Determinants of Disabling Foot Pain in Retirement Village Residents

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The aim of this study was to evaluate the relative contribution of structural foot characteristics and comorbidities to the presence of disabling foot pain in older people. One hundred seventy-two people (55 men and 117 women) aged 62 to 96 years (mean ± SD, 80.1 ± 6.4 years) who lived in a retirement village underwent tests of foot posture, range of motion, and deformity in addition to completing a medical history questionnaire. Disabling foot pain was determined using the Manchester Foot Pain and Disability Index. Thirty-eight subjects (22%) reported disabling foot pain. Subjects with disabling foot pain had a higher body mass index and were more likely to be female; to report osteoarthritis in the spine, hips, hands or wrists, and feet; and to report pain in the back, hips, and hands or wrists. The only significant difference between the groups regarding structural foot characteristics was that those with disabling foot pain exhibited more severe hallux valgus deformity. The strongest determinants of disabling foot pain revealed by a discriminant function analysis were foot osteoarthritis, pain in the hips, and pain in the hands or wrists. These findings indicate that disabling foot pain in older people is more closely related to pain and osteoarthritis in other body regions than to structural characteristics of the foot, and they suggest that more severe forms of foot pain in older people may be a component of a general chronic pain syndrome or a polyarticular form of osteoarthritis. (J Am Podiatr Med Assoc 95(6): 573-579, 2005)

Advancing age is often associated with pathologic changes in the feet. Epidemiologic studies[1-4] report very high prevalence rates, generally in the range of 60% to 80%, for common conditions such as corns, calluses, and toe deformities. A range of these foot conditions have been associated with impaired gait,[5-7] problems with balance,[6] decreased ability to perform activities of daily living,[8, 9] and increased risk of falls.[10, 11] However, the prevalence of foot pain in older people is far lower, generally 20% to 30%,[1, 4, 12-14] which suggests that structural foot abnormalities may not be accurate predictors of the development of symptoms.

Despite this observation, relatively few studies have been undertaken to determine which factors predispose older people to the development of foot pain. In a study of 459 people older than 65 years, Benvenuti et al[1] reported that foot pain when standing or at rest was significantly associated with the presence of calluses and corns, hallux valgus, lesser-toe deformities, and edema. In contrast, Leveille et al[3] did not find an association between foot pain and toe deformities in 1,002 women aged 65 years and older; however, their definition of foot pain included only those subjects who reported severe pain (7–10 on a visual analog scale) that was present for at least

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1 month. Factors strongly associated with foot pain were obesity, edema, and osteoarthritis in the knees or hands, suggesting that foot pain generally occurred as part of a more generalized pain syndrome. These findings were confirmed by Gorter et al,[5] who reported significant associations between foot pain that was present for at least 1 month and self-reported osteoarthritis in the feet or another region of the body in 7,200 people aged 65 years and older.

The suggestion that foot pain in older people may be part of a generalized chronic pain syndrome or generalized arthritic condition warrants further investigation because it may help explain the significant disparity between reported symptoms and observed conditions, and it may provide further insights into the management of this common problem. Therefore, the aim of this study was to determine the relative contribution of a wide range of structural foot characteristics (such as foot lesions, toe deformity, joint range of motion, and posture) and comorbidities to the presence of disabling foot pain in older people. We hypothesized that a combination of foot characteristics and chronic medical conditions would be significant determinants of disabling foot pain.

Methods

Subjects

The study sample comprised 172 individuals (55 men and 117 women) aged 62 to 96 years (mean ± SD, 80.1 ± 6.4 years) who lived in a retirement village. A total of 151 subjects resided in independent-living units, and 21 resided in serviced apartments. Residents in serviced apartments attended a communal dining room for all meals and had their rooms maintained by staff; however, all were independent in dressing, bathing, and toileting. Residents were deemed ineligible for the study if they were unable to walk household distances without an assistive device, scored less than 7 on the Short Portable Mental Status Questionnaire,[15] or had a history of any diffuse connective-tissue disease (rheumatoid arthritis, fibromyalgia, polymyalgia rheumatica, and systemic lupus erythematosus) or systemic pain syndrome. Age and sex data were available for residents who did not volunteer to participate in the study. Nonparticipants were of similar age (mean ± SD, 80.1 ± 7.3 years) and sex (38% men) as participants. The Human Studies Ethics Committee at La Trobe University gave approval for the study, and written informed consent was obtained from all subjects before participation.

Medical History Questionnaire

Age, medication use, medical history, and pain location were determined by means of an interviewer-administered questionnaire. The medical history questionnaire required subjects to select from a list of 15 common conditions. Subjects who reported a history of osteoarthritis were also requested to report the location of their osteoarthritis (back, hips, knees, hands or wrists, or feet).

Foot and Ankle Assessment

All assessments were performed by a single examiner. Foot posture was assessed using three techniques: the Foot Posture Index, the arch index, and navicular height. The Foot Posture Index involved the rating of eight criteria with the subject standing bipedally. Each of these criteria was scored on a 5-point scale (range, –2 to +2), and the summed score provided a single index of the degree of the pronated/supinated posture of the foot.[16] To calculate the arch index, static footprints were obtained using carbon-paper imprint material with the subject standing in a relaxed position. Using a computer graphics tablet and graphics software, the arch index was calculated as the ratio of the area of the middle third of the footprint to the entire footprint area (ignoring the toes).[17] The lower the arch, the higher the arch index.[18] Navicular height was measured in millimeters while the subject was fully weightbearing, and it was then corrected for differences in foot size by dividing it by the length of the foot.[19]

Two measures of foot and ankle range of motion were obtained. Ankle flexibility was measured in degrees using a modified version of the weightbearing lunge test.[19] The lateral malleolus and head of the fibula were first located and marked with an ink pen. The subject then stood with the right foot placed alongside a vertically aligned clear acrylic plate inscribed with 2° protractor markings and was instructed to take a comfortable step forward with the left leg. In this position, the subject was instructed to bend the knees to squat down as low as possible, without lifting the right heel from the ground and while keeping the trunk upright. The position of the fibular head was marked on the clear acrylic plate, and the angle formed between the lateral malleolus and the fibular head was measured. The test was completed three times, and the highest score was documented as the test result.[19] First metatarsophalangeal joint range of motion was measured in a nonweightbearing position using a goniometer while the examiner maximally extended the hallux. The value

recorded was the maximum angle at which the hallux could not be passively moved into further extension.[20]

The presence and severity of hallux valgus was determined using the Manchester Scale.[21] This instrument consists of standardized photographs of feet used to determine the four grades of hallux valgus: none, 0; mild, 1; moderate, 2; and severe, 3. An overall measure of hallux valgus severity was determined by summing the scores for the right and left feet. The presence of lesser-digital deformities (hammer toes and claw toes), corns, and calluses was determined according to previously published criteria,[6] and a sum of the total number of each of these abnormalities for both feet was documented.

The reliability of these foot and ankle assessments when performed on older people has been established previously,[19, 22] with the exception of the Foot Posture Index and first metatarsophalangeal joint range of motion. To determine the reliability of these assessments, 1-month retests were performed on 24 subjects randomly selected from the sample. The reliability was found to be excellent for first metatarsophalangeal joint range of motion (intraclass correlation coefficient [ICC], 0.85; 95% confidence interval [CI], 0.68–0.93) and moderate for the Foot Posture Index (ICC, 0.61; 95% CI, 0.28–0.81).[23]

Foot Pain Assessment

Disabling foot pain was assessed using the previously validated Manchester Foot Pain and Disability Index.[24] This index is a 19-item questionnaire with four subscales that represent ambulation difficulty, pain, personal appearance, and difficulties with work or leisure activities. A case definition of disabling foot pain according to Garrow et al[25] was used, which required subjects to have had pain at some stage in the past month and current foot pain and to have marked at least one disability item on the Manchester Foot Pain and Disability Index. Location and duration of pain were also documented.

Statistical Analysis

All statistical tests were conducted using SPSS, version 11.5 for Windows (SPSS Science, Chicago, Illinois). For continuously scored variables, independent-samples *t*-tests were performed to compare mean values between subjects with and without disabling foot pain. For dichotomous variables, χ^2 tests and unadjusted odds ratios (ORs) were used. Factors found to be significantly associated with disabling foot pain were then entered into a stepwise discriminant function analysis model to determine which variables were the most important determinants of disabling foot pain.

Results

Prevalence and Patterns of Disabling Foot Pain

Thirty-eight subjects (22%) reported disabling foot pain. The most common site of pain was the plantar metatarsophalangeal joints (18 subjects), followed by the toes (11), ankle (11), medial arch (4), dorsum of the foot (3), and heel (2). Two subjects reported a generalized pain over the entire plantar surface of their feet. The median duration of pain was 4 years.

Associations Among Disabling Foot Pain, Subject Characteristics, and Medical Conditions

Subject characteristics and the prevalence of medical conditions for subjects with and without disabling foot pain are given in Table 1. Subjects with disabling foot pain were more likely to be female (χ^2 = 5.89; P = .015; OR, 3.08; 95% CI, 1.20–7.87), had a higher body mass index (t_{170} = –2.16; P = .032), and were more likely to have any form of osteoarthritis (χ^2 = 7.22; P = .007; OR, 4.79; 95% CI, 1.39–16.49): osteoarthritis in the spine (χ^2 = 13.00; P < .001; OR, 3.99; 95% CI, 1.83–8.74), hips (χ^2 = 5.45; P = .020; OR, 2.47; 95% CI, 1.14–5.35), hands or wrists (χ^2 = 12.72; P < .001; OR, 3.80; 95% CI, 1.78–8.13), and feet (χ^2 = 39.86; P < .001; OR, 11.31; 95% CI, 4.91–26.04).

Associations Between Disabling Foot Pain and Pain at Other Body Regions

The prevalence of pain at other body regions for subjects with and without disabling foot pain is given in Table 2. Every subject with disabling foot pain reported pain at another body region, compared with 63% of those without disabling foot pain (χ^2 = 19.00; P < .001). Subjects with disabling foot pain were more likely to report pain in the back (χ^2 = 6.24; P = .012; OR, 2.54; 95% CI, 1.21–5.35), hips (χ^2 = 16.70; P < .001; OR, 4.90; 95% CI, 2.20–10.94), and hands or wrists (χ^2 = 18.39; P < .001; OR, 5.09; 95% CI, 2.33–11.14).

Associations Between Disabling Foot Pain and Foot and Ankle Characteristics

Differences in foot and ankle characteristics between subjects with and without disabling foot pain are given in Table 3. The only variable that signifi-

Table 1. Demographics and Medical History of Subjects With and Without Disabling Foot Pain

	No Disabling Foot Pain (n = 134)	Disabling Foot Pain (n = 38)	Total (N = 172)
Age (mean [SD]) (years)	80.03 (6.51)	80.16 (6.22)	80.06 (6.43)
Female (No. [%])[a]	85 (63)	32 (84)	117 (68)
Body mass index (mean [SD]) (kg/m^2)[a]	26.29 (4.01)	27.96 (4.88)	26.66 (4.26)
Medications (mean [SD]) (No.)	4.74 (3.06)	5.84 (3.32)	4.98 (3.15)
Cancer (No. [%])	29 (22)	6 (16)	35 (20)
Peripheral vascular disease (No. [%])	30 (22)	8 (21)	38 (22)
Diabetes mellitus (No. [%])	5 (4)	13 (34)	18 (10)
Heart condition (No. [%])	47 (35)	13 (34)	60 (35)
Hypertension (No. [%])	75 (56)	27 (71)	102 (59)
Stroke (No. [%])	5 (4)	3 (8)	8 (5)
Osteoarthritis (No. [%])			
Any site[b]	95 (71)	35 (92)	130 (76)
Spine[b]	51 (38)	27 (71)	78 (45)
Hips[a]	28 (21)	15 (39)	43 (25)
Knees	45 (34)	16 (42)	61 (35)
Hands or wrists[b]	45 (34)	25 (66)	70 (41)
Feet[b]	16 (12)	23 (61)	39 (23)

Note: Medical conditions reported by less than 5% of subjects are not included in the table.
[a]Significant at $P < .05$.
[b]Significant at $P < .01$.

Table 2. Prevalence of Pain in Subjects With and Without Disabling Foot Pain

Site	No Disabling Foot Pain (n = 134)	Disabling Foot Pain (n = 38)	Total (N = 172)
Any site[a]	84 (63)	38 (100)	122 (71)
Back[b]	54 (40)	24 (63)	78 (45)
Hips[a]	19 (14)	17 (45)	36 (21)
Knees	45 (34)	16 (42)	61 (35)
Hands or wrists[a]	22 (16)	19 (50)	41 (24)

Note: Data are given as number (percentage).
[a]Significant at $P < .01$.
[b]Significant at $P < .05$.

cantly differed between the two groups was the severity of hallux valgus ($t_{170} = -2.15$; $P = .036$).

Discriminant Function Analysis

After entering those variables with significant associations with disabling foot pain into a stepwise discriminant function analysis, three variables were found to be significant independent predictors of disabling foot pain: osteoarthritis in the feet (standardized canonical coefficient = 0.75), pain in the hips (0.45), and pain in the hands or wrists (0.33). Sex and body mass index were not found to be significant independent predictors of disabling foot pain. This combination of variables classified subjects into the disabling foot pain or no disabling foot pain group with an accuracy of 82.6% following validation (Wilks $\lambda = 0.69$; $P < .001$).

Discussion

This study examined the relative contribution of structural foot characteristics and comorbidities to the presence of disabling foot pain in retirement village residents. The case definition of foot pain required that subjects had current pain, pain for at least 1 month, and pain that interfered with their mobility. This definition was used to enable comparisons to be made with previous applications of the Manchester Foot Pain and Disability Index.[25] However, this definition could be considered to represent the upper level of foot pain and disability in the sample, and, as such, the associations reported may not necessarily apply to older people with less severe pain or pain that does not affect mobility.

Consistent with previous investigations,[1, 4, 5, 25] women were more likely to report foot pain than men. The reasons for this skewed sex ratio are unclear; however, three explanations have been put forward. First, women exhibit higher rates of hallux valgus, lesser-toe deformities, corns, and calluses than men, and it is plausible that such conditions increase the likelihood of developing symptoms. However, the association between the presence of these conditions and symptoms is inconsistent.[3, 25] Second, it is

Table 3. Foot and Ankle Characteristics in Subjects With and Without Disabling Foot Pain

Characteristic	No Disabling Foot Pain (n = 134)	Disabling Foot Pain (n = 38)	Total (N = 172)
Foot posture			
Foot Posture Index	5.04 (4.59)	5.00 (5.23)	5.03 (4.72)
Arch index	0.24 (0.06)	0.24 (0.05)	0.24 (0.06)
Navicular height/foot length	0.10 (0.03)	0.11 (0.03)	0.10 (0.03)
Foot range of motion			
Ankle flexibility (°)	33.24 (10.86)	33.53 (10.90)	33.30 (10.84)
First metatarsophalangeal joint range of motion (°)	55.75 (16.98)	55.18 (16.89)	55.62 (16.91)
Foot deformity and lesions			
Hallux valgus severity[a]	1.74 (1.84)	2.50 (1.96)	1.91 (1.88)
No. of lesser-toe deformities	2.51 (2.41)	3.32 (2.78)	2.69 (2.51)
No. of corns	0.13 (0.52)	0.26 (0.76)	0.16 (0.58)
No. of calluses	1.30 (1.90)	2.42 (3.44)	1.55 (2.36)

Note: Data are given as mean (SD).
[a]Significant at $P < .05$.

possible that these underlying foot problems are exacerbated by tight-fitting footwear, which is common in older women owing to sex differences in shoe design.[26] Finally, the higher prevalence of foot pain in older women may simply reflect sex differences in pain tolerance in general, since women are also more likely to report musculoskeletal pain and pain interference at other body regions.[14]

Structural foot characteristics were, in general, poorly correlated with disabling foot pain in older people. This result is in contrast to that of Benvenuti et al,[1] who reported significant associations between pain and the presence of calluses and corns, hallux deformities, hammer toes, and edema in 459 older people. However, it is consistent with those of Leveille et al,[3] who found no association between foot pain and toe deformities in 1,002 older women, and Garrow et al,[25] who found no association between foot pain and nail problems, corns and calluses, verrucae, foot posture, hallux valgus, or lesser-toe deformities in a study of 281 people aged 18 to 80 years. These differences can be largely attributed to variations in case definitions of foot pain. The Benvenuti et al[1] definition included any pain when standing or at rest, which is likely to result in the positive classification of milder forms of foot pain than the definition used by Leveille et al[3] (pain scoring 7–10 on a visual analog scale that is present for at least 1 month) or that of the Manchester Foot Pain and Disability Index.[25]

The only structural foot variable found to be significantly associated with disabling foot pain in this study was hallux valgus severity. Hallux valgus is one of the most common foot problems in older people, and the resultant medial prominence of the first metatarsophalangeal joint often becomes chronically inflamed and may lead to ulceration. More severe forms of the condition involve the entire forefoot, resulting in the development of secondary lesions on the plantar surface and lesser-toe deformity.[27] The significant association between hallux valgus and disabling foot pain is not surprising; indeed, correction of hallux valgus is the most commonly performed foot surgery procedure in people older than 55 years.[28]

Despite the relationship between hallux valgus and disabling foot pain, the results of this study indicate that disabling foot pain in older people generally occurs as part of a more general pain condition rather than being the result of a specific foot condition. Concurrent pain in another region of the body was evident in every subject who reported disabling foot pain, compared with 63% of those without foot pain. In particular, pain in the hips and hands or wrists was strongly associated with disabling foot pain. Although the relationship between foot pain and hip osteoarthritis or pain could be explained mechanically (ie, gait alterations associated with foot pain could result in abnormal forces placed through the hip joint), this does not explain the strong association with pain in the hands or wrists. Similar findings reported by Leveille et al[3] and Garrow et al[25] led them to speculate that more severe forms of foot pain may be part of a polyarticular form of generalized osteoarthritis. The concept of generalized osteoarthritis has been debated extensively in the literature; however, most authors agree that the condition involves joints in the hands, neck, lower back, and knees.[29, 30] The potential involvement of foot joints has not been evaluated and warrants further study.

These findings need to be considered in light of the cross-sectional design used, which does not allow for a temporal relationship between these variables to be established. Moreover, the presence of major medical conditions was based on self-report. Although the concordance between self-report and physician diagnosis is high for conditions such as diabetes mellitus and stroke, the level of agreement is generally lower for arthritic conditions.[31, 32] The accuracy of self-report of foot osteoarthritis has not been evaluated, and it is possible that the strong association between foot osteoarthritis and disabling foot pain may partly reflect the tendency for many older people (or their health-care providers) to label any foot pain or stiffness as "arthritis." Further clarification of this issue using radiographic criteria would be worthwhile. It is also acknowledged that the inclusion of additional foot and ankle variables, such as plantar soft-tissue thickness, may have provided further discrimination between the groups. However, the range of tests used was broader than that used in previous investigations[1-5] and addressed many of the factors widely considered to be associated with foot pain.

Conclusion

The findings of this study suggest that disabling foot pain in older people is more strongly associated with pain or osteoarthritis at other body regions than with structural foot characteristics. The possibility that foot pain in some older people may be part of a polyarticular form of generalized osteoarthritis requires further investigation because it may provide useful insights into the management of this common and disabling condition.

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