Prevalence of Podiatric Medical Problems in Veterans versus Nonveterans

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ORIGINAL ARTICLES

Prevalence of Podiatric Medical Problems in Veterans versus Nonveterans

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Background: Lower-extremity pathologic abnormalities have been common in military recruits for many years. Many of these conditions can become chronic and persist even after retiring from military service. We hypothesized that certain foot abnormalities are more prevalent in veterans versus nonveterans. The purpose of this study was to evaluate what foot and ankle disorders are associated with veteran status while controlling for other demographic factors.

Methods: The National Health Interview Survey (Podiatry Supplement) from 1990 was used for this secondary data analysis. The data were divided into veterans and nonveterans, and the prevalence of podiatric medical problems, including callus, flatfoot deformity, bunion deformity, hammer toe deformity, arthritis, and sprain, was evaluated for each group.

Results: Flatfoot deformity and arthritis were significantly more prevalent in veterans versus nonveterans in the United States. Bunion deformity was significantly more prevalent in male veterans than in male nonveterans. Male veterans were less likely than male nonveterans to have sprains, and female veterans were more likely than their nonveteran counterparts to have sprains.

Conclusions: These results may help us understand the potential risk factors for podiatric medical problems and may be used for formulating prevention programs. (J Am Podiatr Med Assoc 101(4): 323-330, 2011)

Congress created the Veterans Administration in 1930 to provide medical services for veterans. This population represents a special cohort of patients with increased health-care needs. Podiatric medical care, in particular, is important to this population because mobility has a substantial influence on the overall health and psychological well-being of veterans.

Lower-extremity pathologic abnormalities have been a common problem for military recruits for many years.[1] New military recruits make a sudden change in their activity level from civilian lifestyle. A high incidence of injuries in the lower extremities leads to loss and repetition of training days.[1] Kaufman et al[2] showed that stress fractures in 22,000 Marine Corps trainees cost more than $16.5 million in 1 year in today's dollars. Historically, recruits were issued a thick-soled, rigid boot with the purpose of producing a rigid gait. This type of boot assisted the lower-leg muscles in stabilizing the foot but caused pain and fatigue after excessive activity and training owing to its abnormal distribution of pressure and strain.[3] Initially, military boots were made to fit the average foot dimensions of American soldiers. They provided comfort and durability; however, foot disorders continued to mount in military recruits. In 1965, a report from Fort Dix basic training camp stated that 78% of new recruits were treated for a foot problem in the first 4 weeks of training.[4] To counteract the problem, the

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government focused on pre-enlistment screening processes, investigations of relationships between injuries and training programs, a proper shoe-fitting program, education on foot hygiene, and attempts at early detection and treatment of injuries.

After the Vietnam War, the demand for physical conditioning in new recruits increased. In 1976, the study by Bensel[5] on the two types of existing military boots showed that neither was protecting Marine recruits from foot and ankle injuries. In the same study, he found that heel contusions, stress fractures, and retrocalcaneal bursitis were more common in high-arched recruits and that blisters were more common in normal-arched recruits. The author concluded that a new boot design was necessary.[5]

A recent study showed that most military-related injuries of any body parts were attributable to overuse. Jones and colleagues[6] found that pain was attributable to overuse in 24% of male recruits. In addition, low-back pain and tendinitis were the most common injuries in men, and muscle strain and stress fractures were more common in women.[6] Currently, military recruits do not run in combat boots but do march, train, and conduct land and flight navigations in the boots. deMoya[7] examined ground reaction forces beneath military boots versus running shoes in 21 active-duty military officers. He found that the shock-absorbing and impact-cushioning characteristics were significantly better in the running shoes than in the boots. He suggested that the lack of shock absorption in military boots might cause severe trauma to the lower extremities when individuals are running.[7]

Many of these conditions can become chronic and residual even after individuals retire from military service. Some of the problems seen in podiatric medical clinics in the VA Health Care System today are service-related conditions that have resulted from combat or training, and others are not unique to the veteran population. However, because of the activity levels experienced and the type of shoes worn by military personnel during their service, we hypothesized that certain foot abnormalities are more prevalent in veterans than in nonveterans. The purpose of this study was to evaluate what foot and ankle disorders are more likely to occur in veterans who served in the pre–Gulf War era than in the corresponding nonveteran population.

Methods

The National Health Interview Survey, 1990 (Podiatry Supplement), was used for this secondary data analysis. The data were collected by the National Center for Health Statistics, US Department of Health and Human Services. These deidentified data were distributed by the Inter-university Consortium for Political and Social Research (Ann Arbor, Michigan) and were obtained from their Web site (http://www.icpsr.umich.edu).[8] No medical records/files from any institution, including the VA Health Care System, were collected or analyzed.

The original data were collected from noninstitutionalized civilians in the 50 states and the District of Columbia. The data measured 90 variables, including respondents' demographics, podiatric medical problems, and type of health-care professionals sought for treatment of pedal problems.

For this secondary analysis, the data were divided into veterans and nonveterans. Analyzed podiatric medical problems were callus, flatfoot deformity, bunion deformity, hammer toe deformity, arthritis, and sprain. The data were analyzed to determine relative risks and odds ratios (ORs) for these abnormalities, comparing veterans and nonveterans, while controlling for potential confounders: age, race, sex, and body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared).

The original data set contained 119,631 records. We removed the records for those respondents 10 years or younger (n = 20,997), those whose race was unknown (n = 684), those whose veteran status was unknown (n = 1,114), and those who did not respond to questions regarding the foot deformities examined in this study (n = 3).

Most analyzed data were nominal, and age was not normally distributed; therefore, nonparametric tests were used for comparisons of distributions (Mann-Whitney *U* test). Deviance from normality of the ages of respondents was assessed using the Kolmogorov-Smirnov test. Contingency tables were checked for deviance from independence using a χ^2 test with a Yates correction for continuity.

The Woolf test was used to determine whether ORs were consistent across strata (eg, the OR of the occurrence of a disease between the sexes, stratified by race). The ORs and relative risks of diseases were originally computed directly from contingency tables. Then logistic regression was used to obtain 95% confidence intervals (CIs) for, and estimates of, ORs for disease in veterans versus nonveterans controlling for the other covariates (age, race, and sex). Thus, the coefficient for each variable and its CI are the model OR and 95% CI, respectively.

We followed the same procedure as described previously herein to analyze BMI but removed all of the respondents younger than 18 years (for whom no height or weight data were recorded) (n = 33,243), whose race was unknown (n = 571), whose veteran status was unknown (n = 1,114), who did not respond to foot deformity questions (n = 3), whose height was unknown (n = 575), or whose weight was unknown (n = 975). Respondents with missing heights or weights were simply removed rather than having height or weight imputed. This choice was made because attempting to use a linear regression model to extrapolate from known data revealed that the model was a poor fit and that the assumptions of the linear regression model were not well met.

Because all of the diseases considered herein are rare (<10% of respondents with disease), the relative risk in these models is estimated by the ORs. All of the statistical analyses were performed using the R statistical package (http://www.R-project.org). In the "Results" section, *t*-tests and their nonparametric equivalents, and any proportions, are derived from the raw data. The ORs presented are those derived from the logistic regression model and represent the odds in veterans versus nonveterans.

Results

Demographics

After filtering, the study comprised 96,833 respondents: 45,610 men and 51,223 women. The mean ± SD age of respondents was 40.55 ± 19.46 years. Women were slightly but significantly older (mean ± SD: 41.53 ± 19.85 versus 39.46 ± 18.95 years, Mann-Whitney U $P < .001$). Age was not normally distributed in either sex or in the population as a whole. Six racial groups were included in the study; a breakdown of the numbers in each racial group and the proportions of men are provided in Table 1. We noted that there was oversampling of African American women (χ^2 test of African American sex breakdown versus those of all other races, $P < .001$).

Veterans made up 13.69% of the total sample population, but only 1% of women were veterans. The mean ± SD age of veterans was significantly greater than that of nonveterans (52.96 ± 14.53 versus 38.59 ± 19.42 years, Mann-Whitney U $P < .001$). We noted as well that male veterans were significantly older than female veterans (Mann-Whitney U $P < .001$) and that the opposite relationship held among nonveterans. The various races had significantly different proportions of veterans (χ^2 $P < .001$). Mann-Whitney U tests revealed that the ages of veterans and nonveterans in each racial group were significantly different ($P < .001$) (Table 2). Prevalence of diseases in veterans versus nonveterans is shown in Table 3.

Callus. The most important determining factors associated with callus are sex, age, and race. Women had double the risk of callus (OR = 1.96, 95% CI = 1.822–2.098), and African American participants were significantly more likely to have calluses than were all other racial groups combined (7.3% versus 5.2%, χ^2 $P < .001$). Similarly, white participants were significantly more likely to have calluses than were all other racial groups (except African American) combined (5.3% versus 3.6%, χ^2 $P < .001$). We also noted a sharp increase in reports of calluses with increased age.

Although veteran status is not an important determining factor in the occurrence of calluses in the logistic model, we remark that 1) the proportions of female veterans and nonveterans with calluses were not significantly different and 2) the proportion of male veterans with calluses was significantly higher than that of male nonveterans (χ^2 $P < .001$). Given these data, we decided to analyze men and women separately (Table 4). In this case, we noted that in men, veteran status was a significant factor, controlling for the sex, age, and race covariates, in the appearance of calluses (OR = 1.16, 95% CI = 1.043–1.296), whereas in women it was not (OR = 0.93, 95% CI = 0.678–1.266).

Table 1. Race Demographics: Proportion of the Total Population and Sex Proportions

	Race of 96,833 Respondents					
	Aleutian	Asian	African American	White	Other	Multiple
All, No.	750	2,268	13,921	78,514	1,307	73
Proportion of all	0.008	0.023	0.144	0.811	0.014	<0.001
Men, No.	361	1,094	6,011	37,439	669	36
Women, No.	389	1,174	7,910	41,075	638	37
Proportion of men	0.481	0.482	0.432	0.477	0.512	0.493

Table 2. Proportion of Veterans Overall and by Sex and Race and Ages of Veterans and Nonveterans

	Nonveterans (No.)	Veterans (No.)	Proportion Veterans	Age (Mean) [y][a]	
				Veterans	Nonveterans
All	83,579	13,254	0.137	52.96	38.59
Sex					
Men	32,957	12,653	0.277	53.28	34.16
Women	50,622	601	0.012	46.25	41.47
Race					
Aleutian	662	88	0.117	48.66	33.97
Asian	2,180	88	0.039	50.70	35.38
African American	12,588	1,333	0.096	50.18	36.59
White	66,846	11,668	0.149	53.39	39.23
Other	1,243	64	0.049	42.40	32.59
Multiple	60	13	0.178	52.69	32.63

[a]Mann-Whitney U $P < .001$, veterans vs nonveterans, for all.

Table 3. Odds Ratios, Relative Risks, and Logistic Regression Model Odds Ratios for the Occurrence of Foot Deformities in Veterans versus Nonveterans

	Odds Ratio[a]	Relative Risk[a]	Model Odds Ratio[b]	95% Confidence Interval[b]	*P* Value[c]
Callus	0.95	0.95	1.08	0.098–1.187	.135
Flatfoot	1.24	1.24	1.18	1.024–1.348	.021
Clubfoot	0.88	0.88	0.75	0.310–1.814	.523
Hammer toe	0.89	0.90	0.90	0.726–1.106	.306
Bunion	0.60	0.60	1.19	0.989–1.440	.066
Sprain	0.74	0.75	0.86	0.748–0.999	.048
Arthritis	1.27	1.26	1.46	1.242–1.705	<.001

[a]Computed from contingency tables.
[b]Estimated from logistic regression.
[c]Coefficient *P* value in the given logistic regression model.

Flatfoot. Although there was no sex bias in the occurrence of flatfoot, those with flat feet were slightly but significantly older than were those without (mean ± SD: 42.61 ± 19.39 versus 40.51 ± 19.46 years, Mann-Whitney U $P < .001$). African American participants had a significantly greater occurrence of flatfoot (2.9%) than did all other racial groups combined (2.0%), and Asian participants had less (0.9% versus 2.1%) (χ^2 $P < .001$ for both).

Comparing veterans and nonveterans, the ORs for the occurrence of flatfoot were homogenous when stratified by sex (Woolf test). Although race (African American, Asian) had greater significance in the occurrence of flatfoot, veteran status was also important (OR = 1.18, 95% CI = 1.02–1.35). Looking at sex-specific models, veteran status is not a significant factor for women but remained significant for men.

Clubfoot. This was the rarest of all diseases that we assessed, with only 0.06% of the entire population afflicted. There was no sex, age, or veteran status bias. Although there is significance of veteran status in the female-specific model, the number of individuals with clubfoot makes it difficult to ascribe clinical significance to this result.

Hammer Toe. Women were twice as likely as men to have hammer toe (OR = 1.90, 95% CI = 1.634–2.218). Age was a significant factor; the mean age of those reporting hammer toe is 17 years greater than those not reporting hammer toe (mean ± SD: 57.43 ± 18.92 versus 40.35 ± 19.38 years, Mann-Whitney U $P < .001$). White participants had a significantly greater occurrence of hammer toe (1.3%) than did nonwhite participants (0.6%). Asian participants had significantly less (0.2% versus 1.2%) (χ^2 $P < .001$ for both).

Veteran status was not an important factor in the logistic model. On the other hand, the proportion of male veterans (0.010) and nonveterans (0.006) with hammer toe were significantly different when not

Table 4. Odds Ratios, Relative Risks, and Logistic Regression Model Odds Ratios for the Occurrence of Foot Deformities in Veterans versus Nonveterans by Sex

	Odds Ratio[a]	Relative Risk[a]	Model Odds Ratio[b]	95% Confidence Interval[b]	*P* Value[c]
Men					
Callus	1.74	1.70	1.16	1.043–1.296	.006
Flatfoot	1.27	1.26	1.22	1.050–1.426	.010
Clubfoot	0.62	0.62	0.52	0.184–1.501	.230
Hammer toe	1.60	1.59	0.94	0.743–1.188	.603
Bunion	2.13	2.12	1.30	1.040–1.629	.021
Sprain	0.64	0.64	1.00	0.849–1.182	.982
Arthritis	3.01	2.96	1.47	1.230–1.744	<.001
Women					
Callus	1.02	1.02	0.93	0.678–1.266	.633
Flatfoot	1.37	1.36	1.34	0.823–2.180	.239
Clubfoot	5.82	5.81	5.38	1.276–22.659	.022
Hammer toe	1.71	1.69	1.47	0.889–2.447	.133
Bunion	1.24	1.23	1.10	0.731–1.648	.654
Sprain	1.59	1.57	1.62	1.065–2.472	.024
Arthritis	1.62	1.60	1.44	0.952–2.171	.084

[a]Computed from contingency tables.
[b]Estimated from logistic regression.
[c]Coefficient *P* value in the given logistic regression model.

controlling for the age and race covariates (χ^2 $P <$ .001). These proportions were smaller than those of all veterans (0.011) or nonveterans (0.012) having hammer toe and the proportion of all respondents (0.012) having hammer toe. This finding prompted us to analyze men and women separately (Table 4). It remained the case that veteran status, when controlling for age and race, was not a significant indicator for hammer toe in either men or women.

Bunion. Women were four times as likely as men to have bunions (OR = 4.50, 95% CI = 3.91–5.18), and those with bunions were on average 15 years older than those without (mean ± SD: 55.23 ± 18.76 versus 40.23 ± 19.35 years, Mann-Whitney U $P <$ .001). African American (0.024) and white (0.022) participants each had a higher rate of occurrence of bunions than the remaining population (0.021 and 0.011, respectively, χ^2 $P <$ .001 for both). Age, sex, and race were the important factors, and we noticed exactly the same phenomenon regarding sex and veteran status as with hammer toe: male veterans (1.2%) had a significantly greater occurrence of bunion than did male nonveterans (0.6%) (χ^2 $P <$ .001) but less than the population as a whole (2.2%) and nonveterans as a whole (2.3%). Again, we analyzed men and women separately. Veteran status was a significant factor in the appearance of bunions among men (OR = 1.30, 95% CI = 1.04–1.63) but not among women, in both cases controlling for age and race.

Sprain. There was no sex bias in the occurrence of sprain. Those with sprains were on average 5 years younger than those without (mean ± SD: 35.59 ± 17.32 versus 40.69 ± 19.50 years, Mann-Whitney U $P <$ .001), and white participants had a significantly higher percentage (2.7%) of respondents with sprain compared with all other racial groups combined (1.8%) (χ^2 $P <$ .001).

Male veterans (2.0%) were less likely than male nonveterans (3.0%) to have sprains, whereas female veterans (4.0%) were more likely than their nonveteran counterparts (2.0%) to have sprains (χ^2 $P <$ .05 for both). Because the number of female veterans is so small, veteran status as a whole was still a significant indicator of decreased risk of sprain, controlling for age, sex, and race. This is borne out by the sex-specific models. In men, veteran status was not a significant factor, whereas in women it was.

Arthritis. Women were twice as likely to experience arthritis as were men (OR = 2.33, 95% CI = 2.05–2.66). Respondents with arthritis were older, with a difference in mean age of 21 years (mean ± SD: 61.54 ± 15.79 versus 40.14 ± 19.23 years, Mann-Whitney U $P <$ .001). White (2.0%) and African American (1.8%) participants had a significantly higher prevalence of arthritis than did all other racial groups combined (1.5% and 0.9%, χ^2 $P <$ .001 for both). Although female veterans had a much higher prevalence of arthritis (4.2%) than did male veterans (2.3%) (χ^2 $P < .05$) both had a higher prevalence than did the population as a whole (2.0%) and nonveterans as a group (1.9%). Male and female veterans had a higher prevalence of arthritis than did their nonveteran counterparts (χ^2 $P < .05$). Controlling for age, sex, and race, veteran status was a significant indicator of the incidence of arthritis (OR = 1.46, 95% CI = 1.24–1.71).

In the sex-specific models, arthritis was a significant factor for men and just missed significance for women. The latter is due to the fact that although the prevalence of arthritis was so much higher in veterans than in nonveterans, the number of female veterans was very small.

Body Mass Index

Weight and BMI played a role in the occurrence of the some of the podiatric medical problems. We, thus, filtered the data, as described in the "Methods" section (leaving 83,150 respondents), and reran the analyses, paying special attention to the logistic regression, with BMI added as a new explanatory variable. Mean ± SD BMI was higher in veterans (26.09 ± 3.96) than in nonveterans (24.93 ± 4.87) ($P < .001$ by t test). This is, to an extent, caused by the fact that veterans tend to be older than nonveterans and that more veterans are men than women: mean ± SD BMI was higher in men (25.74 ± 4.09) than in women (24.56 ± 5.20) ($P < .001$ by t test), and BMI was significantly correlated with age (Pearson correlation coefficient = 0.116, $P < .001$). The BMI played a role in the frequency of certain diseases, although the effect of including this covariate was very small overall.

Callus. In the female sex model, veteran status was still not significant, although BMI was a significant factor in the model. In the male sex model, veteran status remained significant, as was BMI. In the model with both sexes, BMI was a significant factor, and veteran status remained nonsignificant.

Flatfoot. No substantive changes were noted after including the BMI variable in the analysis. The BMI was a significant factor in the model.

Clubfoot. No substantive changes were noted. The BMI was not a significant factor in the model.

Hammer Toe. No substantive changes were noted. Veteran status was not significant in either sex-specific model, and neither was it in the model with both sexes. BMI was a significant factor only in the female sex model.

Bunion. In the male sex model, BMI was not significant, but veteran status had also become nonsignificant; in other words, controlling for BMI ablated the effect of veteran status, although BMI was not itself significant. In the female sex model, veteran status remained nonsignificant, whereas BMI was significant. In the model with both sexes, neither BMI nor veteran status was significant.

Sprain. Veteran status was no longer a significant factor for this abnormality. The BMI was a significant factor in the model.

Arthritis. No substantive changes were noted. The BMI was a significant factor in the model.

Discussion

The national survey that we analyzed herein has been analyzed previously by multiple authors. In 1994, Lavy and Mates[9] presented a descriptive analysis of this national health survey and studied the prevalence of different podiatric medical conditions in demographically different groups. They looked at different age and income groups and geographical locations. They reported an increased prevalence of foot abnormalities in females and people with a poverty-level income. Furthermore, they identified differences in the regional distribution of common podiatric medical conditions. Lavy and Mates theorized that socioeconomic and cultural factors might play a role in podiatric medical conditions. In 1993, Greenberg and Davis[10] also analyzed the national survey. They found that foot problems increased dramatically with age and were more common in females than in males and in white participants than in African American participants. They reported that farm areas had the lowest reported prevalence of foot problems and that nonfarm nonmetropolitan areas had the highest reported prevalence of foot problems. They also stated that foot problems decrease markedly with increases in family income. Neither study looked at veteran status as a risk factor for podiatric medical problems.

In 1980, a survey of foot problems in 45,000 family shoe store customers in the continental United States showed that approximately 1 of 2.5 people, or 40% of the population, had foot problems.[11] Among the conditions they studied, flatfoot was the most commonly observed. The study also suggested that foot conditions were equally distributed in both sexes in different age groups, except women aged

31 to 60 years, who had a higher prevalence of foot problems than other groups.

In 2004, Dunn et al[12] published a study on the prevalence of foot and ankle conditions in 784 adults 65 years or older in Springfield, Massachusetts. They found that bunions and corns/calluses were more common in women. Bunions were almost twice as frequent in women as in men and were more common in the African American population. The prevalence of flatfoot did not differ by sex or education.

In 1985, Hung and colleagues[13] studied foot deformities in 166 geriatric inpatients 65 years or older admitted to the geriatric or orthopedic ward for problems not directly related to the foot at a facility in China. They found that more than 50% of the feet had angular abnormality, indicating bunion deformity. Clawing, hammering, overlapping, and deviating of the toes were found in 20% of the patients. An abnormally lowered arch was seen in 10% of women and 5% of men. Calluses were reported in 40% of the feet examined. They found that approximately 50% of the geriatric patients had foot deformities of various types.

In 1989, Holewski et al[14] studied the prevalence of foot abnormalities and lower-extremity complications in 92 diabetic patients seen in a Veterans Affairs Metabolic Clinic. Lower-extremity complications, including pedal ulceration and amputation, were seen in 16% of the study participants. Structural abnormality of the foot was seen in 68% of the patients: 51% with callus, 32% with hammer toes, 8% with bunions, and 1% with Charcot's neuroarthropathy.

Holmer et al[15] investigated 766 patients in a single hospital in Denmark in 1994 for incidence of ankle sprain. They reported the incidence of sprains as 7 of 1,000 persons per year. Males had a higher incidence in younger populations, whereas females had a higher incidence in those 40 years or older. In 2002, Dawson and colleagues[16] interviewed and examined 127 women aged 50 to 70 years in Great Britain. They found that corns (62%), bunions (38%), and toe deformities (37%) were the most common foot conditions reported by women in this sample.

As evidenced by the studies discussed previously herein, people with different demographic backgrounds have different degrees of risk for podiatric medical problems. In the present study, attention was directed to the respondents' veteran status. Other demographic factors known to affect the prevalence of podiatric medical problems were controlled in an attempt to determine whether military background itself predisposes to some of the podiatric medical problems studied. We found that flatfoot deformity and arthritis were significantly more prevalent in veterans than in nonveterans in the United States. Bunion deformity was significantly more prevalent in male veterans than in male nonveterans. Male veterans were less likely than male nonveterans to have sprains, whereas female veterans were more likely to have sprains than were their nonveteran counterparts.

Because the data were collected from a survey, professionals did not confirm most of the self-reported problems. In addition, greater accessibility to health-care professionals during and after active duty may allow veterans more familiarity with and be better able to recognize podiatric medical problems than nonveterans. This, in turn, may falsely inflate the prevalence of pathologic disorders in the veteran population. On the other hand, the pre-enlistment screening program for new recruits may falsely decrease the abnormalities in veterans. Although pre-enlistment screening is part of "veteran status," this would bias against a high prevalence of foot problems that may be caused by military activities or footwear. Also, note that the data included civilians only; therefore, this study did not include acute problems in active military personnel, whereas all of the acute problems in civilians were included. To minimize the effect of this bias, all of the respondents younger than 10 years were excluded from the study. This screening would also eliminate individuals with congenital deformities.

A further weakness of the study comes from the fact that the survey was performed in 1990, thus excluding veterans of the first and second Gulf Wars. These younger soldiers benefited from the military's newer, lighter, more flexible boots and improved training programs.

Because this was a cross-sectional study, causal relationships could not be assessed; however, identifying risk factors may provide a better understanding of the natural history of foot deformities. This may, in turn, provide more information to formulate better preventive programs. We suggest that veteran status before 1990 is associated with an increased risk of some podiatric medical conditions, such as flatfoot deformity and arthritis.

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