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Foot Pain: Is Current or Past Shoewear a Factor? The Framingham Foot Study

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Abstract

Objective—Foot pain is common yet few studies have examined the condition in relation to shoewear. In this cross-sectional study of men and women from the population-based Framingham Study, the authors examine the association between foot pain and type of shoe wear.

Methods—Data were collected on 3378 members of the Framingham Study who completed the foot examination between 2002 and 2008. Foot pain, generalized and at specific locations, was measured by their response to the question “on most days, do you have pain, aching or stiffness in either foot?” Shoewear was recorded for the present time and five past age periods, by the subject’s choice of the appropriate shoe from a list. The responses were then categorized into three groups (Good, Average, Poor shoes). Sex-specific multivariate logistic regression models were used to examine the effect of shoewear (referent group of Average) on generalized and location-specific foot pain, adjusting for age and weight.

Results—In women, compared to average shoes, those who wore good shoes in the past were 67% less likely to report hind-foot pain (*P* 0.02), after adjusting for age and weight. In men, there was no association between foot pain, at any location, and shoewear, possibly due to the fact that <2% wore bad shoe types, making it difficult to see any relation.

Conclusion—Even after taking age and weight into account, past shoewear use in women remained associated with hind-foot pain. Future studies should address specific support and structural features of shoewear.

Key terms

foot; epidemiology; foot pain; shoes; adults

Many podiatric clinicians note that foot problems are common in older persons 1, 2, yet very little epidemiologic information exists on foot pain, especially in relation to shoewear, in older persons. National data reveal that foot and toe symptoms are among the top twenty reasons for physician office visits among those aged 65–74 years3. Prior research indicates that not enough attention has been given to foot pain and other foot disorders since historically these factors have not been regarded as important health risks1. Women are

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more likely to have foot pain than men[4, 5], but it is unknown whether this is due to a higher prevalence of foot deformities, underlying disease, shoewear or other lifestyle choices.

Foot pain and foot disorders are serious burdens for many older individuals, especially those with rheumatic diseases[6–8]. While foot pain is considered to be a very common musculoskeletal complaint in the U.S. adult population, relatively little is known of the prevalence or cause of foot pain in older Americans in a population-based sample. Examining the association between shoewear and foot pain may lead to a greater understanding of this relationship, which is important when considering strategies to prevent sequelae due to foot pain in older adults.

Previous studies have examined the influence of footwear on foot problems and other diseases in older adults but have focused on small numbers of older adults or diseased patients. A 1993 study by Frey et al[9] presented descriptive information on shoe trends and their effect on the development of foot deformities and pain in 356 women, aged 20–60. They observed that the majority of women wore shoes that were too small for their feet and had foot pain. However, no statistical analysis was presented in this paper. In a 2005 study by Menz and Morris, the relationship between footwear characteristics (length, width and area) and the prevalence of common forefoot problems were examined in 176 older adults residing in a retirement community[10]. Similar to the study by Frey, it was found that incorrectly fitting footwear is common and associated with forefoot disease and foot pain. Menz et al have also examined the relationship between footwear characteristics and the risk of indoor and outdoor falls in the same cohort of older adults. They found that there was no association between the type of shoe and the risk of falling either inside or outside the home[11]. Harrison et al reported an assessment of the fit of footwear in 100 patients with diabetes in 2007 and found that many diabetics wear shoes that are too narrow for their feet[12]. Garrow et al conducted a population-based foot pain and disability survey in 3417 adults, which examined age- and sex-differences in a variety of foot symptoms, but did not have any information on shoewear[13].

In addition, the preventative effects of footwear, like plantar pressure relief, have been shown to be important in previous studies. Lobman et al studied the effect of preventative footwear on foot pressure in 81 older diabetic patients[14]. This type of footwear was shown to be successful in reducing plantar pressure. Also, Burnfield et al found that, in 20 healthy, older adults, faster walking speed and walking barefoot result in higher foot pressures[15].

To evaluate the relationship between foot pain and shoewear in a large, population-based cross-sectional study, we collected information on major type of shoe worn currently and in the past, along with self-report of foot pain, by men and women of the Framingham Study. In addition to the aforementioned information, the Framingham Study has extensive data collected on many clinical and other factors, notably medical conditions, comorbidities and other potential confounders. The purpose of this study was to evaluate the relationship between type of shoe worn and foot pain, accounting for other possible risk factors, in men and women of the Framingham cohort.

MATERIALS AND METHODS

Study Sample

The sample of men and women who are members of the Framingham Foot Study cohort are derived from two large, population-based samples of residents of Framingham, Massachusetts, USA. The majority of the cohort is comprised of members from the Framingham Study Original Cohort and Framingham Offspring Cohort. The Framingham Study Original Cohort was formed in 1948 from a two-thirds sample of the town of

Framingham, MA in order to study risk factors for heart disease16. This cohort has been followed biennially since that time. The Framingham Offspring cohort, formed in 1972, consists of adult offspring who had a parent in the Original Cohort, and the offspring spouses17. This group has been followed every four years since cohort inception to study familial risk factors for heart disease. Members of the Framingham cohorts were examined for the current study either at their scheduled Framingham clinic examination or at a call-back examination.

The second population-based group is a new population sample that was derived from census-based, random-digit dialing within the Framingham community by the Center for Survey Research at the University of Massachusetts, selecting subjects who were at least 50 years of age and ambulatory. This group was added to the Framingham Foot Study recruitment to increase participation by minority persons and other community members of the Framingham catchment area (using a targeted random-digit dialing schema in selected Framingham census tracts).

Persons contacted via the random-digit dialing methodology who were interested in being part of a multiphasic physical examination (foot, osteoarthritis, bone health, general health), received a written letter of invitation to join the study and a follow-up phone call to schedule a study appointment.

The collection of study data and information from these Framingham Foot Study participants followed strict, well-established protocols, which are available upon request from the Framingham Study. All Framingham Foot Study participants have given informed consent for the data collection and this study has undergone institutional review by both the Hebrew SeniorLife and the Boston University Medical Center IRBs. The data are extensive, systematically collected, of high quality and gathered by trained personnel.

From these combined population-based cohorts, the Framingham Foot Study conducted a physical examination of the foot, and collected participant history, performance measures and other data via questionnaire.

Foot Assessment Clinical Tool

We used a validated foot exam with specific criteria to assess foot pain, foot symptoms and presence of foot disorders. Trained clinical examiners performed all foot exams. All participants were ambulatory and cognitively intact (as indicated by Mini-Mental score screening to identify qualified study subjects who would be able to give symptom information about their feet).

Between 2002 and 2008, foot pain was assessed in 1477 men and 1901 women of the population-based Framingham Foot Study. Generalized foot pain was measured using an NHANES-based query about foot pain: “on most days, do you have pain, aching or stiffness in either of your feet?” Available responses included: no; yes, left foot only; yes, right foot only; yes, both feet; yes, not sure what side; and unknown. For this analysis, responses were collapsed into two groups: yes, pain in one or both foot; or no, no pain in either foot. All subjects responded with either yes or no. Foot pain at specific locations was also assessed. Participants were given a picture of the top and bottom of the feet and were asked to point out any areas with pain, aching or stiffness on most days (Figure 1). The identifiable areas were nails, forefoot, hind-foot, heel, arch of foot and ball of foot. As with generalized foot pain, the responses to the location-specific foot pain were classified as yes or no pain.

Shoewear

Participants were asked about their one type of most regularly worn shoe currently and over five age periods in their past. Given the time constraints of the multiphasic Framingham examinations, we collected self report questionnaire data on general shoe type. To assess current and past shoewear, subjects were handed a list of eleven shoewear types and asked, "From this list of shoes, could you tell me which one type of shoe you currently wear most frequently?" The question was then asked for each age category (20–29, 30–44, 45–64, 65–74 and 75+) and recorded by the examiner. If the subject had not yet reached a given age, no response was recorded for that age group. Current and past shoewear were then classified into 3 groups (Good, Average, and Poor shoes). The 'Poor' group consisted of high-risk shoewear that lack support and sound structure, including high-heeled shoes, sandals and slippers. The 'Average', referent group included mid-risk shoes such as hard or rubber soled shoes, special shoes and work boots. The 'Good' group consisted of low-risk shoes including athletic and casual sneakers, as these shoes have the characteristics that theoretically make them safer, (namely rigid heel counters, fixation or firm nonflexible soles)[18, 19]. Past shoewear, across the five ages, were further summarized into one worst past shoe type, as the most high-risk shoe worn at any age. In the analysis of footwear style and falls in older adults, Koepsell et al. created similar shoewear groups to those that were chosen here [20]. Although our use of this simple, self-report did not use a validated instrument for shoewear (and we are unaware if one exists), we believe this self-report of shoewear provides insight into an important measure of exposure.

Potential Covariates

We examined potential confounders in our analyses including: age, sex, weight, height, and smoking status. Age (years) at time of exam was recorded. Weight in pounds was measured using a standardized balance beam scale and recorded to the nearest ½ pound. Height (without shoes) was measured in inches using a calibrated stadiometer and recorded to the nearest ¼ inch. A participant's smoking status was assessed via questionnaire as current cigarette smoker (smoked regularly in the past year), former smoker or never smoked. Co-morbidities were queried with each study participant at the clinic visit.

Data Analysis

Descriptive statistics were generated overall and separately for men and women. Multivariate logistic models were performed to examine the effect of the potential risk factors, with current and past shoewear as our main focus, on foot pain. Each foot pain outcome was modeled separately. Generalized foot pain, and all location-specific foot pain variables were modeled as functions of current shoewear, past shoewear and other risk factors.

Because gender is a strong confounder for both foot pain and for types of shoewear, all analyses were done sex-specific. All analyses were conducted using the SAS statistical analysis package (SAS Institute Inc., Cary, NC, U.S.A.; version 9.1).

RESULTS

Of the 3378 participants of the Framingham Foot Study, there were 1472 men and 1900 women who had complete foot exam data and were included in this analysis. The mean age for subjects was 66 years (range 36–100) and the sample was 56% female. The mean height and weight were 65.5 inches and 174.0 pounds, respectively. Table 1 shows the characteristics of the study sample by gender. All subjects had valid measurements for age, weight, height, sex and reported their typical shoewear type. 65 subjects were missing a response for smoking status.

Of the 3372 subjects under study, 25% of participants reported the presence of generalized foot pain on most days. Figure 1 shows the six specific anatomical locations of foot pain for the total sample. Table 1 also shows the sex-specific distribution of the report of foot pain, generalized and at specific locations. 19% of men and 29% of women reported generalized foot pain.

The distribution of current shoewear and past shoewear is shown in Table 2 over the original eleven categories. We collapsed these categories into three major groupings, as shown in Table 2 and Figure 2. Rubber soled shoes were the most commonly reported shoe, being worn by 28% of men and 32% of women.

Table 3 and Table 4 show the covariate-adjusted results of foot pain modeled on shoewear, current and past. All models were adjusted for age and weight. Exploratory models showed that height and smoking had no relation to foot pain so those risk factors were not included in the analysis. Table 3 shows the results for sex-specific analysis of generalized foot pain and current shoewear. There was no association between generalized, toe, forefoot, ball of foot, heel or arch of foot pain and current shoewear in women or in men. We also examined the relationship between generalized foot pain and past shoewear and similarly found no associations for this relation or for most of the specific locations of foot pain. The exception was a statistically significant association in women who reported pain at the hind-foot and past shoewear. Table 4 shows the associations in women between past shoewear and hind-foot pain, adjusting for age and weight. Compared to women who wore average shoes, women whose worst past shoe was in the Good category were 67% less likely to report hind-foot pain, after adjusting for age and weight (*P* 0.022; crude *P* 0.026). In men, no significant relation was found between foot pain at any location, and shoewear groups, whether current or past shoewear.

DISCUSSION

In our study of community dwelling older adults, past shoewear among women was a predictive, statistically significant, factor for hind-foot pain; however, no significant associations were seen in men. In women, we found an increased risk between foot pain at the hind-foot location and shoewear. This was the only site-specific association in women and none were seen among the men in our sample, or among generalized foot pain. In our study, weight was significantly associated with foot pain for both the men and women. Age was not significantly associated with foot pain in our sample, but we included it as a covariate in order to compare to other studies and to address possible residual confounding. Even after taking age and weight into account, past shoewear in women remained associated with hind-foot pain.

We found that 25% of participants (19% of men and 29% of women) reported the presence of generalized foot pain on most days, which is in line with other studies examining foot pain. Similar to our study, Garrow et al. found that 20% of men and 24% of women reported foot pain13. Menz et al also found that more women report foot pain than men10, 11.

In men, less than 2% of our population reported wearing Poor shoe types. This could make seeing any possible relation between foot pain and shoewear very difficult due to sparse statistical power to detect a possible difference. We also observed several protective, non-significant associations in men between shoewear and foot pain. *Despite the large numbers of men in our study, very few reported wearing Good or Poor shoes*. It may well be that other studies with larger numbers of men reporting good or poor shoe types (57 % and 92% of men in our study reported average shoes for current shoewear and past shoewear,

respectively) could have sufficient power to examine these possible protective effects further and in more detail.

No statistically significant associations were found in a study by Manna et al21 that evaluated the relation between foot troubles and type of footwear (shoe, sandal or slipper) in 300 men and women. While this study was limited by their definition of 'foot troubles', their null results between foot troubles and shoe, sandal or slipper use are in agreement with our results. A study by Dawson et al22 examined the association of age at which heels were first worn for different heel heights and maximum heel height in relation to foot pain and other foot problems in women. While no statistically significant associations were observed between age at which heels were first worn and foot pain, the authors found statistically significant associations between maximum heel height worn for going out socially and for dancing with foot pain ($P < .05$). These associations of high heel use and foot pain were not seen in our study, which found no association between shoewear and generalized foot pain. It is quite interesting to note, however, that Poor shoewear (including high heels) was associated with hind-foot pain.

It is interesting to note that we observed an association with foot pain at specific locations in the foot but not with generalized foot pain. The definition of good shoes (athletic shoe or casual sneaker) used in this study implies a shoe design with better fit, foot posture and shock absorption characteristics. Each heel strike during walking may produce a biomechanical shock of 3–7 g (note: 1 g = 1 times the acceleration due to gravity). "Good shoes" often have softer out-soles, mid-soles, or insoles which may use elements of gel, foamed polyurthethane, or air chambers which serve to smooth (low pass filter) the raw shock wave. Attenuation of shock could be responsible for the reduction in perceived pain at the hind-foot. It is important to note that the hind-foot receives the largest shock wave within the foot at each and every heel strike. Thus, it makes sense that "Good shoes" will protect for pain within the hind-foot. It is also possible that the lone association seen at the hind-foot is due to the tightness of the heelcords that might result from sustained use of high heels. If this is the case, it is possible that interventions with stretching exercises could mitigate the influence of the "poor" shoes.

Given that no correction for multiple comparisons was made, the results should be conservatively interpreted; specifically, note that there is only one significant association and thus other studies are needed to confirm or extend these results.

Our study has several limitations that should be addressed. Since our population was predominately Caucasian adults, we have limited ability to generalize to other racial populations. The cross sectional study design limited our ability to infer causality. Thus, we cannot note whether the choice of shoewear caused the foot pain or if the foot pain caused the participant to select a particular type of shoe.

In addition, participants were given a list of eleven, non-specific, categories from which to choose the one shoe type that was worn most often currently and at past age groupings. Since these categories were broad and inadequately specified, there is, without a doubt, misclassification that has occurred in the categorization of footwear. Due to the time constraints of the study, we were forced to limit the choices of categories and were not able to measure this as accurately or specifically as would have been ideal. This probable misclassification would lead to results that are biased towards the null. Sandals, in particular, are likely to be misclassified given the fact that some sandals may actually provide excellent support for the foot. Due to the time constraints in this study, only one category for sandals was used. Despite this limitation, it is important to realize that regular sandal use in the North Eastern United States is not particularly common (4% in this study),

and therefore may not be a major factor. There was also opportunity for recall bias when participants were asked to remember what type of shoe they were wearing as long ago as 60 years.

Also, part of what makes this analysis more complicated may be the precise category in which we placed certain shoe types. For example, a work shoe that was categorized as 'average' may be steel toed for construction and very uncomfortable and might actually be better classified as 'poor'. Even an athletic shoe which was classified as 'good' may have pronatory control elements and the person may actually have pes cavus and hence be an over supinator - so the shoe was a 'poor' match for that person. Furthermore, previous work on specific qualities of shoewear has suggested that foot structure and shoe structure interact with foot function[23–26]. This implies that the shoe may actually dominate this relationship so the issue is not simply if one is wearing a 'good' shoe but if they are wearing a 'good' shoe for their foot type. We were not able to account for this possibility in our analysis, as we did not have a reliable measure of the subject's foot type.

Despite the aforementioned limitations, our study also has several strengths. To our knowledge, this is one of the first studies to examine the association between shoewear, beyond just high heel use, and foot pain. Our study sample includes both men and women, which enables us to generalize the results to both genders. Foot pain was measured across multiple sites of the foot. We obtained information on nail pain, toe pain, forefoot pain, hind-foot pain, heel pain, pain in the arch, and pain in the ball of the foot, in addition to the measure of generalized foot pain. This allows us to conduct more specified analyses of a particular pain location. The foot examination was conducted by a trained examiner and was not simply self-report. This information is likely to be more reliable and should result in less misclassification or recall bias than a simple self-report of foot conditions.

Further research is needed to address the specific support features of shoewear such as arch support, toe box width and toe box depth. Also, future studies should examine the relationship between the severity of foot pain and whether the subject has a pes planus, rectus or pes cavus foot type. Furthermore, examining the relationship between foot type, shoe structure, the presence or absence of foot pathologies and associated pain would be of keen interest to the rheumatology and podiatric community.

In conclusion, our study found that in women, past shoewear is a statistically significant, predictive factor for hind-foot pain, but there no such association was found in men. In men, less than 2% wore Poor shoe types, making it difficult to see any relation. Given the small percentage of men wearing Poor shoes, it appears that shoe type may not be a major factor for developing foot pain in men. Past shoewear in women is associated with hind-foot pain, regardless of age or weight. Thus, young women should make careful choices regarding their shoe type in order to potentially avoid hind-foot pain later in life, or perform stretching exercises to alleviate the effect of high heels on hind-foot pain.

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REFERENCES

1. Helfand A. Podiatry in a total geriatric health program: common foot problems of the aged. Journal of the American Geriatrics Society. 1967; 15:593–599. [PubMed: 4225795]
2. Karpman R. Foot problems in the geriatric patient. Clinical Orthopaedics & Related Research. 1995; 316:59–62. [PubMed: 7634725]
3. US Department of Health and Human Services NCfHS. National Ambulatory Medical Care Survey, 1995 summary. Centers for Disease Control and Prevention. 1997
4. Hannan M. Epidemiologic perspectives on women and arthritis: an overview. Arthritis Care & Research. 1996; 9:424–434. [PubMed: 9136285]
5. Hill C, Gill T, Menz H, Taylor A. Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. J Foot Ankle Res. 2008; 1:2. [PubMed: 18822153]
6. Rosenbaum D, Schmiegel A, Meermeier M, Gaubitz M. Plantar Sensitivity, Foot Loading and Walking Pain in Rheumatoid Arthritis. Rheumatology. 2006; 45:212–214. [PubMed: 16204375]
7. van der Leeden M, Steultjens M, Dekker J, Prins A, Dekker J. Forefoot Joint Damage, Pain and Disability in Rheumatoid Arthritis Patients with Foot Complaints: The Role of Plantar Pressure and Gait Characteristics. Rheumatology. 2006; 45:465–469. [PubMed: 16287922]
8. Woodburn J, Helliwell P. Foot Problems in Rheumatology. British Journal of Rheumatology. 1997; 36:932–934. [PubMed: 9376986]
9. Frey C, Thompson F, Smith J, Sanders M, Horstman H. American Orthopaedic Foot and Ankle Society Women's Shoe Survey. Foot & Ankle. 1993; 14:78–81. [PubMed: 8454237]
10. Menz H, Morris M. Footwear Characteristics and Foot Problems in Older People. Gerontology. 2005; 51:346–351. [PubMed: 16110238]
11. Menz H, Morris M, Lord S. Footwear Characteristics and Risk of Indoor and Outdoor Falls in Older People. Gerontology. 2006; 52:174–180. [PubMed: 16645298]
12. Harrison S, Cochrane L, Abboud R, Leese G. Do Patients with Diabetes Wear Shoes of the Correct Size? International Journal of Clinical Practice. 2007; 61:1900–1904. [PubMed: 17935549]
13. Garrow AP, Silman AJ, Macfarlane GJ. The Cheshire Foot Pain and Disability Survey: a population survey assessing prevalence and associations. Pain. 2004; 110:378–383. [PubMed: 15275789]
14. Lobmann R, Kayser R, Kasten G, Kasten U, Kluge K, Neumann W, Lehnert H. Effects of Preventative Footwear on foot Pressures as Determined by Pedobarography in Diabetic Patients: A Prospective Study. Diabetic Medicine. 2001; 18:314–319. [PubMed: 11437863]
15. Burnfield J, Few C, Mohamed O, Perry J. The Influence of Walking Speed and Footwear on Plantar Pressures in Older Adults. Clinical Biomechanics. 2004; 19:78–84. [PubMed: 14659934]
16. Dawber T, Meadors G, Moore F. Epidemiological approaches to heart disease: the Framingham Study. Am J Public Health Nations Health. 1951; 41:279–281. [PubMed: 14819398]
17. Feinleib M, Kannel W, Garrison R, McNamara P, Castelli W. The Framingham Offspring Study. Design and preliminary data. Prev Med. 1975; 4:518–525. [PubMed: 1208363]
18. Menz H, Lord S, McIntosh A. Slip resistance of casual footwear: implications for falls in older adults. Gerontology. 2001; 47:145–149. [PubMed: 11340320]
19. Sherrington C, Menz H. An evaluation of footwear worn at the time of fall-related hip fracture. Age Ageing. 2003; 32:310–314. [PubMed: 12720618]
20. Koepsell TD, Wolf ME, Buchner DM, Kukull WA, LaCroix AZ, Tencer AF, Frankenfeld CL, Tautvydas M, Larson EB. Footwear Style and Risk of Falls in Older Adults. Journal of the American Geriatrics Society. 2004; 52:1495–1501. [PubMed: 15341551]
21. Manna I, Pradhan D, Ghosh S, Kar SK, Dhara P. A Comparative Study of Foot Dimension between Adult Male and Female and Evaluation of Foot Hazards due to Using of Footwear. Journal of Physiological Anthropology and Applied Human Sciences. 2001; 20:241–246.
22. Dawson J, Thorogood M, Marks S-A, Juszczak E, Dodd C, Lavis G, Fitzpatrick R. The prevalence of foot problems in older women: a cause for concern. Journal of Public Health Medicine. 2002; 24:77–84. [PubMed: 12141589]

23. Helliwell P, Woodburn J, Redmond A, Turner D, Davys H. The Foot and Ankle in Rheumatoid Arthritis: A Comprehensive Guide: Elsevier Limited. 2007:84–88.

24. Hillstrom, H.; Whitney, K.; McGuire, J.; Mahan, K.; Lemont, H. Clinical Care in the Rheumatic Diseases. 3 ed.. Atlanta, GA: The Association of Rheumatology Health Professionals; 2006. Conservative and Surgical Management of the Foot and Ankle.

25. Parham, KR.; Gordon, CC.; Bensel, CK. Anthropometry of the Foot and Lower Leg of U.S. Army Soldiers: Fort Jackson, SC – 1985: Army Natick Research Development and Engineering. Center MA: 1992.

26. Shakoor N, Block J. Walking barefoot decreases loading on the lower extremity joints in knee osteoarthritis. Arthritis Rheum. 2006; 54:2923–2927. [PubMed: 16947448]

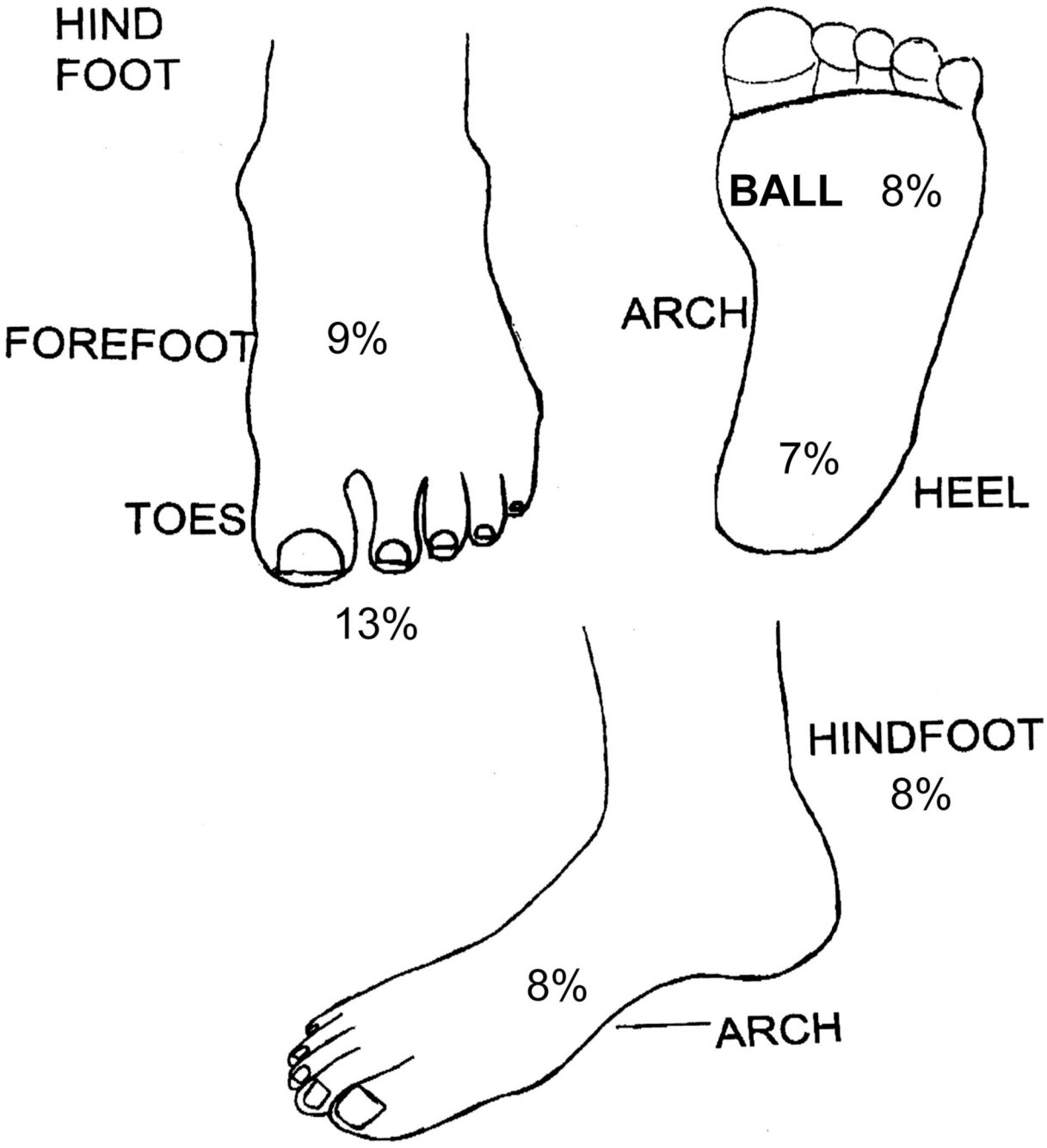

Figure 1. Diagram of the foot and prevalence of pain in each location

The diagram shows the distribution of pain at each location of the foot for the men and women of the Framingham Foot Study (2002–2008).

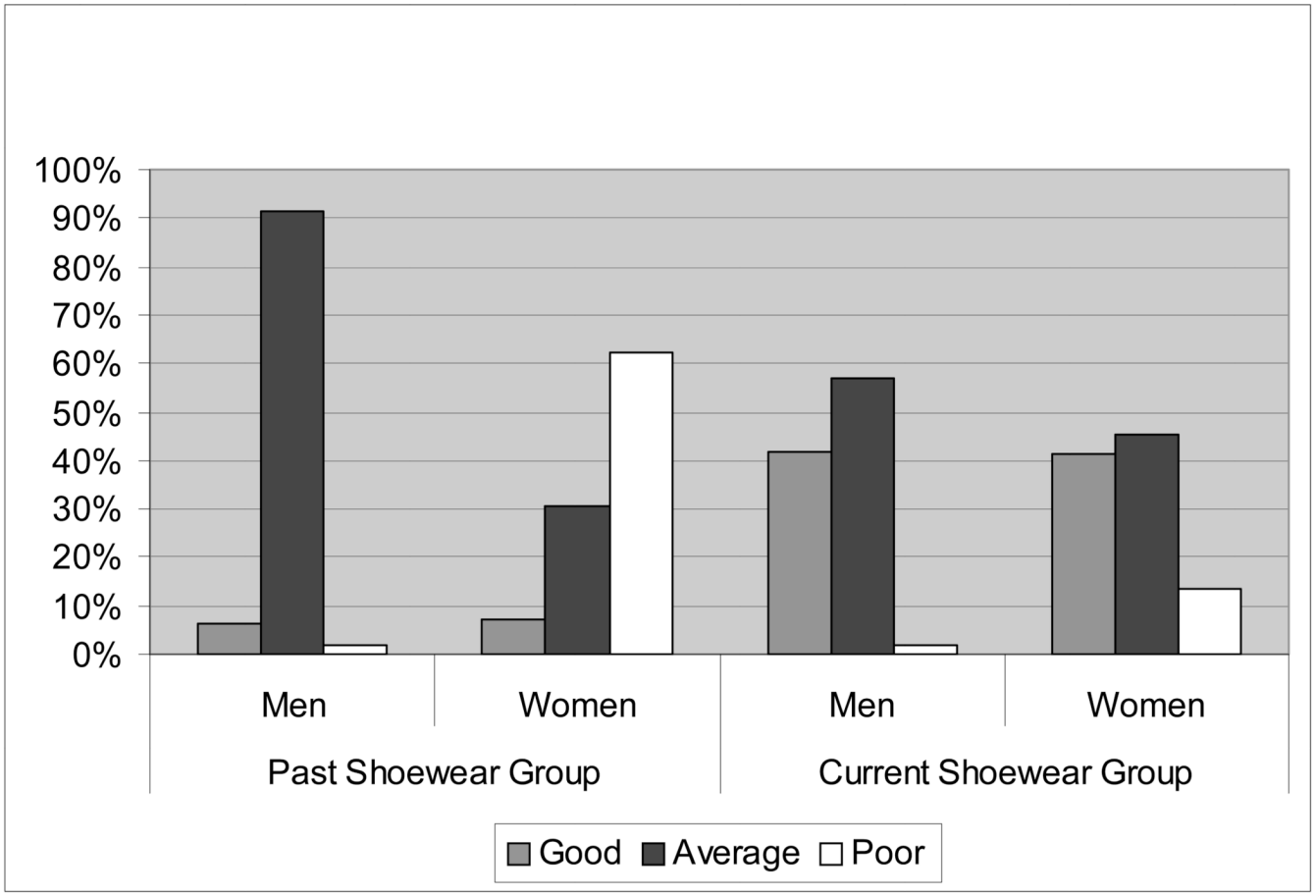

Figure 2. Distribution of Past and Current Shoewear by Category of Structural Support in Men and Women

The bar graph shows the distribution of past and current shoewear for men and women of the Framingham Foot Study (2002–2008).

Table 1

Descriptive characteristics of men and women in the Framingham Foot Study who completed the foot exam between 2002 and 2008.

Characteristic*	Men (n=1472)	Women (n=1900)
Age (years, mean ± SD)	65.7 ± 10.3	65.9 ± 11.0
Weight (lbs, mean ± SD)	194.1 ± 34.7	158.5 ± 35.9
Height (inches, mean ± SD)	68.7 ± 2.8	63.1 ± 2.7
Current smoker	127 (8.8)	178 (9.5)
Foot pain (generalized)	279 (19.0)	557 (29.3)
Toe or Nail pain	146 (9.9)	303 (16.0)
Forefoot pain	87 (5.9)	224 (11.8)
Hind-foot pain	99 (6.7)	167 (8.8)
Heel pain	101 (6.9)	145 (7.6)
Arch pain	100 (6.8)	179 (9.4)
Ball of foot pain	92 (6.3)	183 (9.6)

* N (%) unless otherwise noted

Table 2

Distribution of current shoewear patterns of the men and women in the Framingham Foot Study (2002–2008).

	MEN	WOMEN
	N(%)	N(%)
Good Shoes	**612 (41.6)**	**785 (41.3)**
Athletic shoe	405 (27.5)	511 (26.9)
Casual sneaker	207 (14.1)	274 (14.4)
Average Shoes	**836 (56.8)**	**862 (45.4)**
Hard soled leather shoe	278 (18.9)	206 (10.8)
Rubber soled shoe	415 (28.2)	615 (32.4)
Work boot	132 (9.0)	8 (0.4)
Cowboy boots	1 (0.1)	8 (0.4)
Special shoe	5 (0.3)	11 (0.6)
Other/na/unknown	5 (0.3)	14(0.7)
Poor Shoes	**24 (1.6)**	**253 (13.3)**
Heels or pumps	0 (0.0)	91 (4.8)
Sandals	16 (1.1)	124 (6.5)
Slipper	8 (0.5)	38 (2.0)

Table 3

Odds ratios (OR) and 95% confidence intervals (95% CI) for the association between current shoewear and generalized foot pain in the men and women of the Framingham Foot Study (2002–2008).

		MEN			WOMEN		
	Current Shoewear	**OR**	**95% CI**	***P* value**	**OR**	**95% CI**	***P* value**
Crude	Good vs Average Shoe	0.89	0.68, 1.16	0.398	1.14	0.92, 1.40	0.240
	Poor vs Average Shoe	0.81	0.27, 2.41	0.710	0.97	0.71, 1.33	0.843
Age- & Weight-adjusted	Good vs Average Shoe	0.89	0.68, 1.17	0.419	1.11	0.90, 1.37	0.344
	Poor vs Average Shoe	0.88	0.29, 2.61	0.814	0.99	0.72, 1.35	0.930

Table 4

Odds ratios (OR) and 95% confidence intervals (95% CI) for the association between past shoewear and hind-foot pain in women of the Framingham Foot Study (2002–2008).

		HIND-FOOT		
	Past Shoewear	**OR**	**95% CI**	***P* value**
Crude	Good vs Average Shoe	0.35	0.14, 0.88	0.026
	Poor vs Average Shoe	0.92	0.66, 1.30	0.651
Age- & Weight-adjusted	Good vs Average Shoe	0.33	0.13, 0.85	0.022
	Poor vs Average Shoe	0.92	0.65, 1.29	0.620