate in the study. In an interview, patients provided information regarding their age, body mass index, lifestyle and underwear characteristics, diabetes, present dermatophyte infections and sexual partners. The reasons for the hospital admission of the patients are presented in Table 2.

Informed consent was obtained from the patients before sampling. The patients were classified as symptomatic, carriers or uninfected, on the basis of a combination of clinical and mycological findings. Asymptomatic carriers were defined by the recovery of dermatophytes without clinical symptoms. We recorded the clinical diagnoses, mycological results and detailed histories of all participants. Patients who tested positive consulted one of the authors and underwent treatment (M. Karakaş). The study protocol was approved by the Faculty of Medicine's Ethics Committee of Çukurova University.

### Sample collection

Bilateral groin samples were collected from all patients by vigorously brushing each side of the groin four times with a cotton swab that had been dipped in sterile physiological saline.[8,9] Participants who tested positive for dermatophytic fungi in the groin area were also assessed for possible dermatophyte infections of the scalp, nail and toe webs. Scalp and toe web samples were also inoculated onto the study media irrespective of the presence of lesions. In addition, partners of the participants were also invited to be examined for possible sexually transmitted infections.

### Fungal culture

Sabouraud glucose agar (Merck, Darmstadt, Germany) plates containing 100 μg $ml^{-1}$ cycloheximide (Sigma, Steinheim, Germany), 100 μg $ml^{-1}$ chloramphenicol (Sigma) and 50 μg $ml^{-1}$ gentamicin (Sigma) were used as the study medium. The study medium was inoculated with the cotton swabs by rotating the swab head while streaking it along the surface of the medium. All clinical samples were plated on site, and the plates were then sent to the Mycology Laboratory at the Faculty of Medicine, University of Çukurova. The cultures were incubated at 25 °C and examined after 7, 14 and 21 days.[8,9]

### DNA extraction, PCR and molecular analysis

The identification of fungal isolates was confirmed using molecular diagnosis. DNA extraction and PCR amplification were performed according to the protocol described by Turin *et al.* [11] The rDNA regions spanning the internal transcribed spacer (ITS) 1 region were amplified with the universal fungal primers ITS1 and ITS4, on an ABI 3730XL DNA sequencer at Dr Zeydanlı Biotechnologies (Ankara, Turkey). Assembled DNA sequences were examined using the Basic BLAST (nucleotide–nucleotide) software (Oligo Yap 5.0, Gata, Turkey) on the National Center for Biotechnology Information database.

### Treatment

Clinical and mycologic follow-up was performed 3 weeks after the initial visit, and dermatophyte-positive patients were prescribed 1% terbinafine cream twice daily for 2 weeks. These patients were asked to return for a second follow-up examination 4 weeks after treatment initiation.

### Statistical analysis

For continuous variables, one-way analysis of variance was used to compare more than two groups. For the association between a single predisposing factor and the response variable, binary logistic regression was employed. Multivariate analysis was employed to evaluate the associations between risk factors and response variables among women with asymptomatic groin dermatophyte carriage or tinea inguinalis. $P < 0.05$ was considered statistically significant.

## Results

Of 1970 women, 5 (0.25%) were positive for dermatophytic fungi in the bilateral inguinal areas: four were asymptomatic carriers and one had tinea inguinalis. The four carriers had no clinical evidence of tinea inguinalis. We recovered four *T. rubrum* isolates (three isolates, 97% sequence homology, and one isolate,

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100% sequence homology) and one *Arthroderma vanbreuseghemii* isolate (98% sequence homology). Tinea pedis was also present in four of the five patients who were positive for dermatophytes from the groin area. *T. rubrum* was the only dermatophyte isolated from toe webs (Table 1). No dermatophytes were isolated from scalp samples of the five patients, and their finger and toe nails all appeared normal. The study isolates have been deposited at the Centraalbureau voor Schimmelcultures (CBS)-KNAW Fungal Biodiversity Centre, culture collections, Utrecht, the Netherlands (Table 1).

All five patients were screened during follow-up visits after 3 and 7 weeks. One groin dermatophyte carriage was found to have converted into symptomatic infection at the first follow-up visit. For groin and toe web infections, 1% terbinafine cream was found to be effective and safe. After treatment, all patients were dermatophyte free, and the two symptomatic cases were clinically cured (cases 1 and 2). Remarkably, no patients discontinued treatment because of an adverse event. The partners of the five patients were invited for dermatologic and mycologic examination for possible sexually transmitted infections. Patient 3 had no sexual partner; patients 2, 4 and 5 had partners, but their partners declined inclusion in the study. Therefore, we were only able to examine the partner of patient 1. No dermatophytes were recovered from the groin or toe web areas of the partner.

Baseline characteristics of the study group are shown in Table 2. Univariate analysis of the risk factors revealed that patients aged >49 had a 22.6-fold increased risk of dermatophyte isolation ($P = 0.002$; 95% CI = 2.5–203) (Table 2). Dermatophyte infections in family members, diabetes mellitus, regular exercise, underwear characteristics and common use of such areas were not associated with groin dermatophyte carriage or groin ringworm ($P > 0.05$; Table 3). However, the results of multivariate analysis are not provided as the prevalence rate is very low (5/1970 = 0.25%). Due to this low prevalence rate, we encountered problems in the estimation and hypothesis testing of parameters in multivariate analysis.

## Discussion

Several epidemiological studies conducted by our group have determined the prevalence of asymptomatic dermatophyte scalp carriage in different populations: (i) 0.1–1.3% in primary school children;[12,13] (ii) 0.6% in the mentally challenged population;[14] (iii) 0.1% in women attending a gynaecology clinic in the Çukurova region of Turkey[15] and (iv) 4.1% in junior Greco-Roman wrestlers.[8] However, our experience with groin carriage is limited to male wrestlers.[8,9] Recently, our group reported a clonal outbreak of *T. tonsurans* tinea capitis gladiatorum among 14 wrestlers in Adana, Turkey. Of these wrestlers, *T. tonsurans* groin dermatophyte carriage was observed in two individuals who also had tinea capitis superficialis.[9] In another study, we recovered dermatophytic fungi from the groin area in 3 of 194 junior wrestlers (1.5%) and demonstrated both groin and scalp carriage due to *T. tonsurans* in a wrestler. In addition, *T. rubrum* tinea inguinalis was diagnosed in two wrestlers; one was a *T. tonsurans* scalp carrier, whereas a scalp sample from the other was dermatophyte free.[8]

Although dermatophytic flora of the inguinal area is well documented in the literature, the epidemiology of tinea inguinalis in women is discussed less frequently than that in men.[1–3,16] To the best of our knowledge, this study is one of the first to highlight this issue in a large population. Our results showed that the prevalence of groin ringworm was low (0.25%), which does not indicate an increase in frequency among women attending a gynaecology clinic. The low recovery of these moulds may be because of the gender of the patients as well the study period (autumn and winter seasons). However, the importance of the carrier state

**Table 1** Characteristics of patients with groin ringworm and carrier state.

| Patient | Age (year) | BMI (kg m$^{-2}$) | Gynaecologic diagnoses | Causative fungus | CBS no | Follow-up (3 weeks) | Follow-up (7-weeks) | Concomitant tinea pedis |
|---|---|---|---|---|---|---|---|---|
| 1 | 55 | 35.1 | Cervical cancer, remission | *Trichophyton rubrum* | 132249 | *T. rubrum*[1] | – | *T. rubrum* |
| 2 | 32 | 26.7 | Primer infertility | *T. rubrum*[1] | 132250 | *T. rubrum* | – | *T. rubrum* |
| 3 | 53 | 26 | Menopause control | *T. rubrum* | 132251 | *T. rubrum* | – | – |
| 4 | 58 | 27 | Menopause control, ichthyosis | *Arthroderma vanbreuseghemii* | 132252 | *A. vanbreuseghemii* | – | *T. rubrum* |
| 5 | 64 | 35.6 | Endometrial cancer, remission | *T. rubrum* | 132253 | *T. rubrum* | – | *T. rubrum* |

[1]Symptomatic tinea inguinalis.


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**Table 2** Baseline characteristics of the study group.

| | Total | | Dermatophyte positive | | |
|---|---|---|---|---|---|
| | *n* | % | *n* | % | *P* |
| Age (year) | 36.2 ± 12.5 (range: 11–90) | | | | 0.002 |
| <49 | 1671 | 84.8 | 1 | 0.06 | |
| ≥50 | 299 | 15.2 | 4 | 1.3 | |
| BMI (kg $m^{-2}$) | | | | | |
| 20–24 | 608 | 30.9 | 0 | | 0.087 |
| 25–29 | 841 | 42.7 | 3 | 0.4 | |
| 30–34 | 306 | 15.5 | 0 | | |
| ≥35 | 215 | 10.9 | 2 | 0.9 | |
| Gravida | | | | | |
| Nulliparity | 509 | 25.8 | 1 | 0.2 | 0.956 |
| 1–4 | 1104 | 56.1 | 3 | 0.3 | |
| >4 | 357 | 18.1 | 1 | 0.3 | |
| Menopausal status | | | | | |
| Premenopausal | 1531 | 77.7 | 1 | 0.07 | <0.001 |
| Perimenopausal | 130 | 6.6 | 0 | | |
| Postmenopausal | 309 | 15.7 | 4 | 1.3 | |
| Education status | | | | | |
| Absent | 256 | 13.2 | 1 | 0.4 | 0.706 |
| Primary school | 839 | 42.5 | 3 | 0.4 | |
| Secondary school | 190 | 9.6 | 0 | | |
| High school | 402 | 20.4 | 0 | | |
| University | 283 | 14.3 | 1 | 0.4 | |
| Marital status | | | | | |
| Bachelor | 284 | 14.4 | 0 | | 0.002 |
| Married | 1658 | 84.2 | 4 | 0.2 | |
| Separated/divorced | 28 | 1.4 | 1 | 3.6 | |
| Reason for administration | | | | | |
| Hospital attendant | 324 | 16.4 | 0 | | 0.012 |
| Control | 782 | 39.7 | 2 | 0.3 | |
| Pregnancy | 264 | 13.4 | 0 | | |
| Vaginal discharge, itching | 59 | 3.0 | 0 | | |
| Abnormal vaginal bleeding | 155 | 7.9 | 0 | | |
| Gynaecologic malignancies | 64 | 3.2 | 2 | 3.1 | |
| Uterine pathologies (myoma uteri, endometrial polyps and endometrial hyperplasia) | 151 | 7.7 | 0 | | |
| Infertility | 56 | 2.8 | 1 | 1.8 | |
| Groin pain | 21 | 1.1 | 0 | | |
| Other | 94 | 4.8 | 0 | | |

should not be ignored and should be carefully considered in patients at risk. We found that age of more than 49 years increased the risk of groin dermatophyte carriage ($P = 0.002$; Table 2). Unlike tinea inguinalis, the carrier state is not apparent on visual inspection and mycologic examination is therefore essential. In addition, the carrier state may present as an overt infection or may be sexually transmitted to partners.[17] In the present study, we recovered *T. rubrum* isolates from four patients and *A. vanbreuseghemii* isolates from one (Table 1). These individuals remain at risk for subsequent symptomatic infections when relevant conditions for the development of ringworm, as in case 1. Therefore, we suggest treatment with 1% terbinafine cream and resampling to ensure resolution.

In a review of global trends of dermatophytic fungi, Borman *et al.* [3] found strong evidence supporting the continuing dominance of anthropophilic *T. rubrum*. They concluded that *T. rubrum* infection often becomes chronic, lasting for months or even years. Typically, a disease of the feet, it can spread to the groin and hands, and is the most common cause of tinea unguium.[3,5] Sadri *et al.* [7] examined the frequency of tinea pedis in

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**Table 3** Univariate analysis by a logistic model of factors contributing to groin ringworm risk.

| | Total | | Dermatophyte positive | | |
|---|---|---|---|---|---|
| | *n* | % | *n* | % | *P* |
| Dermatophytosis in family | | | | | |
| Absent | 1690 | 85.8 | 4 | 0.2 | 0.239 |
| Partner groin | 72 | 3.7 | 1 | 1.4 | |
| Partner toe web/body | 82 | 4.1 | 0 | 0 | |
| Other family members | 126 | 6.4 | 0 | 0 | |
| Diabetes mellitus | | | | | |
| Absent | 1776 | 90.1 | 5 | 0.3 | 0.595 |
| Present | 194 | 9.9 | 0 | 0 | |
| Exercise | | | | | |
| Absent | 1669 | 84.7 | 5 | 0.3 | 0.436 |
| Present | 301 | 15.3 | 0 | 0 | |
| Underwear | | | | | |
| Cotton | 1713 | 87.0 | 5 | 0.3 | 0.497 |
| Synthetic | 257 | 13.0 | 0 | 0 | |
| Common use area | | | | | |
| Toilet | 1150 | 58.4 | 5 | 0.4 | 0.311 |
| Epilation centre | 64 | 3.2 | 0 | 0 | |
| Sauna | 72 | 3.7 | 0 | 0 | |
| All | 684 | 34.7 | 0 | 0 | |

60 patients with tinea cruris (65% caused by *E. floccosum* and only 3% caused by *T. rubrum*) and detected tinea pedis in only four of these patients. However, there was no correlation between the isolates from the inguinal area and toe webs.

Otero *et al.* [17] described the cases of seven prostitutes with tinea inguinalis. With a mean of 50 sexual partners per month, the spread of active lesions in prostitutes probably occurred through multiple contacts with clients, and the authors suggested that 'the use of condoms would not be a protective measure'. Moreover, they reviewed two additional cases of tinea inguinalis in the perineal and buttock areas, without involvement of the crural area, in passive homosexual men.[17] Therefore, tinea inguinalis can potentially become a sexually transmitted infection.

Isolates of the *T. mentagrophytes* complex vary phenotypically. It is unknown whether closely related zoophilic and anthropophilic anamorphs currently associated with *A. vanbreuseghemii* are members of the same biological species.[18] Recently, Kano *et al.* [19] suggested that anthropophilic *T. mentagrophytes* (*T. interdigitale*) evolved from a (+) mating strain of *A. vanbreuseghemii*. Deng *et al.* [20] investigated 97 elementary school children with tinea capitis and found that five had zoophilic *A. vanbreuseghemii* (sheep origin). Of these five children, one had a black-dot form and four had grey patch. Zhang *et al.* [21] reported intrafamilial human-to-human transmission of *A. vanbreuseghemii*, possibly originating from a rabbit, between a 4-year-old boy with kerion celsi and his parents with tinea corporis. To the best of our knowledge, this study provides the first documented case of a carrier state of *A. vanbreuseghemii* in humans (CBS 132252). However, we were unable to identify an animal source. Given that this is the first recovery of this microorganism in Turkey, clinicians and mycologists should pay particular attention to *A. vanbreuseghemii* infections.

Finally, this study addressed the actual prevalence of groin dermatophytic infections in women. Although tinea inguinalis is rare in women, the carrier state is more common than symptomatic infection. It is important to be aware of these various states because not only can untreated carriers spread the infection to their partners but they are also susceptible to overt clinical infection, as in case 1. To determine the spread of groin dermatophytic fungus, the scalp, nails and toe webs should be carefully examined, and treated if infected. We successfully treated both groin dermatophyte carriage and tinea inguinalis with 1% terbinafine cream; this strategy would help reduce the incidence of clinically apparent infection or its spread to other body site(s) or humans. Nevertheless, it is not yet clear why some patients carry dermatophytic fungi. Future research may focus on special patient populations, such as those of more than 49 years, which we found to be a risk factor for groin carriage.

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## Conflict of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and the writing of the article.

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