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ORIGINAL RESEARCH

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Patent leather shoes increase the frequency of tinea pedis

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ABSTRACT

Background: Patent leather shoes may prevent aeration of feet, and thus causing tinea pedis, but there are no specific scientific studies on the subject. We aimed to clarify whether patent leather shoes may increase the frequency of tinea pedis.
Material and Methods: We studied military high school students receiving a diagnosis of tinea pedis before and after they began to wear patent leather shoes after a specific date retrospectively. We used medical records as data.
Results: The prevalence of tinea pedis was 32.70% before patent leather shoes were used in school, increasing to 71.48% in the 2 years afterward. The 2.18-fold increase in the tinea pedis incidence without any change in the daily activities or the school environment of the students indicates that patent leather shoes may be a factor in tinea pedis development.
Conclusion: Patent leather shoes, usually worn for aesthetic reasons, are not suitable for foot health as they have low air permeability and can increase the incidence of tinea pedis. Natural products should, therefore, be preferred for shoe production, as in many other areas, and consumers should be educated on this subject. Results indicate that the public and patients should be notified about patent leather shoes as well as the other preventive measures.

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Tinea pedis; patent leather shoes; athlete's foot

Introduction

Tinea pedis, also known as "athlete's foot", is a cutaneous fungal infection of the body and has been first reported in a written source by Pellizzari [1] although it is believed to be one of the most frequent diseases in the history of humankind. The first written source on the causative agent of tinea pedis has been by Whitfield in 1908 where it was suggested that the causative agent was the same as that of Tinea capitis [2]. Tinea pedis is accepted as the most common dermatophytosis in the world. It is estimated that 70% of the population is affected by tinea pedis infection at one stage of their lives [3]. There is no information suggesting that an ethnic group or race is more commonly affected by Tinea pedis but it is known that men are more frequently affected than women [4]. The disease is seen rarely during childhood but the frequency increases with age, while adolescence is the period when tinea pedis is most frequently encountered [3].

Although *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Epidermophyton floccosum* are common causative agents of Tinea pedis, the most common agent is *T. rubrum*, and it is known that this microorganism was endemic only in some parts of Southeast Asia and Africa in the past [2]. However, tinea pedis has gradually been encountered less and less in these regions, probably due to the people avoiding shoes with low air permeability [2]. The use of shoes which had prominent isolation characteristics against various environmental factors such as hot, cold; and mechanical factors during mass migration of large communities due to wars, trips, and migration; and the lack of attention to personal hygiene during such activities has led to the rapid spread of *T. rubrum* throughout the world [4].

The primary accepted risk factors for tinea pedis development are (a) hot, humid, and tropical climates, (b) wearing shoes with little air permeability for extended periods, (c) using public facilities such as pools or Turkish baths, and (d) genetic

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predisposition. Although the fact that tinea pedis is an infection decreases the validity of a genetic predisposition factor, it is suggested that a defect in the immune system can facilitate tinea pedis development [4].

It is seen that some of the accepted risk factors for tinea pedis development cannot be altered for various reasons and the most critical factor that can be personally changed is wearing shoes with little permeability for extended periods [5].

Although the primary function of shoes is to protect the feet against various environmental factors such as hot, cold and mechanical factor while walking, they have assumed many different functions over time. The protection of foot health has gradually become less important, while durability, cost, and esthetic properties have become more important when choosing shoes. The principal approach to increase durability and decreases cost in shoe production is to use synthetic products instead of genuine leather, and this dramatically decreases the air permeability of the shoe. The use of polyurethane during shoe production to increase the durability and decrease the water permeability of genuine leather or synthetic products and to provide a lasting polish to the leather also leads to a marked decrease in the air permeability of the produced shoe [6]. Shoes produced from such leather, named patent leather, are used extensively by the public for various purposes (shoes for social events, special event/ceremony shoes, as part of the formal dress at some institutions, or for daily wear). As the choice of shoes is a primary factor for tinea pedis development and can be altered, the role of patent leather shoe usage on the development of fungal infections of the feet is clear. Although there are personal opinions and experiences, we have not found any scientific investigations about the effects of patent leather shoe usage on the development of fungal infections of the feet.

We studied the incidence of fungal infections of the foot before and after patent leather shoe usage in an environment where such shoes are used for daily activities, together with the demographical and environmental factors that may be associated.

Materials and Methods

The study was carried out at a high school-level military school where patent leather shoes were used all day. The main characteristics of the study environment and participants were that the students had begun using patent leather shoes for about 10 hours per day in 1998 and that there were no other changes in environmental conditions and daily activities. The data were obtained by retrospective screening of the examination records of the school physician. As students started to wear patent leather shoes in stages in 1998, data for this year were not included in the study.

As we could only reach the records for the 2 years before the change of shoe style, we included the 2 years before and after 1998 in the study (1996, 1997, 1999, and 2000). The date of birth, examination date, diagnosis, procedure, and prescribed medication were noted from the examination records. Only the first records of those students who had complained of foot fungal infections more than once during the year were taken into consideration.

The data were transferred into the computer environment with the SPSS for Windows 11.0 statistical software, and statistical comparisons were made between the appropriate data with the chi-square test.

Results

The ages of the patients included in the study ranged from 14 to 18 with a median value of 15 and the mean value of 15.25 ± 0.72. A total of 19,409 visit records over 4 years were scanned for this study and the records for the 907 patients receiving a diagnosis of tinea pedis were included in the study after they were transferred into the computer environment.

When the tinea pedis frequency among all examinations during the study years was investigated, it was found that there was a statistically significant difference among the frequency of tinea pedis cases by year (Table 1, chi-square = 35.334, p = 0.0001). While there were a total of 289 tinea pedis cases in the 2 years before patent leather shoes were used, but this number increased to 618 in the 2 years following the start of patent leather shoe usage although the total number of students did not change (Fig. 1).

The incidence of tinea pedis before patent leather shoes was used was 32.70%, increasing to 71.48% in the 2 years afterward.

When the distribution of the tinea pedis cases included in the study to months was studied June, October, and May were the months when the most diagnoses of tinea pedis were made (15.7%, 14.2%, and 13.9%, respectively). There was a statistically significant difference in the number of tinea pedis

Table 1. Distribution of tinea pedis cases by year.

Year	Tinea pedis cases*
1996	114
%	12.6
1997	175
%	19.3
1999	209
%	23.0
2000	409
%	45.1
Total	907

Chi-square = 35.334, p = 0.0001.
*The percentages are column percentage.

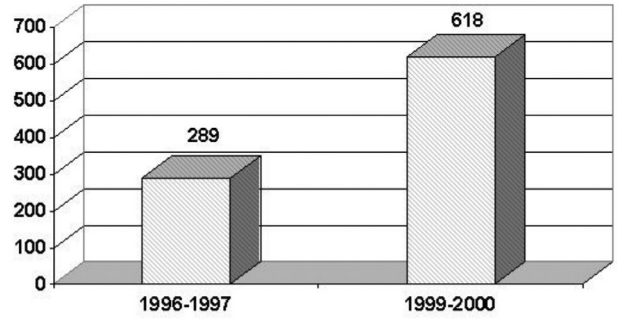

Figure 1. The number of fungal cases in the 2 years before and after the start of patent leather shoe usage. The number of fungal cases in the 2 years before and after the start of patent leather shoe usage.

cases by month (chi-square = 21.851, p = 0.026) (Table 2).

A total of 899 antifungal cream/powder had been prescribed, a dressing had been applied to 890 patients because of maceration, and 710 patients had been advised not to wear shoes for a total of 3,204 days during the years included in the study. Thirty three (3.6%) of the patients with tinea pedis had disease severe enough to require bed rest.

Discussion

The students in the military school, where the study was carried out, using genuine leather shoes before 1998 but switched to patent leather shoes for their daily activities from 1998. This makes the study group very suitable for investigating the effect of patent leather shoes on foot health. Another factor increasing the importance of the study is the fact that the ages of the subjects ranged from 14 to 18, a dangerous period for tinea pedis development.

The incidence of tinea pedis in the students was calculated as 32.70% for the years before patent leather shoes were worn, increasing to 71.48% for the 2 years afterward. Although the incidence of tinea pedis in the community ranges from 3% to 51% according to various studies, it is generally accepted that 15% of adults in industrialized nations suffer from the disease [7]. However, studies on military personnel have shown that the incidence of tinea pedis is 56% to 85% [8]. The fact that the environment where we carried out the study was a military environment where the students wore shoes regularly for their daily activities for an average duration of 14 hours a day may explain the high incidence of tinea pedis also before patent leather shoes were worn. The more than two-fold increase in tinea pedis incidence once patent leather shoes were started to be worn although the students' daily activities and hours of shoe wear did not change

Table 2. Distribution of the tinea pedis cases by month*.

Month	Tinea pedis cases*
January	24
%	2.6
February	42
%	4.6
March	53
%	5.8
April	57
%	6.3
May	126
%	13.9
June	142
%	15.7
July	85
%	9.4
August	12
%	1.3
September	61
%	6.7
October	129
%	14.2
November	87
%	9.6
December	89
%	9.8
Total	907

Chi-square = 21.851, p = 0.026.
*The percentages are column percentage.

patent leather shoe usage was the primary factor in the increased tinea pedis incidence.

June, October, and May were, in order, the months with the highest frequency of tinea pedis. The reason may be the increased temperature in May and June and the children returning to school following their holidays in October. The students starting to wear patent leather shoes again after wearing different shoes for the holidays may explain the increased frequency of tinea pedis during October when the weather starts to turn cold. The decreased frequency in the following months (until May) may be due to the decreased temperature and the students employing personal protective measures.

An antifungal drug was prescribed for 99.1% of the students receiving a diagnosis of tinea pedis. Although drugs are frequently used for tinea pedis treatment, the expected benefit is not experienced unless the patients practice proper foot hygiene procedures [4]. Another reason for not observing the expected benefit from drug usage may be misdiagnosing patients as tinea pedis when the actual diagnosis should have been shoe dermatitis. However, shoe dermatitis is also seen more frequently in patients with tinea pedis. The physician should, therefore, keep these in mind for the differential diagnosis to prevent unnecessary drug consumption [9].

The shoes should be considered as a factor, especially when there are recurring foot skin irritation and tinea pedis in a patient despite the use of antifungal treatment and attention to foot hygiene [10]. Fungal cultures, fungal potassium hydroxide (KOH) microscopy, and the patch test may be used for the differential diagnosis of tinea pedis, shoe dermatitis, and chronic foot dermatitis but special care should be taken with sample collection, especially for culture and microscopy for the results to be reliable [11,12].

Patent leather should be avoided in shoe production and natural products preferred as the raw material of polyurethane used for patent leather shoe production, toluene di-isocyanate, may have undesirable effects on health such as local irritation (shoe dermatitis) and allergy in addition to an increased incidence of tinea pedis [6].

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