The Results of *Trichophyton tonsurans* Screening Examinations and Infection Management in University Judo Federation of Tokyo Athletes over a 4-year Period

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ABSTRACT

Background: *T. tonsurans* infection is spreading among combat sport athletes in Japan, and preventive measures are necessary.

Methods: A questionnaire survey and hairbrush-culture tests were conducted over a 4-year period on university judo athletes from about 50 university teams affiliated with the University Judo Federation of Tokyo. Culture-positive individuals were given specific treatment recommendations based on culture results and were advised to seek treatment at a medical clinic. Culture-positive individuals were re-tested at 3 months post-treatment.

Results: Approximately 65% of participants reported a history of *T. tonsurans* infection. The incidence of hairbrush culture-positive individuals overall gradually decreased from 11.3% (academic year 2008) to 5.4% (2011). Each year the incoming freshmen had the highest infection rate of the four academic classes. Beginning in 2009 the infection rates decreased sharply among those who had participated in the survey the previous year, and the decreases continued the following year(s) until graduation. Among culture-positive individuals, the incidence of asymptomatic carriers increased each year, from 86% in 2008 to 98% in 2011. The culture-negative conversion rate was 86% overall for those undergoing treatment.

Conclusion: Preventive measures against *T. tonsurans* infection in the University Judo Federation of Tokyo were successful in increasing awareness of the disease, lowering the incidence of infection, and detecting asymptomatic carriers who require treatment.

Key words: *Trichophyton tonsurans*, screening examination, preventive measures

Introduction

*Trichophyton tonsurans* was first found in Japan around the year 2000, having entered through international competitions for combat athletes. Since that time, infection has spread from combat athletes to other students, families and friends. *T. tonsurans* has become a significant social problem as one of the emerging fungal infectious diseases¹⁻³.

To prevent an epidemic of the infection, we undertook several initiatives focusing on increasing public awareness of the disease, particularly among judo athletes. In 2003 we published the pamphlet, “Cutaneous fungal infection in athletes: hairbrush method, treatment, and guidelines for prevention”⁴, and distributed it to judo clubs throughout Japan. We also conducted a nationwide questionnaire survey of judo clubs⁵ and
screening examinations in the University Judo Federation of Tokyo.

The present paper describes the results of questionnaire surveys and screening examinations against *Trichophyton tonsurans* infection conducted from 2008 through 2011 in judo athletes affiliated with the University Judo Federation of Tokyo. The outcome of guideline-based treatment is also discussed.

**Subjects and methods**

The study was conducted over a 4-year period, from 2008 until 2011, in synchrony with the academic year, which begins in April in Japan. Judo athletes (both male and female) from approximately 50 universities who were registered with the University Judo Federation of Tokyo were invited to participate in the study, which was approved by the Juntendo University Ethics Committee, and all participants provided written informed consent.

Results of the initial screening examination performed in 2008 were described earlier. Generally the study population was recruited each year from the same judo clubs, but every year 2 or 3 universities would have new clubs registering with the Federation or clubs not renewing the registration. After the first study year, therefore, most of the participants had already undergone screening examinations. In each of the 4 years of the study, the freshman class was assumed to be screening-naive.

Screening was initiated in mid-April. Participants were asked to complete a questionnaire with questions on age, gender, height, body weight, type of housing, number of cohabitants, duration of daily exercise, current presence or history of tinea-like rashes, and treatment history. Questions concerning history of tinea or previous treatment were not included in the 2008 questionnaire.

Sample collection, which was performed before judo training, consisted of giving each subject a circular hairbrush with 126 spikes and asking him/her to scrub the scalp vigorously, approximately 15–20 times. Hairbrushes were collected, placed in individual plastic bags and sent to our laboratory at Juntendo University. The hairbrush spikes were used to inoculate plates containing Mycosel agar (Eiken Chemical Co., Tokyo), and the plates were incubated at 25°C for 2 weeks. Colony growth indicated the presence of infection.

A summary of the test results reporting the number of colonies observed was sent to each individual who tested positive in the hairbrush test. The individuals were advised to consult a local dermatologist and undergo treatment. For those whose hairbrush test results showed only 1 or 2 colonies, the recommended treatment was anti-fungal shampoo alone. If 3 or more colonies were observed in the test, the recommended treatment was systemic therapy with oral anti-fungal agents: i) oral itraconazole, 400 mg/day for 1 week; ii) oral terbinafine, 125 mg/day for 6 weeks; or iii) oral terbinafine, 500 mg/day for 1 week. In addition, all hairbrush-positive individuals received management recommendations that emphasized the importance of preventive measures, such as cleaning the judo halls daily and washing judo uniforms and undergarments after each practice.

Three months after undergoing treatment, individuals with positive test results were retested by the hairbrush method. If the second hairbrush–culture test was positive, treatment was repeated.

**Results**

Each year approximately 1,000 students from
the University Judo Federation of Tokyo participated in the survey examining *T. tonsurans* infection. Results for the last 4 years are summarized below.

**T. tonsurans** infection status

As previously reported, 102 (11.3%) of 902 participants tested positive by the hairbrush-culture method in 2008. The following year, only 76 (6%) of 1,260 participants tested positive, indicating a decrease of nearly 50%. The infection rate continued to show a gradual decrease, with 76 (5.9%) of 1,281 subjects testing positive in 2010 and 71 (5.4%) of 1,308 subjects testing positive in 2011 (Table 1). Self-awareness of *T. tonsurans* infection appeared high, with more than 60% of participants each year responding affirmatively to the statement “I have a history of tinea infection” that was included in the questionnaire after 2008.

**Change in the percentage of culture-positive individuals by academic class**

In 2008, the percentage of culture-positive individuals was roughly similar across the 4 classes, ranging from 8.8% to 12.9%, with a trend towards decreasing infection rates in upperclassmen. Specifically, in 2008 the distribution of the 102 culture-positive individuals as a percentage of participants for each year grade was as follows: freshmen, 30/233 (12.9%); sophomores, 30/236 (12.7%); juniors, 22/205 (10.7%); and seniors, 20/228 (8.8%). Each year the incoming freshmen had the highest infection rate of the four academic classes (Table 2). After the survey was initiated in 2008, the percentage of hairbrush-culture-positive individuals decreased year by year for those who had repeatedly participated in the survey and benefited from treatment and management recommendations (Table 2). Notably, the infection rates for a given class decreased sharply in the year following initial participation in the survey. For example, in 2009 the percentages of hairbrush-culture positive individuals showed a striking 50% or greater decrease compared to the percentages in their respective classes the previous year. Similar reductions in infection rate were observed for each year’s advance from freshman through sophomore classes (2008 entry, 12.9% to 5.3%; 2009 entry, 13.6% to 4.3%; 2010 entry, 16.2% to 3.7%, Table 2).

**Incidence of asymptomatic carriers in hairbrush-culture-positive individuals**

Most of the individuals who tested positive for *T. tonsurans* infection by the hairbrush-culture method were found to be asymptomatic carriers: 88/102 (86.3%) in 2008, 70/76 (92.1%) in 2009, and 69/76 (90.8%) in 2010. In 2011, questionnaire responses concerning symptoms were not available for one culture-positive individual; however, all of the remaining 70 individuals who tested positive for *T. tonsurans* infection were asymptomatic (Table 1).

**Post-treatment testing of culture-positive individuals**

Culture-positive individuals continued to participate in judo competition while receiving treatment. After undergoing 3 months of the anti-fungal treatment recommended based on colony count in the initial hairbrush-culture test, each culture-positive individual was retested by the hairbrush-culture method. As shown in Table 3, in each of the 4 years of the study, greater than 85% of culture-positive individuals who received treatment converted from positive to negative following treatment: 85/96 (88.5%) in 2008, 60/70 (85.7%) in 2009, 64/74 (86.5%) in 2010, and 62/71 (87.3%) in 2011.

<table>
<thead>
<tr>
<th>Year</th>
<th>Freshmen</th>
<th>Sophomores</th>
<th>Juniors</th>
<th>Seniors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>233</td>
<td>236</td>
<td>205</td>
<td>228</td>
</tr>
<tr>
<td>2009</td>
<td>309</td>
<td>359</td>
<td>328</td>
<td>264</td>
</tr>
<tr>
<td>2010</td>
<td>277</td>
<td>369</td>
<td>323</td>
<td>312</td>
</tr>
<tr>
<td>2011</td>
<td>309</td>
<td>353</td>
<td>348</td>
<td>298</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>TOTAL</th>
<th>Culture-positive</th>
<th>TOTAL</th>
<th>Culture-positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>902</td>
<td>102 (11.3%)</td>
<td>1,260</td>
<td>76 (6.0%)</td>
</tr>
<tr>
<td>2009</td>
<td>76</td>
<td>70 (92.1%)</td>
<td>298</td>
<td>5 (1.7%)</td>
</tr>
<tr>
<td>2010</td>
<td>71</td>
<td>69 (90.8%)</td>
<td>359</td>
<td>71 (5.4%)</td>
</tr>
<tr>
<td>2011</td>
<td>71</td>
<td>62 (87.3%)</td>
<td>30(12.7%)</td>
<td>6 (1.7%)</td>
</tr>
</tbody>
</table>
Discussion

Outbreaks of *T. tonsurans* infection in combat sport clubs in Japan were first reported in 2000\(^9\). Although outbreaks are now less common in Japan, many infected individuals have become asymptomatic carriers and the infection still poses a health risk\(^{10,11}\). For this reason, we began a program to increase awareness of the disease among combat sports participants, physicians, and the general public. We have promoted screening examinations, treatment awareness, and improved hygiene in sports clubs\(^4\), and we have tried to increase disease awareness among physicians. If an infected patient sees a dermatologist who is not familiar with this fungus, the patient may be misdiagnosed and given steroids, leading to deterioration in clinical status. The website of the *T. tonsurans* infection study group ([http://tonsurans.jp/](http://tonsurans.jp/)) is designed to serve as an educational resource for healthcare professionals in Japan.

The survey of *T. tonsurans* infection in the University Judo Federation of Tokyo was targeted at a single large population. Questionnaire responses indicated that a majority of subjects had a history of tinea infection, suggesting that the infection may still be spreading among judo players. Support for the effectiveness of our educational efforts and the screening and treatment guidelines is seen in the striking decrease in hairbrush-culture-positive individuals after the first year of participation in the survey. Moreover, treatment results in judo athletes affiliated with the University Judo Federation of Tokyo showed a high positive-to-negative conversion rate, with 87.3% to 88.5% of hairbrush-culture-positive individuals testing negative following 3 months of treatment.

One of the advantages of the hairbrush-culture screening method is that it reveals asymptomatic carriers, who may be unaware that they are infected. In our survey, every year the majority of hairbrush-culture positive individuals were asymptomatic carriers. The absence of symptoms precludes most asymptomatic carriers from ever receiving a diagnosis of *T. tonsurans* infection. If patients receive treatment, physicians may finish treatment without confirming complete cure, or the patients themselves may choose to discontinue treatment. To stop the spread of *T. tonsurans* infection, it is essential to find asymptomatic carriers and treat them.

Although the hairbrush-culture test is a good method, for large-scale screening improvements are necessary. The circular hairbrush is large and inconvenient for shipping by mail. The agar plates required for culture are 9 cm in diameter, and a small laboratory room is inadequate for large-scale screening: to screen hundreds of samples, a large testing room is needed. Finally, the possibility of emergence of resistant strains of *T. tonsurans* is a concern, and determination of MIC is necessary to ensure effective treatment.

With no action taken, *T. tonsurans* infection could spread throughout the community, from judo athletes to junior high school students or elementary school students. Spread of infection to family members or friends has already been observed\(^11,12\). Educational campaigns are necessary to increase public awareness of the disease. Control of *T. tonsurans* infection requires periodic screening examinations, performed systematically in each generation, along with treatment of infected individuals, including asymptomatic carriers. Building a network among combat sport associations, medical institutions, and the general population is an essential step in accomplishing this goal.

### Table 3. Culture negative conversion rate after 3 months of treatment

<table>
<thead>
<tr>
<th>Academic year</th>
<th>Culture-positive individuals who had received treatment</th>
<th>3 months post-treatment</th>
<th>Culture-negative</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>102</td>
<td>96</td>
<td>85</td>
<td>88.5</td>
</tr>
<tr>
<td>2009</td>
<td>76</td>
<td>70</td>
<td>60</td>
<td>85.7</td>
</tr>
<tr>
<td>2010</td>
<td>76</td>
<td>74</td>
<td>64</td>
<td>86.5</td>
</tr>
<tr>
<td>2011</td>
<td>71</td>
<td>71</td>
<td>62</td>
<td>87.3</td>
</tr>
<tr>
<td>Total</td>
<td>325</td>
<td>311</td>
<td>271</td>
<td>87.1</td>
</tr>
</tbody>
</table>
Acknowledgment

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References


