Do US Veterans Wear Appropriately Sized Shoes?

The Veterans Affairs Shoe Size Selection Study

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Poorly fitting footwear has frequently been cited as an etiologic factor in the pathway to diabetic foot ulceration. However, we are unaware of any reports in the medical literature specifically measuring shoe size *versus* foot size in this high-risk population. We assessed the prevalence of poorly fitting footwear in individuals with and without diabetic foot ulceration. We evaluated the shoe size of 440 consecutive patients (94.1% male; mean ± SD age, 67.2 ± 12.5 years) presenting to an interdisciplinary teaching clinic. Of this population, 58.4% were diagnosed as having diabetes, and 6.8% had active diabetic foot ulceration. Only 25.5% of the patients were wearing appropriately sized shoes. Individuals with diabetic foot ulceration were 5.1 times more likely to have poorly fitting shoes than those without a wound (93.3% *versus* 73.2%; odds ratio [OR], 5.1; 95% confidence interval [CI], 1.2–21.9; $P = .02$). This association was also evident when assessing only the 32.3% of the total population with diabetes and loss of protective sensation (93.3% *versus* 75.0%; OR, 4.8; 95% CI, 1.1–20.9; $P = .04$). Poorly fitting shoes seem to be more prevalent in people with diabetic foot wounds than in those without wounds with or without peripheral neuropathy. This implies that appropriate meticulous screening for shoe-foot mismatches may be useful in reducing the risk of lower-extremity ulceration. (J Am Podiatr Med Assoc 96(4): 290-292, 2006)

Diabetic foot ulcerations are among the most common severe complications of diabetes mellitus. Approximately one-quarter of all hospital days for patients with diabetes are related to foot complications.[1-3] In the United States, 45% to 83% of all lower-extremity amputations involve diabetes.[4-7] Overall, patients with diabetes are 15 to 46 times more likely to undergo amputation than patients without diabetes.[5, 8-10]

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The cost of healing an ulcer is conservatively estimated to be $7,000 to $45,000.[11] Lower-extremity complications in patients with diabetes are common, costly, and associated with high rates of recurrence, morbidity, and mortality, and the prevention of foot ulcers should be considered a major public health goal.

Ulcers form in people with diabetes because of a lack of sensation (neuropathy), coupled with repetitive pressure forces (walking). One of the central tenets of reducing the incidence of ulcers is pressure reduction through the use of appropriate shoes and insoles. Only a few studies in the existing scientific literature address improper shoe fit. Poorly fitting shoes may account for the development of a sizable proportion of foot ulcers[5, 8, 9] in the diabetic population and may be the source of a host of maladies in individuals at lower risk (without diabetes). Some authors have provided evidence of such a problem in the elderly population. It has also been suggested that inappropriate footwear accounts for 50% of overuse injuries among military recruits.[12, 13] We are unaware of the prevalence of foot-shoe mismatches in US veterans. In this study, we assessed how likely it is that a US veteran with or without diabetes, with or without foot wounds, and with or without neuropathy wears a correctly sized pair of shoes.

Materials and Methods

This prospective study was performed at a large, urban, referral-based foot clinic at Southern Arizona Veterans Affairs Medical Center. We enrolled 440 consecutive patients, all US veterans, in the study. Information obtained from the subjects included shoe size and width, sex, presence or absence of diabetes, presence or absence of neuropathy, presence or absence of foot wound, and type and condition of the shoes usually worn. Actual foot size and width were measured using a standardized method and the Apex 1141 "Ritz stick" (Aetrex, Teaneck, New Jersey) foot-measuring device.[12, 13] Each investigator in this study received identical training in use of the Apex 1141 foot-measuring device by one of us (B.P.N.), a certified pedorthist. Inappropriately sized footwear was defined as a shoe size at least one full size too large or too small using the aforementioned measuring device and clinical examination. Neuropathy was defined as the inability to sense the 10-g Semmes-Weinstein monofilament or a vibration perception threshold greater than 25 V.[14-16] Individuals who could not walk without the aid of a walker or wheelchair were excluded. The foot was also inspected for the presence of any ulcerations defined as at least grade 1A using the University of Texas system.[12, 13] All of the results are expressed as mean ± SD. Dichotomous variables were evaluated using a χ^2 test, with odds ratio (OR) and 95% confidence interval (CI). For all of the measures, α was set at 5%.[17]

Results

Of the 440 consecutive subjects enrolled in this study, 94.1% were men (mean ± SD age, 67.2 ± 12.5 years). Of this population, 58.4% were diagnosed as having diabetes, and 6.8% had active diabetic foot ulceration. For the entire population, only 25.5% of the patients were wearing appropriately sized shoes. Patients with diabetic foot ulceration were 5.1 times more likely to have poorly fitting shoes than were those without a wound (93.3% *versus* 73.2%; OR, 5.1; 95% CI, 1.2–21.9; $P = .02$). This association was also evident when assessing only the 32.3% of the total population with diabetes and loss of protective sensation (93.3% *versus* 75.0%; OR, 4.8; 95% CI, 1.1–20.9; $P = .04$).

Discussion

Diabetic foot ulcerations are among the most common severe complications of diabetes. Ulcers form in patients with diabetes because of a lack of sensation (neuropathy), coupled with repetitive pressure forces (walking). One of the central tenets in reducing the incidence of ulcers is pressure reduction through the use of appropriate shoes and insoles. Poorly fitting shoes may account for a large proportion of diabetic foot ulcers[5, 8, 9] and may also play a role in creating or exacerbating other complications in people without diabetes.

The importance of wearing correctly sized shoes is obvious, especially for those who are at risk for foot infection and possible loss of limb. However, judging by the results of the few studies performed on this topic, choosing appropriately sized shoes is still problematic. This clearly highlights the importance of a coordinated effort to help patients and their providers become more knowledgeable about fitting shoes. The results of the present study confirm this, particularly for individuals at highest risk for pathologic abnormalities.

A 1995 study by Uccioli and coworkers[18] suggested that custom-made shoes were very effective in preventing ulcerations in the diabetic population, but many people do not have access to or the financial means to acquire such shoes. Other authors[19, 20] have noted that over-the-counter or minimally modified shoes have pressure-relieving ability equivalent to that of custom-made shoes and (if able to be fitted

adequately to the foot) should theoretically provide similar protection and accommodation.

According to Rossi,[21] it is important to fit the longer foot, because 70% of men and women have one foot that is longer than the other. This is evident in the study by Kusumoto and Ashizawa,[22] which noted that only 33% of the subjects had equal right-left foot length. In addition, only 8% or fewer students in the study wore correctly sized shoes, which is even lower than in the study by Burns et al,[12] in which 28% of the elderly population used the correct shoe size. However, in the same study, none of the patients with diabetes were wearing shoes of the correct size. The present study confirms these previously reported trends. In the present study, patients with diabetic foot ulceration were 5.1 times more likely to have poorly fitting shoes than those without a wound. It is understandable that no two feet are alike and that it is almost impossible for a patient with loss of sensation to make a correct decision as to whether a shoe is too tight or too loose. Therefore, we suggest that when choosing shoes, this population be meticulously fitted by an experienced professional.

A host of factors are involved in selecting an appropriately (or inappropriately) sized shoe. The present study measured only the most obvious. Heel-to-toe, heel-to-ball, width, and volumetric dimensions are at least as important. However, we intended to identify the prevalence of poor fit with the most basic assessment of shoe-foot size in a large patient population. We hope that further work in this area will evaluate the prevalence of poor fit when using these and additional measurements.

Conclusion

Many people presenting for foot care in this study were wearing incorrectly sized shoes. This was especially true for individuals who already had diabetic foot wounds. Greater accuracy in the shoe-foot match can be useful in reducing the risk of foot ulceration. Educating consumers, shoe store sales personnel, and health-care professionals in proper shoe-fitting techniques can be beneficial to all of the parties involved in this therapeutic relationship.

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