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Prevalence of Foot and Ankle Conditions in a Multiethnic Community Sample of Older Adults

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The prevalence of foot and ankle disorders was determined in a community-based, multiethnic (non-Hispanic White, African American, and Puerto Rican) random sample of 784 community-dwelling adults aged 65 or more years in 2001–2002 in Springfield, Massachusetts. Overall, the five most common conditions were toenail disorders (74.9%), lesser toe deformities (60.0%), corns and calluses (58.2%), bunions (37.1%), and signs of fungal infection, cracks/fissures, or maceration between toes (36.3%); 30.9% had some tenderness to palpation of the foot or ankle, and 14.9% had ankle joint pain on most days in the past 4 weeks. Toenail conditions, fungal symptoms, and ulcers or lacerations were more common in men, while bunions and corns and calluses were more common in women ($p < 0.001$). Significant racial/ethnic differences, independent of education or gender, were found for the prevalence of most toe deformities and flat feet, as well as for corns and calluses, fungal signs, edema, ankle joint pain, tenderness to palpation, and sensory loss. Foot and ankle disorders are common in these older adults. Examination of their prevalence in different segments of the community may inform future studies to determine etiology and means of prevention.

aged; epidemiologic measurements; foot deformities; foot dermatoses; foot diseases; prevalence

Abbreviations: NHANES III, Third National Health and Nutrition Examination Survey; NHIS, National Health Interview Survey.

Foot and ankle conditions in older adults are associated with mobility and balance impairment, disability, falls, and fractures (1–5). Although these conditions are thought to be common among older adults, most epidemiologic studies have been conducted outside the United States (6–9) or with institutionalized, clinic-based, or convenience samples (10–14). The National Health Interview Survey (NHIS) includes questions on bunions, corns and calluses, and "toenail problems," and the 1990 NHIS included a podiatry supplement with questions on foot infections, arthritis, and orthopedic conditions (15, 16). However, these data were based on self-report alone, which is of questionable validity in estimating the prevalence of foot conditions (7, 17). Furthermore, the 1988–1994 Third National Health and Nutrition Examination Survey (NHANES III) assessed only two foot conditions, hammer toe and bunion (18). While some studies have examined foot and ankle conditions in homeless populations (13, 17, 19, 20) or high-risk groups such as diabetics (21–23), we are not aware of any comprehensive assessments of foot and ankle conditions in a representative community sample in the United States.

We report prevalence estimates of selected foot and ankle conditions based on examination of 784 older adults from a community-based sample in the northeastern United States.

MATERIALS AND METHODS

Feet First is a study designed to determine the prevalence and correlates of foot and ankle conditions and pain in a random sample of community-dwelling, older (aged ≥65 years) adults. Springfield, Massachusetts, was chosen because of its size (population, about 152,000) and socioeconomic and racial/ethnic diversity (13 percent of adults aged ≥65 years identified as Black or African American and 7 percent as Hispanic or Latino in the 2000 US Census). Based on screening data from this study, about 93 percent of the

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TABLE 1. Contact, response, cooperation, and refusal rates, Springfield, Massachusetts, 2001–2002

	Formula*	%
Contact rate	$(I + P + R + O)/(I + P + R + O + e(U))$	59
Cooperation rate	$(I + P)/(I + P + R + O)$	42
Response rate	$(I + P)/(I + P + R + O + e(U))$	25
Refusal rate	$R/(I + P + R + O + e(U))$	31

* *I*, complete interviews (n = 784); *P*, partial interviews (n = 138); *R*, refusals (n = 1,153); *O*, known eligible but not interviewed (n = 123); *U*, unknown eligibility (n = 2,240); *e*, estimated eligible proportion of sampling frame (0.6873).

Springfield Hispanic/Latino population is of Puerto Rican ethnicity.

Sampling and recruitment

The sampling frame consisted of individuals born on or before July 31, 1935, and residing in Springfield as identified by Medicare beneficiary files and the Springfield town census. The town census list was used to supplement the Medicare list to better capture elders of Puerto Rican ethnicity, those not vested in Social Security, or those who had moved recently. Institutional residences other than assisted living facilities were excluded. Probable race (to define sampling strata) was obtained from Medicare beneficiary files. Probable Puerto Rican names were identified by staff of the Spanish-American Union, a local community organization. To provide meaningful gender and racial/ethnic comparisons, we conducted simple random sampling within eight gender (male, female) and probable racial/ethnic (White/non-Hispanic, Black/African American, Puerto Rican, other/unknown) strata.

The final sample included 7,755 names. Telephone numbers were found for about half. Mailings to those without phone numbers included a reply card for respondents to return contact information. Efforts were made to reach those without telephones by sending interviewers to their homes. Mailings were followed by a telephone eligibility screen. The criteria were the following: aged 65 or more years; noninstitutional (Springfield) residence; having at least one foot; not bed or chair bound; race/ethnicity of either Puerto Rican (for Hispanics/Latinos), African-American, or White (Caucasian) (for non-Hispanics/Latinos) descent; and ability to communicate in either English or Spanish. Respondents unable to understand or communicate with interviewers for health reasons were asked to name a proxy respondent, preferably from the same household. Those who could not provide a willing proxy were excluded.

Of the sample, 33 percent were ineligible, 19 percent refused screening, and 29 percent could not be contacted after multiple attempts. Of those eligible and contacted (n = 1,062), 922 completed screening and an initial interview. Contact, cooperation, response, and refusal rates were calculated according to methodology of the American Association for Public Opinion Research (24) (table 1). Eligibility rates in those unable to be contacted or who refused screening were assumed to be the same as those of similar gender and presumed racial/ethnic strata who were screened.

A total of 784 individuals completed the entire study that included the following:

- a short telephone interview, including a Foot Health Status Questionnaire (25) and questions on current and/or usual occupation;
- in-home interview, with questions on pain and comorbid conditions; and
- in-home examination, including assessments of dermatologic conditions, toe or arch deformities, pain and tenderness, edema, sensory loss, height, and weight.

Interviewers and examiners underwent certification, including the standard quality assurance measures used by the New England Research Institutes. Examiners had clinical backgrounds (two nurses, a graduate physician, and a certified medical assistant) and underwent extensive training under the direction of clinical consultants (M. G. C., J. J. K., D. T. F.).

Examination components

The dermatologic conditions assessed included discrete, raised calluses and corns; cracks or fissures; maceration between the toes; fungal or other infections or rashes; thickened, elongated, or ingrown toenails; ulcers or lacerations; and excessively dry skin.

The orthopedic examination was conducted with the examinee in a standing, weight-bearing position. The conditions assessed were great-toe deformities (bunions, cock-up hallux (plantarflexion of the interphalangeal joint, with dorsiflexion of the metatarsal phalangeal joint)); lesser-toe deformities (including hammer (plantarflexion of the proximal interphalangeal joint), mallet (plantarflexion of the distal interphalangeal joint), and claw (plantarflexion of both interphalangeal joints) toes), overlapping toes, and bunionette or Taylor's bunion (prominence at the lateral aspect of the fifth metatarsal head with the fifth toe deflected to varus); missing toe (amputations); and arch deformities, including flat foot (pes planus) and high arch (pes cavus). Flat foot was considered present if the examiner was unable to insert his/her fingers under the arch of the foot with the respondent in a standing position. High arch was considered present if the examiner could insert his/her fingers all the way underneath the arch to the lateral edge of the foot.

Ankle/foot joint pain was determined by asking participants if they had pain or discomfort in any of their joints on most days during the past 4 weeks. Those answering "yes" were asked to point to each painful location on a diagram with joint locations indicated by circles; indication of one or both ankle/foot regions was counted as a positive response. Tenderness to palpation was assessed for plantar fascia, plantar heel pad, each metaphalangeal joint, each interdigital space, Achilles tendon, lateral ankle ligaments, and just behind and below the medial malleolus.

Edema in the ankle region assessed by visual inspection and palpation was graded as "none," "visually swollen," "pitting," or "marked" (massive swelling and pitting).

TABLE 2. Characteristics of the study population (unweighted) showing demographics and prevalence of selected comorbidities, Springfield, Massachusetts, 2001–2002

	Puerto Rican	Non-Hispanic White	African American	Total
Males (no. (%))	45 (41)	153 (47)	141 (41)	339 (43)
Females (no. (%))	64 (59)	174 (53)	207 (59)	445 (57)
Total (no. (%))	109 (14)	327 (42)	348 (44)	784 (100)
Age (mean years (standard deviation))	73.2 (4.93)	75.3 (6.11)	74.2 (6.19)	74.5 (6.03)
Education: high school graduate or postgraduate (no. (%))	12 (11.1)	267 (81.6)	189 (54.8)	468 (60.0)
Obesity (no. (%))*	46 (43.8)	93 (29.6)	150 (45.3)	289(38.5)
Diabetes (no. (%))	58 (53.2)	60 (18.4)	123 (35.3)	241 (30.7)
Arthritis (no. (%))	76 (69.7)	165 (50.6)	212 (60.9)	453 (57.9)
Lower extremity vascular conditions (no. (%))†	78 (72.2)	125 (38.8)	150 (43.2)	353 (45.4)

* Body mass index of ≥30 kg/m^2.
† History of blood clots, varicose veins, claudication, or other lower extremity vascular conditions.

Edema graded as pitting or marked was considered to be clinically significant. Loss of sensation was determined by testing four locations on each plantar surface (medial and lateral forefoot, medial and lateral heel) with a 10-g force using a Semmes-Weinstein 5.07 monofilament (Bailey Instruments, Ltd., Manchester, United Kingdom) with the subject's eyes closed. A sham test was also performed, where the examiner asked, "Did you feel that?", without actually touching the monofilament to the foot. Inability to feel any of the actual tests, or positive response to the sham test, was counted as loss of sensation.

Statistical methods

Prevalence estimates are weighted to reflect the demographics of Springfield in 2000. The sampling weights are proportional to the inverse of the probability of selection given the individual's initial stratum. To evaluate whether foot disorders differed by gender, race/ethnicity, or education, we included appropriate indicator variables in logistic regression models. For example, if the indicator variable "female" was nonsignificant, foot disorders were assumed not to vary by gender. In the case of racial/ethnic group comparison, least significant difference multiple comparisons (26) (a method of determining differences using multiple comparisons) are given indicating which groups are different. When a condition was not present in one demographic group, analysis of variance was used to test equality of prevalence estimates by demographic category, since logistic regression does not work with a zero cell. The analyses were also repeated to test equality when adjusting for other demographic variables. Analysis of variance was used to test whether the number of orthopedic, dermatologic, and other conditions differed by demographic group.

RESULTS

Study population

The study population used to generate the following estimates (n = 784) (table 2) had a mean age of 74.5 (range, 65–101) years. The male/female ratio was similar across racial/ethnic strata, but educational attainment was not: non-Hispanic Whites were more likely, and Puerto Ricans least likely, to have completed high school. The proportion of comorbid conditions varied by race/ethnicity, most markedly for diabetes and lower extremity vascular conditions.

Dermatologic conditions

Dermatologic conditions are shown in table 3. Nearly three fourths of these older adults had some type of toenail condition, including thickened, elongated, and ingrown nails. Over half had corns or calluses, and over a third had fungal and related symptoms, including signs of fungal infection, cracks or fissures, and maceration between toes. Thickened toenails, cracks and fissures, maceration, and ulcers or lacerations were more common in men, while corns and calluses were more common in women. None of these conditions differed in prevalence by education when adjusting for gender and race/ethnicity (data not shown), but all showed differences by race/ethnicity that persisted when adjusting for gender and education (adjusted estimates not shown).

Orthopedic conditions

Orthopedic conditions are shown in table 4. Lesser-toe deformities were seen in 60 percent overall, with hammer toe and mallet toe most common, followed by claw toe and bunionette. The only lesser-toe deformity to differ by gender was claw toe, which was more common in women. All lesser-toe disorders were less common in Puerto Ricans than in non-Hispanic Whites or African Americans, a finding that persisted after adjusting for education and gender. The magnitude of the racial/ethnic differences was considerable: "any" lesser-toe deformity was found in only 8.9 percent of Puerto Ricans compared with 60.8–63.6 percent of African Americans and non-Hispanic Whites, respectively.

Bunions were nearly twice as frequent in women as in men and more common in African Americans than in others (table 4).

TABLE 3. Estimates of the population prevalence of dermatologic conditions, Springfield, Massachusetts, 2001–2002

	Total (%) (mean (standard error))	By gender			By race/ethnicity			
		Men (%)	Women (%)	*p* value	Puerto Rican (%)	Non-Hispanic White (%)	African American (%)	*p* value
Thickened, elongated, or ingrown toenails	74.9 (2.1)	85.0	68.7	<0.001	69.5	74.3	80.6	0.040*
Thickened nails	65.2 (2.3)	74.8	59.3	<0.001	62.1	63.8	74.8	0.003†
Elongated nails	40.4 (2.3)	46.0	37.0	0.052	30.0	40.6	44.2	0.075
Ingrown nails	7.4 (1.2)	7.2	7.5	0.913	12.8	6.9	8.0	0.154
Corns/calluses	58.2 (2.3)	45.7	65.9	<0.001	34.1	58.0	70.0	<0.001‡
Fungal infection, cracks/fissures, maceration	36.3 (2.2)	45.9	30.4	0.001	50.6	34.2	42.8	0.010§
Fungal infection or rash	22.4 (1.9)	24.9	20.9	0.293	47.5	20.1	25.3	<0.001¶
Cracks/fissures	14.0 (1.5)	20.9	9.7	<0.001	1.6	14.0	19.0	0.009#
Maceration between toes	3.2 (0.7)	5.7	1.6	0.005	10.6	2.2	5.6	0.002§
Dry skin	13.7 (1.5)	15.3	12.8	0.419	19.6	11.7	23.2	0.001§
Ulcers/lacerations	4.2 (0.8)	7.9	1.9	0.003	0.0	4.1	6.8	0.107

* (African American > Puerto Rican); (African American, Puerto Rican) = non-Hispanic White.
† African American > (non-Hispanic White, Puerto Rican).
‡ African American > non-Hispanic White > Puerto Rican.
§ (Puerto Rican, African American) > non-Hispanic White.
¶ Puerto Rican > (African American, non-Hispanic White).
# (African American, non-Hispanic White) > Puerto Rican.

Overall, 19.0 percent had flat feet (pes planus), and 5.2 percent had high arches (pes cavus). The prevalence of flat feet did not differ by gender or education but was greatest in African Americans, followed by non-Hispanic Whites and Puerto Ricans. High arch was more common in women than in men but did not differ by race/ethnicity or education.

Pain and tenderness

Overall, 14.9 percent reported ankle joint pain, and 30.9 percent had some tenderness to palpation (table 5), with metaphalangeal joints and interstitial spaces the sites most likely to be tender. No gender differences were seen in any of the pain/tenderness measures. The prevalence of ankle

TABLE 4. Estimates of the population prevalence of orthopedic conditions, Springfield, Massachusetts, 2001–2002

	Total (%) (mean (standard error))	By gender			By race/ethnicity			
		Men (%)	Women (%)	*p* value	Puerto Rican (%)	Non-Hispanic White (%)	African American (%)	*p* value
Any lesser-toe deformity	60.0 (2.3)	59.0	60.5	0.743	8.9	63.6	60.8	<0.001*
Hammer toe	34.5 (2.3)	37.3	32.8	0.325	2.8	37.1	33.4	<0.001*
Mallet toe	33.4 (2.3)	29.4	35.9	0.142	3.6	35.6	33.8	<0.001*
Claw toe	8.7 (1.4)	5.2	10.8	0.035	0.0	9.1	10.2	<0.001*,†
Bunionette	13.2 (1.7)	14.0	12.7	0.708	2.5	14.4	10.7	0.019*
Overlapping toes	15.6 (1.8)	13.6	16.9	0.349	2.1	17.2	12.5	0.001*
Missing toes	0.5 (0.3)	0.2	0.8	0.132	0.0	0.4	1.5	0.090†
Bunion	37.1 (2.3)	25.3	44.3	<0.001	26.6	36.4	45.6	0.003‡
Hammer toe (great toe)	0.7 (0.4)	0.8	0.6	0.814	0.0	0.7	0.8	0.060†
Cock-up hallux	0.7 (0.4)	0.7	0.7	0.973	0.0†	0.7	0.8	0.063
Flat feet	19.0 (1.8)	17.2	20.1	0.421	3.9	17.6	34.0	<0.001§
High arch	5.2 (1.2)	2.4	7.0	0.034	4.6	5.8	2.0	0.037

* (African American, non-Hispanic White) > Puerto Rican.
† *p* values from analysis of variance due to zero cell for Puerto Ricans.
‡ African American > (non-Hispanic White, Puerto Rican).
§ African American > non-Hispanic White > Puerto Rican.

TABLE 5. Estimates of the population prevalence of pain and tenderness, Springfield, Massachusetts, 2001–2002

	Total (%) (mean (standard error))	By gender			By race/ethnicity			
		Men (%)	Women (%)	*p* value	Puerto Rican (%)	Non-Hispanic White (%)	African American (%)	*p* value
Ankle joint pain	14.9 (1.6)	14.1	15.3	0.695	44.7	12.2	17.5	<0.001*
Tenderness to palpation, any	30.9 (2.2)	26.0	33.9	0.066	50.2	28.9	33.9	0.002*
Tenderness by site: metaphalangeal joint(s)	20.2 (1.9)	17.9	21.7	0.317	15.8	20.2	22.0	0.376
Interstitial spaces	16.8 (1.8)	15.2	17.8	0.448	9.3	16.6	21.5	0.012†
Plantar fascia	6.9 (1.1)	6.4	7.2	0.688	25.8	5.6	6.4	<0.001*
Plantar heel pad	4.2 (0.8)	3.9	4.3	0.809	25.2	2.7	3.5	<0.001*
Ankle ligament or medial malleolus	11.6 (1.4)	9.0	13.2	0.121	35.4	9.3	14.9	<0.001‡

* Puerto Rican > (African American, non-Hispanic White).
† (African American > Puerto Rican); (African American, Puerto Rican) = non-Hispanic White.
‡ Puerto Rican > African American > non-Hispanic White.

pain and tenderness at all sites except the metaphalangeal joints differed by race/ethnicity, independent of education or gender, with Puerto Ricans having the highest rates of ankle joint pain and tenderness at most sites.

Edema and sensory loss

Estimates of the population prevalence of edema and sensory loss are shown in table 6. Signs of edema were present in 26.4 percent of respondents, with pitting or marked pitting in 9 percent. Signs of sensory loss were found in 8.3 percent overall, in 18.5 percent of diabetics, and in 5.2 percent of nondiabetics. The prevalence of sensory loss in men was double that in women. This gender difference was not observed in diabetics but was even more pronounced in nondiabetics, with sensory loss in 10.3 percent of men compared with 2.1 percent of women. The prevalence of sensory loss was 3–4 times higher in Puerto Ricans than in other racial/ethnic groups. This difference remained after adjusting for gender and education (data not shown). While the ethnic difference was attenuated in diabetics, it was even more pronounced in nondiabetics, with sensory loss affecting 23.2 percent of Puerto Ricans compared with 4.2 percent and 6.9 percent of non-Hispanic Whites and African Americans, respectively (table 6). Again, the difference persisted after adjusting for gender and education (data not shown).

Number of conditions

An analysis of the conditions present per person, by demographic factors, is reported in table 7. Study participants had an average of 4.0 foot or ankle conditions, 1.5 dermatologic conditions, 1.7 toe or arch conditions, and three toes with deformities. Compared with men, women had more toe and arch conditions and toes with deformities. Puerto Ricans had fewer toe and arch conditions and toes with deformity than did the other groups, and African Americans had the highest mean number of dermatologic conditions and total number of any type of condition ($p < 0.001$). These differences remained when adjusting for gender and education.

DISCUSSION

Although the prevalence of foot and ankle conditions was high in this community-based population of elders, the rates for most conditions did not differ dramatically from those reported in similar community-based studies of older adults

TABLE 6. Estimates of the population prevalence of edema and sensory loss, Springfield, Massachusetts, 2001–2002

	Total (%) (mean (standard error))	By gender			By race/ethnicity			
		Men (%)	Women (%)	*p* value	Puerto Rican (%)	Non-Hispanic White (%)	African American (%)	*p* value
Any edema	26.4 (2.1)	22.6	28.8	0.139	12.2	26.5	32.3	<0.001*
Significant edema	9.0 (1.4)	10.6	8.0	0.353	2.1	9.5	9.3	0.028*
Sensory loss	8.3 (1.2)	12.1	5.9	0.017	27.7	6.6	9.3	<0.001†
Diabetics	18.5 (3.6)	17.4	19.2	0.789	31.8	17.3	13.6	0.036‡
Nondiabetics	5.2 (1.1)	10.3	2.1	0.001	23.2	4.2	6.9	0.003†

* (African American, non-Hispanic White) > Puerto Rican.
† Puerto Rican > (African American, non-Hispanic White).
‡ Puerto Rican > African American; (Puerto Rican, African American) = non-Hispanic White.

TABLE 7. Mean number of conditions present per person, by demographic factors, Springfield, Massachusetts, 2001–2002

	Total (no.) (mean (standard error))*	By gender			By race/ethnicity			
		Men (no.)	Women (no.)	*p* value	Puerto Rican (no.)	Non-Hispanic White (no.)	African American (no.)	*p* value
Any condition	4.0 (0.10)	3.8	4.1	0.073	3.2	4.0	4.7	<0.001†
Dermatologic conditions‡	1.5 (0.04)	1.6	1.5	0.157	1.3	1.5	1.9	<0.001§
Toe and arch conditions¶	1.7 (0.07)	1.4	1.8	0.004	0.5	1.7	1.8	<0.001#
Toes with deformity	3.0 (0.13)	2.6	3.2	0.027	0.7	3.1	3.4	<0.001#

* Total includes dermatologic and toe/arch conditions, plus any edema, any sensory loss, ankle joint pain, or any tenderness to palpation.
† African American > non-Hispanic White > Puerto Rican.
‡ Dermatologic conditions include toenail conditions, corns/calluses, any sign of fungal infection (including cracks/fissures/maceration), dry skin, and ulcers/lacerations.
§ African American > (non-Hispanic White, Puerto Rican).
¶ Toe and arch conditions include bunion, hammer toe, mallet toe, claw toe, overlapping toe, bunionette, flat foot, or high arch.
# (African American, non-Hispanic White) > Puerto Rican.

in the United Kingdom and Italy. For example, the rates of thickened toenails ranged from 30 to 66 percent (7, 8, 27), with 47 percent for ingrown nails and 19 percent for "other" toenail conditions (7), compared with 75 percent for any toenail condition in this study. Comparable or bracketing rates from other studies were also seen for lesser-toe deformities (7), overlapping toes (27), bunions (7, 27), and edema (7, 8).

The 1988–1994 NHANES III examination (18) found a prevalence of hammer toe similar to that of Feet First for Black men and women and White women, but somewhat lower for Black men (29 percent compared with 40 percent), and higher rates for bunion than those seen in Feet First (40–64 percent compared with 25–55 percent). NHANES III assessed these conditions with the examinee in a seated, nonweight-bearing position, in contrast to Feet First.

In those aged 65 or more years, the 1990 NHIS (28) reported a lower prevalence for "trouble with bunions" (34.6/1,000) and "trouble with corns or calluses" (47.1/1,000) than we found. This discrepancy is likely due to both the self-report methodology and the wording of questions (NHIS asked, "Do you have trouble with bunions?" instead of "Do you have bunions?").

Studies that included clinical evaluations of more specialized populations in the United States have found results in the same general range as ours (13). Others have also found bunions, corns, and calluses to be more common in women (6, 8, 13, 27, 28). Women's footwear is often suggested as a reason. Increasing heel height increases forefoot peak pressure and shifts the location of peak pressure to the hallux (29). Bunions are reported to be unknown in Japan prior to the introduction of Western footwear fashions (30). However, the near universality of past high-heel use among the current generation of older women in the United States makes it difficult to find an association between past footwear and current foot disorders (31). In our study, fewer than 2 percent of the women had current "most often worn" shoes with heels higher than 5 mm, and none had shoes with heels greater than 12 mm in height, but 80 percent reported regular past use of high heels at some point in their lives.

One unexpected finding was the minimal association of condition prevalence with education compared with race/ethnicity. Even after adjusting for education and gender, we found that a number of conditions were more common in certain racial/ethnic groups. This could be due to different levels of access to health care, different rates of chronic conditions (such as diabetes, obesity, or vascular disease) (table 2) possibly associated with foot ailments, early life experiences, or occupational patterns that differ among racial/ethnic groups independently of education. For example, the striking racial/ethnic differences in the prevalence of sensory loss in nondiabetics could be related to the different rates of diabetes risk factors and levels of access to health care, resulting in different rates of undiagnosed diabetes across racial/ethnic groups. Whatever the reasons, these data indicate racial/ethnic disparities in the prevalence of foot and ankle conditions in older adults. Further investigation of these disparities may shed light on etiologic factors.

Study limitations

With regard to the response rate, conservative assumptions were used to calculate it, especially regarding the estimated eligible proportion of the sampling frame (*e*). Had less conservative estimates been used (such as the calculator "default" of the American Association for Public Opinion Research (24)), cooperation and response rates would have increased to 69 and 35 percent, respectively, but refusal rates would have reflected only those who refused further interviews after screening (1.4 percent) and thus been unrealistically low. The sample frame also likely included the names of ineligible (moved or deceased) individuals for whom corroborating information could not be obtained. This assumption is based on the fact that the sampling frame included the names of 22,784 potentially eligible adults aged 65 or more years in Springfield, while the 2000 US Census reported a population of only 18,906 adults aged 65 or more years. Our response rate calculations assume a similar proportion of eligible respondents among those unable to be contacted as for those contacted and screened. If there were

a greater proportion of ineligible respondents among the "no contacts," it could result in an artificially low response rate. Certain positive aspects of this study—use of a community-based rather than a convenience sample, inclusion of individuals without phone numbers to ensure demographic diversity, and extensive (lengthy) data collection—may also have reduced response rates, as may lack of resources to offer monetary incentives for participation. For those who were contacted, the primary barrier to participation was unwillingness to be screened. Some expressed fear of dishonest sales practices, or they had been instructed by family members not to speak to strangers on the phone.

Since low response rates affect study validity only if those interviewed differ systematically from those not interviewed in matters germane to the study, we compared some parameters of our study population with NHANES III data (18) for Black/African-American and non-Hispanic White US adults aged 65 or more years, to estimate comparability with this national sample. The median age difference was minimal (<0.8 years) for African-American men and women, 1.5 years for non-Hispanic White women, and 3 years for non-Hispanic White men. The difference in mean height between samples ranged from 0 cm (non-Hispanic White women) to 1.5 cm (African-American women). The mean weight for our study sample was 6.2–8.2 kg higher in African-American men and women and 3.1–3.8 kg higher in White men and women, likely because of trends of increasing body weight in the United States between 1988–1994 (NHANES III) and 2001–2002 (Feet First) (32).

These data demonstrate that many foot and ankle conditions are widespread in older adults. While some of the most prevalent conditions might not be considered serious or worthy of medical attention (33), they may contribute to more serious problems. Thickened toenails can be painful and may impede personal hygiene (34), and fungal infection may indicate a compromised immune system (35). Corns and calluses may lead to focal pressure points that contribute to the risk of ulcers (36, 37). Any foot condition resulting in pain or discomfort or creating barriers to obtaining well-fitting, comfortable shoes may increase the risk of activity limitation, falls, and decreased quality of life for older adults.

We hope these data will promote an awareness of foot health among heath-care providers to older patients and encourage additional research into the etiology and prevention of foot and ankle disorders.

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