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The Occurrence of Ipsilateral or Contralateral Foot Disorders and Hand Dominance: The Framingham Foot Study

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Abstract

Background—To our knowledge, hand dominance and side of foot disorders has not been described in the literature. The purpose of the current study was to evaluate whether hand dominance was associated with ipsilateral foot disorders among community-dwelling older men and women

Methods—Data were from the Framingham Foot Study (n=2,089, examined 2002–2008). Hand preference for writing was used to classify hand dominance. Foot disorders and side of disorders were based on a validated foot examination. Generalized linear models with GEE was used to estimate odds ratios (OR) and 95% confidence intervals (CI), accounting for intra-person variability.

Results—Left-handed people were less likely to have foot pain or any foot disorders ipsilateral, but were more likely to have hallux valgus ipsilateral to the left hand. Among right-handed people, the following statistically significant increased odds of having an ipsilateral foot disorder versus contralateral foot disorder were seen: 30% for Morton's Neuroma, 18% for hammer toes, 21% for lesser toe deformity, and a 2-fold increased odds of any foot disorder; there was a 17% decreased odds for Tailor's Bunion, and an 11% decreased odds for pes cavus.

Conclusion—For the 2089 study participants, certain forefoot disorders were shown to be ipsilateral while other foot disorders were contralateral to the dominant hand. It is possible that the side of the dominant hand was a proxy for biomechanics of the dominant foot that may explain some of the associations with ipsilateral forefoot disorders.

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Competing Interest Declaration:

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Keywords

Hand dominance; Foot Disorders; Framingham Foot Study; Population-based Study

INTRODUCTION

An individual's predilection for being right-handed or left-handed was thought to be in synchronization with the person's side of foot preference. Indeed, side of hand and foot preference appeared to be highly correlated. In a study of 7,364 children, Nachshon et al. found that over 80% of the children preferred the right hand along with the right foot, and it was believed that cerebral dominance affected both hand and foot dominance.¹¹ While it is unknown if these observations in children are easily transferable to an adult population, work in adults agree with the premise of cerebral dominance. In a study of 5,064 adults, Dargent-Paré et al. found that foot preference was significantly associated with hand dominance, and only five percent had a cross-preference between hand and foot.⁴ In a study by Barut et al, 90% of right-handed women between 18 and 42 years of age preferred their right feet compared with 76% in their male counterparts; for left-handed women, it was 79% who preferred their left foot compared with 57% in their male counterparts.¹ Among older adults, Kumar et al. found that in a population of mostly males between 56 and 83 years of age, 94% had right-side dominance of both hand and foot, and that right-side dominance increased with increasing age.⁹ Thus, dominance of 'handedness' appeared to operate in accord with dominance of 'footedness' for the vast majority of persons, although footedness may depend upon context of a specific foot task.

In addition to side of hand and foot preference, side of hand dominance was also believed to be a risk factor for trauma and injuries. In a study of middle- and high-school students, a significantly higher proportion of left-handers reported seeing a physician for treatment of an injury in the past year, being hospitalized for injury treatment, or requiring surgery because of an injury compared with right-handers.⁵ Also, left-handed college students were at an increased risk for accidental injuries and had a higher risk of being injured in multiple categories of activities compared with right-handed students.³ It is unclear if injuries in a student population transfer to similar results for older individuals and also whether it makes a difference if the injury is to the lower or upper extremity. Nevertheless, left-hand dominance was shown to be a risk factor for proximal humerus fractures¹⁰ and falls in older adults.²

Many clinicians thought that side of hand preference may carry over to the side of clinical foot disorders. Anecdotally, some clinicians have noticed a link between heel, Achilles, and bunion pain with ipsilateral hand dominance. To our knowledge, hand dominance and side of foot disorders has not been described in the literature. To move beyond these clinical observations, we believe this study provides the first population-based insights into whether the side of foot disorders was related to hand dominance. The purpose of the current study was to evaluate whether hand dominance was associated with ipsilateral foot disorders among community-dwelling older men and women.

METHODS

Population

The Framingham Foot Study, an ancillary study of the Framingham Heart Study, occurred between 2002 and 2008 and included members of the Framingham Offspring Cohort. The Framingham Offspring Cohort, formed in 1971, was comprised of the adult offspring (and their spouses) of the Framingham Heart Study cohort members (a population-based sample

of two-thirds of the town of Framingham, MA, USA, enrolled in 1948–51).⁸ The Framingham Offspring Cohort has been seen at 4-year intervals since cohort inception and the Framingham Foot Study occurred as an ancillary study to the parent Framingham Study. Members of the Framingham Offspring Cohort had previously been queried about their hand dominance; in general, participants in this age group were not forced to use only their right hands during their school years. Between 2002 and 2008, members from the Framingham Offspring Cohort were examined in the Framingham Foot Study, including side of any observed foot disorder. All participants were ambulatory, cognitively intact and able to give informed consent for the study procedures. Of the 2181 Framingham Offspring Cohort participants, 30 participants were missing hand dominance data, 48 were missing data on foot disorders, eight were excluded due to foot ulcerations and six were excluded due to amputated toes, leaving data from 2089 people for the current analysis. Of this cross-sectional observational study, the majority of the study participants had no missing data on the variables of interest.

Hebrew SeniorLife Institutional Review Board and the Institutional Review Board of Boston University Medical Center approved this study and all participants provided signed informed consent.

Hand Dominance

At the Framingham Offspring examination cycle between 1996 and 1999 and prior to the start of the Framingham Foot Study, participants were asked to identify which hand they preferred for writing. Using this hand preference information, we classified hand dominance as either left-handed or right-handed; there were no participants identified as ambidextrous.

Foot Conditions and Disorders

During the Framingham Foot Study, trained research nurses conducted a physical examination of a participant's feet, collected data on medical history, performance measures, plantar pressures using a computerized mat, and administered risk assessment questionnaires. We used a validated foot examination with specific criteria⁶ to assess approximately 20 foot disorders and foot symptoms (e.g., self-reported foot pain present on most days in a month), and collected information on side of each foot disorder (right, left, bilateral). We excluded ankle conditions and focused on the foot disorders that were considered structural, sensory, or pain-related foot disorders. Specific disorders of interest included hallux valgus, Tailor's bunion, hallux rigidus, plantar fasciitis, and Morton's neuroma. In addition, we included foot pain, pes cavus, and pes planus. Hammer toes, claw toes, and overlapping toes were also included as individual disorders and summarized together as any lesser toe deformity. We created a summary variable of any bunions (hallux valgus or Tailor's bunion), as well as a variable that indicated the presence of any of the above eleven foot disorders or conditions.

The structural foot disorders were indicated as present or absent based on an atlas of pictorial depiction of each foot disorder. For example, hallux valgus was defined as the angular deviation of the hallux with respect to the first metatarsal bone toward the lesser toes at 15 degrees or more, and appears as a medial bony enlargement of the first metatarsal head.¹¹ The toe disorders were also based on pictorial depiction (hammer toe, claw toe, overlapping toes). Pain-related disorders were evaluated as follows: hallux rigidus was defined as no motion possible in the range-of-motion of the hallux during examination; plantar fasciitis was defined as pain elicited upon the examiner exerting 5-pounds of force at the site of the plantar fascia insert, with the examiner using a calibrated device to estimate 5 pounds of force before an examination and then exerting this level of pressure to evaluate whether pain was present at the plantar fasciitis site. While other methods exist to indicate

Morton's Neuroma, we defined this condition as pain elicited upon exerting five pounds of force at the base of the 3rd or 4th toe. Modeling after the query in the National Health and Nutrition Examination Survey (NHANES) on site-specific joint pain, the presence of foot pain was identified based on a participant's response to the question: "On most days do you have pain, aching or stiffness in either of your feet?"

We defined pes planus and pes cavus using a foot pressure mat. With the computerized mat (MatScan pedobarographic device, Tekscan, Inc. Boston, MA), foot pressure data from each foot were collected with the participant standing quietly on the pressure-sensing device with his/her body weight distributed equally over both feet as described previously.¹² Briefly, a plot of the maximum pressure throughout bipedal quiet stance was obtained, and the Staheli Arch Index, the ratio of arch width to rear-foot width was calculated. More specifically, the ratio of the smallest medial to lateral width of the arch region was divided by the largest medial to lateral width of the heel region (to the nearest 0.01 cm).¹³ The Staheli Arch Index increased with an increasingly planus foot, with pes planus defined as having an arch width of 75% or more of the heel width on the foot. We chose the 75% cut-point for the weightbearing Staheli Arch Index based upon our unpublished previous work from the Framingham Foot Study. This data have shown that the cut-point incorporated all of the persons with a clinical impression of pes planus and none of those without the pes planus. Pes cavus was defined for each foot as having a weight bearing arch index of zero, regardless of the heel width on the foot.

Covariates

Selected covariate data were collected at the Framingham Foot Study exam, including age (years), sex, height (inches), and weight (pounds). Weight in light clothing was measured using a calibrated balance beam scale to the nearest ½ pound and standing height (without shoes) was measured using a standardized stadiometer to the nearest ¼ inch. Weight and height were respectively recalculated as kilograms (kg) and meters (m) in order to calculate body mass index (BMI) as kg/m². We then categorized BMI according to the World Health Organization definitions: <18.5 (underweight), 18.5–24.9 (normal weight), 25.0–29.9 (overweight), 30.0–34.9 (obese), 35.0–39.9 (very obese), and 40.0 (morbidly obese).¹⁴

Statistical Analysis

We provided descriptive statistics for the study population using means, standard deviations, and percentages, as appropriate. We examined the descriptive statistics for side of foot condition or disorder (none, right, left, bilateral) by hand dominance. Based upon known associations of foot problems with age (years), sex, and BMI in categories of < 25.0, 25.0–29.9, and 30.0, these variables were included in all adjusted models. For categorical variables, female was the referent group for sex, and the 25.0–29.9 kg/m² group was the referent for BMI.

Generalized linear models with a logit link were used to calculate the crude and adjusted odds ratios and 95% confidence intervals between presence of sides of foot disorder and hand dominance. Generalized estimating equations (GEE) were used to account for the intra-person variability of analyzing both feet per subject. Each foot condition or disorder was modeled separately, with the foot disorder of interest as the dependent variable, and a variable indicating whether or not the foot being examined was on the same side as the dominant hand. Odds Ratios (OR) indicate the odds of having the foot disorder on the same side as a subjects. dominant hand (ipsilateral) compared to having the foot disorder on the opposite side (contralateral). We could interpret these odds ratios as follows: there was a reduced risk for a given foot disorder being on the same side as the dominant hand; there was no effect for a given foot disorder being on the same side as the dominant hand; or there

was an increased risk for a given foot disorder being on the same side as the dominant hand. We also repeated these GEE analyses stratified by right or left hand-dominance. All analyses were done using the SAS statistical analysis package (SAS Institute Inc., Cary, NC, U.S.A.; version 9.1).

RESULTS

Table 1 describes the characteristics of the study cohort. The mean age (SD) was 65 (9.0) years, with 31% of the cohort 70 years or older. Females made up 55% of the study participants. Mean BMI was 29 (5.5) kg/m², with 36% of the study participants classified as obese to morbidly obese. The majority of the study participants were right-handed (89%).

Subsequent results are organized by side of foot disorder and side of hand dominance (Table 2) and then by whether foot disorders were ipsilateral/contralateral to hand dominance, followed by results stratified by side of hand dominance (Table 3). Descriptive statistics on the distribution of side of foot disorders by side of hand dominance are presented in Table 2. There was no clear pattern of the prevalence of side of foot disorder by side of hand dominance. For example, more right-handed people had right-sided hallux valgus compared to those who were left-handed (6.0% vs. 3.5%, $p=0.13$), yet fewer left-handed people had left-sided foot pain compared to those who were right-handed (1.8% vs. 4.1%, $p=0.08$). When using a summary variable to indicate presence of any of the foot disorders, more right-handed people had right-sided foot disorders compared to those who were left-handed (34.1% vs. 29.4%, $p=0.01$).

We then considered whether the side of foot disorder was ipsilateral or contralateral to the side of the dominant hand. Although hand dominance was associated with older age ($p=0.0002$) and being female ($p=0.008$), age and sex along with BMI did not appear to confound the associations between hand dominance and side of foot disorders in this study, but they did improve precision. Therefore, we presented adjusted estimates from the GEE analyses predicting the likelihood of having foot disorders on the same side as the dominant hand in Table 3, in addition to results stratified by side of the dominant hand.

Compared to having a contralateral foot disorder with regard to side of hand dominance, there was a 27% increased odds of having Morton's Neuroma ipsilateral to the dominant hand (95% CI: 1.07 to 1.51). Similarly, there was a 13% increased odds of having hammer toes (95% CI: 1.01 to 1.26), a 15% increased odds of having a lesser toe deformity (95% CI: 1.02 to 1.29) and a 79% increased odds of having any foot disorders (95% CI: 1.56 to 2.06), as well as a borderline statistically significant 29% increased odds for hallux rigidus (95% CI: 0.97 to 1.72), ipsilateral to the dominant hand. However, there was an 11% decreased odds of having pes cavus (95% CI: 0.80 to 0.99), and a borderline statistically significant 14% decreased odds of having a Tailor's bunion (95% CI: 0.72 to 1.02), ipsilateral to hand dominance.

When we stratified the analysis according to side of hand dominance, the patterns of hand dominance and ipsilateral foot disorders for the above specific foot disorders were slightly stronger in magnitude and remained significant for right-handed but not left-handed participants. In fact, there was a 37% decreased odds for any ipsilateral foot disorders (95% CI: 0.42 to 0.93). In addition, there was a suggested 23% decreased odds for ipsilateral foot pain (95% CI: 0.59 to 1.02) but a 26% increased odds for ipsilateral hallux valgus among left-handed people (95% CI: 0.98 to 1.63).

DISCUSSION

In summary, right-handed people were more likely to have Morton's neuroma, hammer toes, lesser toe deformities, and hallux rigidus ipsilateral to the dominant hand, while more likely to have pes cavus and Tailor's bunion contralateral to the dominant hand. Left-handed people were less likely to have foot pain or any of the foot disorders ipsilateral to the dominant hand, but were more likely to have hallux valgus ipsilateral to the dominant hand.

Our data suggested that certain specific pedal pathologies, and their status as ipsilateral or contralateral to the dominant hand, were more apparent for right-handed compared to left-handed people. It is possible that we had a comparatively large sample of right-handed people so not only were the estimates more stable, but we also had more power to detect significant associations. Conversely, the sample of left-handed people was relatively small such that estimates of associations were less stable and we did not have the power to detect as many significant associations. In addition, though the majority of right-handed people are right-footed, it is possible that left-handed people may have more cross-preference for preferred limb. Thus, this cross-preference may explain the lower magnitude of association between hand dominance and side of foot disorders among left handed people.

It is also possible, however, that there was a 'foot preference' (the pedal analogy to hand dominance) that matched hand dominance in some individuals and that the same mechanism that resulted in ipsilateral hand and foot preference may have explained some of the associations between hand dominance and ipsilateral forefoot disorders. Although we have no data on foot preference to allow us to explore this possibility in our study, we believe that there were more loading of the preferred limb for some of these foot disorders. Therefore, injuries to the digits or nerves on the preferred foot may have been more repetitive, leading to a higher occurrence of foot disorders ipsilateral to the side of hand dominance. Moreover, if the dominant foot was more propulsive while the non-dominant foot more breaking, then the biomechanical differences may have explained the prevalence of more ipsilateral forefoot pathologies associated with the dominant hand. This potential mechanism should be examined in future studies, as well as whether foot preference was more directly associated with pedal pathology prevalence than hand dominance.

There were several limitations to this study that merit discussion. Classification of the side of hand dominance was based solely on self-report of hand preferred for writing; other factors may have influenced dominant handedness and may have been more important especially for people who were truly left-handed. Also, there exists the possibility of change in hand dominance owing to diminished fine motor control as a result of aging, or possibly due to injuries or strokes affecting one side of the body.⁷ Therefore, it is possible there is some classification error of hand-dominance in our study. It was unlikely that this misclassification of hand dominance differed by side of foot disorders. Therefore, any non-differential misclassification of hand dominance would have resulted in an underestimation of the actual magnitude of association between hand dominance and ipsilateral foot disorders (i.e., our results may actually be conservative estimates of these associations). Further, our study participants were predominately Caucasians such that we have limited ability to generalize to other racial groups. Finally, we examined 11 relatively common foot disorders, which we classified only as present or absent without regard to severity; there may have been different associations with other foot disorders or with severe foot disorders that required podiatric surgery.

Despite the limitations, our study had several strengths. Notably, classification of specific foot disorders was based on clinically validated foot exams, thus, reducing the likelihood of misclassification or recall bias from self-report of foot disorders. Also, our data from the

Framingham Foot Study were quite comprehensive, allowing us to study the association of hand dominance with many different types of foot disorders simultaneously. In addition, our study was conducted using a well-established cohort with large numbers of both men and women and can be generalized to older men and women.

In conclusion, certain forefoot disorders were shown to be ipsilateral while other foot disorders were contralateral to the dominant hand depending on side of hand dominance in this sample of community-dwelling adults. It is possible that the side of the dominant hand was a proxy for biomechanics of the dominant foot that may explain some of the associations with ipsilateral forefoot disorders. The possible biomechanical-specific foot disorders may have clinical significance in that some of these forefoot disorders may be prevented with specially designed orthoses that balance the weight acceptance and propulsive peaks of the vertical ground reaction force. Despite the anecdotal reports by clinicians noting a link between hand dominance and side of foot disorders, our study observed no single overall pattern, but rather we saw several interesting patterns specific to certain foot disorders or conditions. Clinicians may want to consider the role of hand dominance upon the side of specific foot disorders in their practice. However they may note that our study showed no clear overall pattern between hand dominance and side of foot pain or disorder but future studies may clarify the possible role for these specific ipsilateral and contralateral results observed in this study. We believe that our study may have been the first to examine hand dominance and ipsilateral foot disorders in a population-based cohort. Future studies should examine whether the same biological mechanism that explains ipsilateral hand and foot preference may explain ipsilateral hand dominance and forefoot disorders.

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Table 1

Description of the Characteristics of the Framingham Foot Study Population

Characteristic	N=2089	% or Mean (SD)
Age (years) mean (SD)		64.8 (9.0)
36–49	80	3.8 %
50–99	527	25.2 %
60–69	840	40.2 %
70–79	515	24.7 %
80–92	127	6.1 %
Sex		
Females	1144	54.8 %
Males	945	45.2 %
Body Mass Index (Kg/m ²) mean (SD)		28.6 (5.5)
14.6–18.4	11	0.5 %
18.5–24.9	509	24.4 %
25.0–29.9	819	39.2 %
30.0–34.9	522	25.0 %
35.0–39.9	146	7.0 %
40.0–57.3	82	3.9 %
Height (m)	2089	1.7 (0.1)
Weight (kg)	2089	80.2(18.0)
Left-Handedness	228	10.9 %

Table 2

Prevalence of Side of Foot Condition or Disorder by Side of Hand Dominance: The Framingham Foot Study

<i>Foot Disorders</i>	All (n=2089)	
	Left Handed (N=228) n (%)	Right Handed (N=1861) n (%)
<i>Hallux Valgus</i>		
None	165 (72.4)	1310 (70.5)
Left Foot Only	17 (7.5)	116 (6.2)
Right Foot Only	8 (3.5)	112 (6.0)
Bilateral	38 (16.7)	321 (17.3)
<i>Tailor's Bunion</i>		
None	218 (95.6)	1763 (94.8)
Left Foot Only	3 (1.3)	28 (1.5)
Right Foot Only	2 (0.9)	15 (0.8)
Bilateral	5 (2.2)	53 (2.9)
<i>Hallux Rigidus</i>		
None	222 (97.4)	1800 (96.9)
Left Foot Only	2 (0.9)	13 (0.7)
Right Foot Only	1 (0.4)	23 (1.2)
Bilateral	3 (1.3)	22 (1.2)
<i>Plantar Fasciitis</i>		
None	222 (97.4)	1787 (96.2)
Left Foot Only	2 (0.9)	21 (1.1)
Right Foot Only	2 (0.9)	25 (1.4)
Bilateral	2 (0.9)	25 (1.4)
<i>Morton's Neuroma</i>		
None	203 (89.0)	1644 (88.5)
Left Foot Only	9 (4.0)	55 (3.0)
Right Foot Only	9 (4.0)	89 (4.8)
Bilateral	7 (3.1)	70 (3.8)
<i>Hammer Toes</i>		
None	172 (75.4)	1464 (78.8)
Left Foot Only	13 (5.7)	85 (4.6)
Right Foot Only	19 (8.3)	124 (6.7)
Bilateral	24 (10.5)	186 (10.0)
<i>Claw Toes</i>		
None	226 (99.1)	1812 (97.5)
Left Foot Only	0	12 (0.7)
Right Foot Only	0	18 (1.0)
Bilateral	2 (0.9)	16 (0.9)
<i>Overlapping Toes</i>		
None	206 (90.4)	1720 (92.5)
Left Foot Only	7 (3.1)	50 (2.7)

All (n=2089)		
<i>Foot Disorders</i>	Left Handed (N=228) n (%)	Right Handed (N=1861) n (%)
Right Foot Only	6 (2.6)	49 (2.6)
Bilateral	9 (4.0) *	40 (2.2) *
<i>Pes Cavus</i>		
None	145 (64.7)	1192 (65.4)
Left Foot Only	21 (9.4)	180 (9.9)
Right Foot Only	21 (9.4)	141 (7.7)
Bilateral	37 (16.5)	311 (17.0)
<i>Pes Planus</i>		
None	206 (92.0)	1688 (92.7)
Left Foot Only	7 (3.1)	48 (2.6)
Right Foot Only	7 (3.1)	54 (3.0)
Bilateral	4 (1.8)	32 (1.8)
<i>Foot Pain</i>		
None	188 (82.5)	1455 (78.3)
Left Foot Only	4 (1.8) *	76 (4.1) *
Right Foot Only	11 (4.8)	92 (4.9)
Bilateral	25 (11.0)	236 (12.7)
<i>Lesser Toe Deformities</i>		
None	158 (69.3)	1353 (72.8)
Left Foot Only	16 (7.0)	128 (6.9)
Right Foot Only	25 (11.0)	181 (9.7)
Bilateral	29 (12.7)	197 (10.6)
<i>Any Bunions</i>		
None	161 (70.6)	1259 (67.7)
Left Foot Only	18 (7.9)	137 (7.4)
Right Foot Only	10 (4.4)	124 (6.7)
Bilateral	39 (17.1)	339 (18.2)
<i>Any Foot Disorders</i>		
None	28 (12.3)	144 (7.7)
Left Foot Only	43 (18.9) **	339 (18.2) **
Right Foot Only	67 (29.4) **	635 (34.1) **
Bilateral	90 (39.5)	743 (39.9)

* 0.05 < p < 0.10 for difference in proportions compared with "None"

** 0.01 < p < 0.05 for difference in proportions compared with "None"

(All other comparisons of hand dominance and foot disorders laterality p>0.13)

Table 3

Adjusted Odds Ratios[/] of Hand Dominance and Ipsilateral Foot Condition or Disorder, Overall and by Side of Hand Dominance: The Framingham Foot Study

Foot Disorder	All (N=2089)		Left-Handed (N=228)		Right-Handed (N=1861)	
	OR	95% CI	OR	95% CI	OR	95% CI
Hallux Valgus	1.01	0.93 to 1.11	1.26	0.98 to 1.63 ζ	0.99	0.90 to 1.08
Tailor's Bunion	0.86	0.72 to 1.02 ζ	1.15	0.62 to 2.10	0.83	0.70 to 1.00[*]
Hallux Rigidus	1.29	0.97 to 1.72 ζ	1.28	0.57 to 2.87	1.30	0.95 to 1.76 ζ
Plantar Fasciitis	1.08	0.82 to 1.42	1.00	0.37 to 2.73	1.09	0.82 to 1.45
Morton's Neuroma	1.27	1.07 to 1.51^{**}	1.00	0.57 to 1.76	1.30	1.09 to 1.56^{**}
Hammer Toes	1.13	1.01 to 1.26[*]	0.83	0.58 to 1.18	1.18	1.05 to 1.33^{**}
Claw Toes	1.20	0.86 to 1.68	NA	NA	1.22	0.85 to 1.74
Overlapping Toes	1.00	0.81 to 1.24	1.07	0.66 to 1.76	0.99	0.78 to 1.25
Pes Cavus	0.89	0.80 to 0.99[*]	1.00	0.71 to 1.40	0.88	0.79 to 0.98[*]
Pes Planus	1.07	0.84 to 1.38	1.00	0.48 to 2.10	1.08	0.83 to 1.41
Foot Pain	1.03	0.94 to 1.13	0.77	0.59 to 1.02 ζ	1.06	0.96 to 1.18
Lesser Toe Deformities	1.15	1.02 to 1.29[*]	0.78	0.55 to 1.10	1.21	1.07 to 1.37[*]
Any Bunions	0.99	0.90 to 1.08	1.22	0.94 to 1.58	0.96	0.87 to 1.06
Any Foot Disorders	1.79	1.56 to 2.06^{***}	0.63	0.42 to 0.93[*]	2.05	1.77 to 2.38^{***}

[/] Adjusted for age, sex, body mass index.

^{*} **0.01 < p < 0.05,**

^{**} **0.001 < p < 0.01,**

^{***} **p < 0.0001, in bold**

ζ 0.05 < p < 0.1