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# Communal Showers and the Risk of Plantar Warts

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**Background.** Plantar warts occur most commonly in adolescents and are more prevalent among users of public locker rooms. Previous studies have not differentiated shower rooms from locker rooms as risk factors.

**Methods.** The current study examined the prevalence of plantar warts among a group of 146 adolescents who used locker rooms. Subjects ranged in age from 10 to 18 years and were recruited from a public school and a swim club. All subjects used public locker rooms but only those in the swim club used communal showers on a regular basis. All subjects were interviewed by a physician and underwent an examination of the feet.

**Results.** There was a statistically significant difference in the prevalence of plantar warts between the shower room users (27%) and those who used only locker rooms (1.25%).

**Conclusions.** The present study suggests that public shower users are at greater risk for plantar warts than are locker room users who do not use communal showers.

**Key words.** Warts; prevalence; swimming; public facilities; foot. (*J Fam Pract* 1995; 40:136-138)

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The prevalence of nongenital warts in the general population has been estimated at 7% to 10%.<sup>1,2</sup> According to the literature, nongenital warts afflict females more than males, are most common in adolescents, and rarely afflict the elderly.<sup>3</sup> The tendency of individuals to seek medical treatment for the relief of pain associated with plantar warts suggests that they are the most annoying of the nongenital warts. Recent studies have found a higher incidence of plantar warts among athletes and users of public swimming pools.<sup>4,5</sup> These studies have suggested that the locker room environment may be a risk factor for users of public facilities. The current study was conducted to determine whether the risk of plantar warts is higher among individuals who use public showers than among those who use only locker rooms.

Plantar warts (*verrucae plantaris*) are usually caused by type 1 human papillomavirus (HPV), although type 4

has been isolated from some mosaic plantar warts. The virus enters a compromised skin surface through direct contact and attacks the granulosum and keratin layers of the epidermis.<sup>6</sup> Inoculation depends on the degree of skin integrity as well as individual susceptibility.<sup>7</sup> Type 1 HPV has been noted to have the highest viral particle density of any of the HPV genotypes, an important factor in the transmission of plantar warts.<sup>8</sup>

A study of plantar warts in more than 13,000 school-aged children in East Anglia, United Kingdom, reported a prevalence of 6.5 per 1000, with a peak incidence at age 13 for girls and 14 to 15 for boys.<sup>9</sup> An extensive literature search produced only one US study of plantar warts in children: a 1953 study of students from five schools in Dixon, Illinois, consisting of 2389 children and adolescents ranging in age from 7 to 18 years.<sup>10</sup> The prevalence of plantar warts in this group was 4.5%

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The opinions expressed in this paper are those of the author and do not represent official positions of the US Public Health Service or the Department of Health and Human Services.

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## Methods

With school board approval and informed parental consent, 146 adolescents ranging in age from 10 to 18 years were recruited from a public school and a swim club in Nashville, Tennessee.

Physical education students from a Nashville middle school were recruited for the first group. The middle school had an enrollment of 300 students, only one half of whom took physical education on a given day. On the day of the study, 80 of the 150 physical education students asked to participate agreed to do so.

The second group consisted of all the members of the swim club who were less than 19 years of age. The groups were similar with respect to age and sex but differed in size (66 vs 80) and ethnicity (minorities vs whites). There was one minority student in the swim club group, but this person was eliminated because of age.

The two groups used different public locker rooms but only the swim club used public showers. Swim sessions were held six times per week.

Each student underwent a short interview followed by a physical examination of the feet. The interviews and examinations were conducted at the school and the swim club during an 8-hour period. Both sets of examinations were performed by the same group of physicians. Each physician examiner used the same protocol to collect the following information: use of public showers, use of shower sandals when bathing, athletic team participation, and history of plantar warts. A diagnosis of plantar warts was based on the presence of the following criteria on physical examination: a well-circumscribed, cauliflower appearance with texture on palpation. All positive cases were reexamined by the principal investigator. Nonparametric tests were used in the data analysis and significance was determined by the chi-square method.

## Results

The demographic data of the overall sample are summarized as follows: 62% of the sample were female, 86% were white, 11% were African-American, and 3% were Asian (3%). Group 1 had a mean age of 13.3 years and a majority of female students (70%). Group 2 had a mean age of 13.4 years with a smaller majority of female students (56%). Of the entire sample, only 7 participants (3 shower room users and 4 nonusers) used foot protection in public facilities, one of whom was found to be infected.

Nineteen cases of plantar warts were discovered among the entire study population (13%). Further examination of the data revealed a sharp difference in plantar wart prevalence between the two groups. The number of warts among the shower room users was much greater than expected: 27% as compared with 1% among nonusers. The difference in prevalence between the two groups is significant ( $\chi^2=15.46$ ; degree of freedom [df]=1,  $P=.001$ ), suggesting that shower users are at a greater risk for contracting plantar warts than are nonusers.

Current literature suggests that having had a plantar wart previously is a risk factor for reinfection. Only 32% of the entire sample reported previous plantar wart infection, whereas 67% of those infected at the time of this study reported previous infection. Fifty percent of the shower room users reported a previous plantar wart infection, compared with only 16% of the nonusers. The present study found a significant association between previous plantar wart infection and concurrent infection ( $\chi^2=10.14$ ,  $df=1$ ,  $P=.02$ ).

## Discussion

A 1973 British study of foot infections found that locker rooms were the most important factor in exposure and inoculation.<sup>11</sup> In the 1953 US study,<sup>10</sup> a difference in prevalence was detected between schools with and without showers (6% vs 2%), but this difference was discounted by the study authors. Unfortunately, these studies did not differentiate between locker room and shower room use.

There are several limitations to the present study. All subjects used a public locker room but not the same locker room, which may have been a factor in some of the differences observed. Second, students in the nonuser group were self-selected rather than randomly assigned. This selection method has the potential to introduce bias, but, as only one student was found to be infected, it may not be an important factor. Third, the sensitivity and specificity of the diagnostic criteria depended on the experience of the examiner, but since all infected individuals were aware of the diagnosis before the examination and the examiner simply confirmed the diagnosis, this factor may not be important. One subject who thought she was infected was found on examination to have only a callus.

Finally, the use of swimmers in the present study raises the question of what role, if any, the swimming pool plays in viral wart transmission. This question was addressed in a 1985 German study of the relationship between public swimming pools and foot dermatoses. The authors concluded that swimming pools did not present any danger to the German public with respect to contracting skin diseases.<sup>11</sup> This conclusion seems reasonable in the case of plantar warts because infection requires virus-to-foot contact, which is unlikely to occur in a swimming pool or on a pool deck because of the chemical treatment of pool water. Current literature has not addressed what effect, if any, swimming pool chemicals might have on HPV survival.

In spite of the limitations, the current study suggests that users of public shower rooms are at greater risk for contracting plantar warts than are users of locker rooms only. It is suspected that the warm, moist, shower-room environment is important for viral transmission in suscep-

tible persons. The author is currently conducting a follow-up study to determine whether the incidence of plantar warts among shower room users (swimmers) can be reduced by limiting foot-to-floor contact.

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