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Impact of Demographic and Impairment-Related Variables on Disability Associated With Plantar Fasciitis

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ABSTRACT

***Background*: Plantar fasciitis is a common foot disorder that impacts many functional activities. Research that quantifies the impact that plantar fasciitis has on function is lacking. In addition, little is known about which variables are associated with disability in patients with plantar fasciitis. The first purpose of this study was to determine if age, gender, body mass index, pain intensity, chronicity of symptoms, or ankle dorsiflexion range of motion was associated with disability in patients with plantar fasciitis. The second purpose was to describe the impact that plantar fasciitis has on functional status in the context of five functional domains: household activities of daily living, usual work and hobbies, nonweightbearing activities, walking-related activities, and running-related activities. *Methods*: Fifty consecutive patients diagnosed with unilateral plantar fasciitis were recruited. Demographic and impairment data were collected and all patients completed the Lower Extremity Functional Scale (LEFS), a validated self-report measure of disability. Multiple regression analysis was used to describe the association between the variables and disability. Graphs depicting five domains of function derived from the LEFS were generated to describe the extent of disability. *Results*: Body mass index (BMI) was the only variable that was significantly associated with disability ($F = 9.87$, $p = .003$). Measures of pain intensity, ankle dorsiflexion, age, gender, chronicity, and time spent weightbearing were not related to disability. Plantar fasciitis showed distinct patterns of disability depending on the functional domain that was assessed. *Conclusions*: With the exception of BMI, impairment and demographic variables do not predict the extent of functional loss in patients with plantar fasciitis. The most likely domains of function to be at least moderately affected in patients with plantar fasciitis are running-related activities and usual work or hobbies.**

Key Words: Disability; Impairment; Plantar Fasciitis

INTRODUCTION

Plantar fasciitis, a localized inflammation of the plantar aponeurosis, is reported to be the most common cause of heel pain.[24] An estimated 1 in 10 people will develop the condition over a lifetime[6] and approximately 2,000,000 Americans are affected annually.[18] It is frequently seen in active populations such as runners[13,29,30] and soldiers,[22] but also in sedentary individuals.[7,33] There is no clear consensus on the etiology of plantar fasciitis, but overuse due to prolonged weightbearing or unaccustomed activity, obesity, and limited dorsiflexion range of motion have all been implicated as contributing factors.[21,30] Generally, the diagnosis is based on symptoms, most commonly pain and tenderness in the region of the bony attachment of the plantar fascia on the medial tubercle of the calcaneus and the classic complaint of first steps pain (significant pain upon weightbearing and initial steps taken after a period of nonweightbearing).[30]

In spite of the prevalence of plantar fasciitis and the relative abundance of published studies that have examined treatment strategies, quantitative studies of the impact of plantar fasciitis on physical function have not, to our knowledge, been previously reported in the literature. One method of gathering data regarding disablement is to survey patients directly about the problems they have as a result of the condition. The Lower Extremity Functional Scale (LEFS) is a validated functional status measure designed to measure lower

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extremity function and therefore has potential utility when used on patients with plantar fasciitis.[4]

Generally, functional status measures like the LEFS are used to document function and measure change in function over time in individual patients or as research tools for group analysis of interventions. Functional status measures are also useful for descriptive research, identifying the nature and extent of disability commonly associated with a particular condition.[19] We found no studies that attempted to characterize the type and extent of disability in patients diagnosed with plantar fasciitis.

Much research has focused on identifying the determinants of disability, those factors which appear to explain a portion of the disability in a given diagnostic group.[10,25,27] The general role of this type of research has been to identify factors, most commonly patient level (e.g., age, gender), disease level (e.g., laboratory test, radiographic finding), and impairment level (e.g., reduced muscle strength, reduced range of motion) variables, which are significantly associated with disability as measured with a functional status instrument. If research can identify factors that explain the variance in disability for a given disorder, better interventions can potentially be designed to reduce disability or prevent disability in susceptible groups. Identification of the characteristics of patients with plantar fasciitis who are likely to experience the most disability or, conversely, to experience only minimal disability will also add to the understanding of this condition. No research was found that attempted to identify factors that are associated with the degree of disability in patients with plantar fasciitis.

Our primary purpose was to determine if age, gender, body mass index (BMI), chronicity of symptoms, or ankle dorsiflexion range of motion is associated with the extent of disability reported by patients with plantar fasciitis. Our second purpose was to describe the impact of plantar fasciitis on functional status in the context of the five functional domains of household activities of daily living, usual work and hobbies, nonweightbearing activities, walking-related activities, and running-related activities.

MATERIALS AND METHODS

Subjects

A total of 50 subjects with plantar fasciitis were recruited from two outpatient physical therapy clinics in the suburban Richmond, Virginia area. Patients who were diagnosed by physicians with plantar fasciitis and who met the following diagnostic criteria were admitted to the study: pain reported to be in the area of the attachment of the plantar fascia on the medial tubercle of the calcaneus, pain in the plantar aspect of the heel when first taking steps in the morning, and pain with weightbearing during the day.[5,16,24] Only patients who had not been instructed by the referring physician to do ankle plantar flexor muscle stretching exercises for treatment of plantar fasciitis were included in the study. Patients diagnosed by the referring physician with a rheumatic disease, tarsal tunnel syndrome, or a calcaneal stress fracture, or any other musculoskeletal disorder that would affect lower extremity function, were excluded. Patients with bilateral heel pain were also excluded. Five patients had been diagnosed with diabetes and five had hypertension. Patients reported no other comorbidities. Data on smoking status were not collected. The patients admitted to this study were part of a case control study designed to identify risk factors for plantar fasciitis.[21] The mean age of the patients was 49 (SD = 11) years. See Table 1 for a description of the sample.

Table 1: Characteristics of the patients

Variable	$n = 50$ (%)
Sex	
Male	17 (34)
Female	33 (66)
Age, years	
30–40	11 (22)
41–50	18 (36)
51–60	16 (32)
61–70	1 (2)
>70	4 (8)
Body Mass Index (kg/m^2)	
25 or less	10 (20)
>25 to 30	11 (22)
>30	29 (58)
On feet majority of workday	
Yes	12 (24)
No	38 (76)
Recreational jogger	
Yes	4 (8)
No	46 (92)
Ankle dorsiflexion (involved side)	
>10°	5 (10)
6°–10°	4 (8)
1°–5°	24 (48)
0° or less	17 (34)
LEFS score (median, mean, SD, min, max)	55.5, 53.8, 15.3, 12, 80

Procedures

Patients admitted to the study were required to read and sign an IRB-approved consent form. Each patient reported their height and weight which we used to calculate BMI (kg/m^2). Self-reported height and weight data have been shown to be valid indicators of actual BMI (Pearson correlation coefficient $r = .89–.97$).[15] Patients also answered ''yes'' or ''no'' to the following questions: ''Do you spend the majority of your workday on your feet?'' and ''Do you run or jog on a regular basis?'' In addition, patients marked a 10-cm visual analog scale for pain intensity. The scale was anchored at one end with ''no pain'' and at the other end with ''worst pain imaginable.'' Patients were asked to place a mark on the scale that represented their pain when it was at its worst. The patients then completed the LEFS.[4]

The LEFS was developed for use in patients with a wide variety of both acute and chronic musculoskeletal conditions of the lower extremity. It is a time-efficient self-report measure that patients complete in approximately 3 minutes or less. The LEFS has 20 items and each item is rated between 0 and 4, corresponding to the degree of difficulty or limitation with a particular activity. A maximum score of 80 indicates a high level of function while a score of 0 indicates severe disability.

The LEFS is designed to measure physical function from several perspectives and is based on the World Health Organization's model of disability. Items were designed to measure nonweightbearing-related function (e.g., putting on shoes or socks), while other items capture walking-related (e.g., walking two blocks) and running-related (e.g., running on even ground) function. Still other items assess household activities of daily living (e.g., getting in or out of bath) and occupational disability (e.g., usual work activities). Test-retest reliability has been reported as excellent (ICC = .86) and correlations with the physical function subscale and the physical component score of the SF-36 (Pearson $r = .80$ and .64) support the construct validity of the LEFS.[4] The instrument has been validated on patients with a variety of lower extremity conditions[4] and specifically on patients with ankle sprains[1] and total joint arthroplasty.[26]

One physical therapist with 25 years of clinical experience measured passive talocrural dorsiflexion range of motion of the patient's involved side. Each patient was asked to lie prone on the examination table with the knees fully extended and feet over the edge of the plinth. The examiner first identified the subtalar joint neutral position of the involved foot. To identify the subtalar joint neutral position, the foot was passively pronated and supinated until the medial and lateral sides of the talar head were neither depressed nor protruded.[17] Once the subtalar joint neutral position was identified and maintained, the axis of the goniometer, marked in 1° increments, was placed over the lateral malleolus. One arm of the goniometer was aligned with the lateral border of the foot and the other arm was aligned with the lateral border of the lower leg. The talocrural joint was then passively dorsiflexed until a firm end feel was perceived by the examiner.[9] The dorsiflexion angle was measured and an investigator (MP) recorded the measurement.

A pilot study was conducted to determine the intrarater reliability of the measurement of talocrural dorsiflexion in subjects with plantar fasciitis. Ten subjects with plantar fasciitis were measured twice by the physical therapist participating in this study. The therapist used the same measurement procedures as those in the study and the goniometer scale was covered to reduce potential bias. An intraclass correlation coefficient (ICC 2,1) of .97 was found indicating the therapist's measures were highly reliable.[23]

Data Analysis

To examine the relationship between functional status and the independent variables of age, gender, pain intensity, chronicity, time spent weightbearing, and passive dorsiflexion range of motion, we used multiple linear regression with backward elimination and an F test p value of .10 to remove or enter variables from/into the model. We also calculated a correlation matrix of the variables to describe the univariate relationships among the variables.

To describe the patterns of disability for the domains of nonweightbearing-related function, walking-related function, running-related function, household activities of daily living, and recreational and occupational disability, five line graphs were generated using Microsoft Excel. The graphs display the proportions of answers (no difficulty, a little difficulty, moderate difficulty, quite a bit of difficulty, extreme difficulty) for each item in the five domains of function captured in the scale.

RESULTS

Multiple regression indicated that BMI was the only variable that stayed in the model ($F = 9.87$, $p = .003$). BMI explained 17% of the variance in disability as measured by the LEFS. After correcting for multiple comparisons in a univariate analysis, BMI was the only variable that was significantly related to disability (see Table 2).

The five line graphs demonstrated distinctive patterns depending on the domain of function that was summarized. Nonweightbearing activities (Fig. 1) and household activities of daily living (Fig. 2) tended to have the largest proportion of patients reporting no difficulty or a little difficulty with the items. A majority of patients

Table 2: Correlation matrix of variables

	Age	BMI	Dorsiflexion	Chronicity (days)	Pain	LEFS Score
Age (years)	1	.11	.07	.21	−.02	−.09
BMI (m/kg^2)	—	1	−.23	.06	.19	−.41*
Dorsiflexion (deg)	—	—	1	−.05	−.15	.25
Chronicity (days)	—	—	—	1	.25	−.01
Pain (VAS)	—	—	—	—	1	−.25
LEFS score	—	—	—	—		1

*$p = .003$

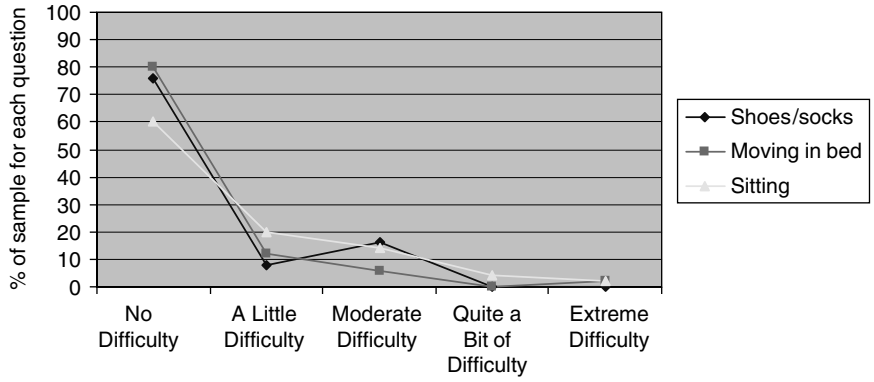

Fig. 1: Summary of proportion of answers to each question related to nonweightbearing activities.

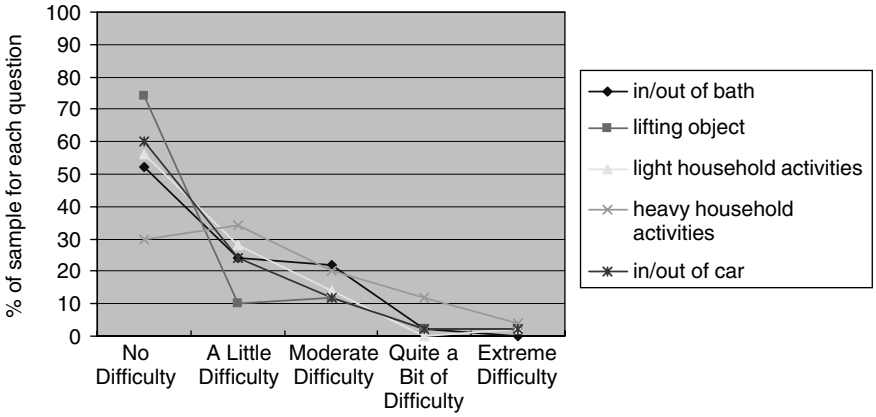

Fig. 2: Summary of proportion of answers to each question related to household activities of daily living.

indicated they had a little difficulty or moderate difficulty with usual work or hobbies (Fig. 3) and walking-related activities (Fig. 4). The most difficult domain of function was running-related activities (Fig. 5) where approximately 70% of patients indicated they had at least moderate difficulty with these items.

DISCUSSION

Variables that are found to be strongly correlated with disability are thought to be important variables for diagnosis and treatment. Lumbar spine flexion measures, for example, are consistently the impairment measures that are most related to disability[8,12,32] and are therefore commonly recommended for examination and to monitor change with treatment.[2,3,28] BMI was the only variable found to be significantly related to the extent of disability reported by patients with plantar fasciitis. Measures of pain intensity and passive ankle dorsiflexion were not significantly correlated with extent of disability. Patient age, gender, time spent weightbearing, and chronicity of symptoms were also

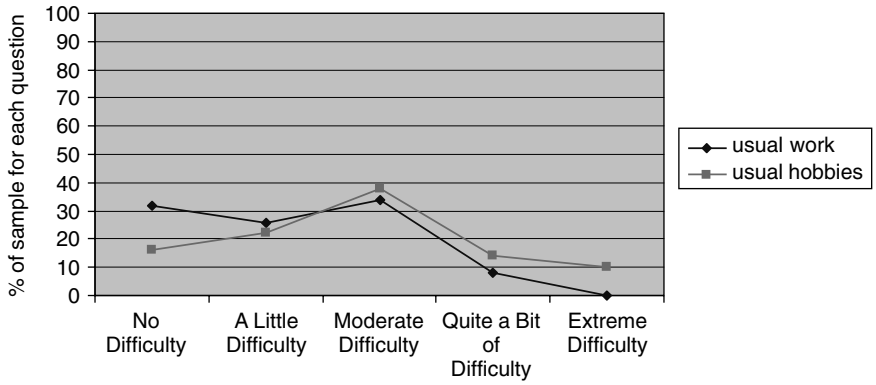

Fig. 3: Summary of proportion of answers to each question related to usual work or hobbies.

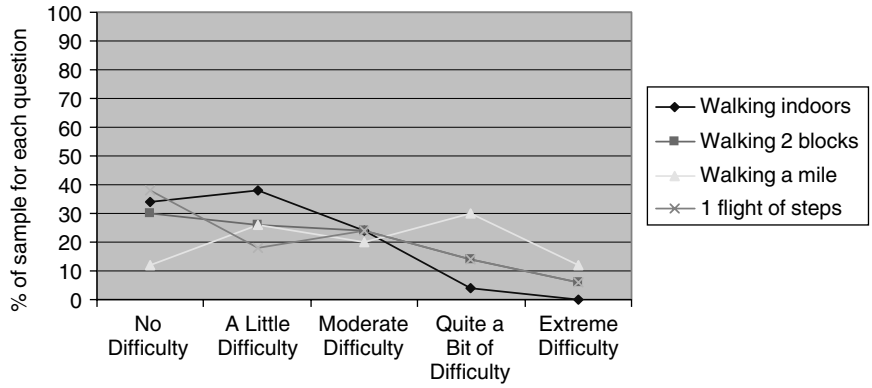

Fig. 4: Summary of proportion of answers to each question describing walking-related activities.

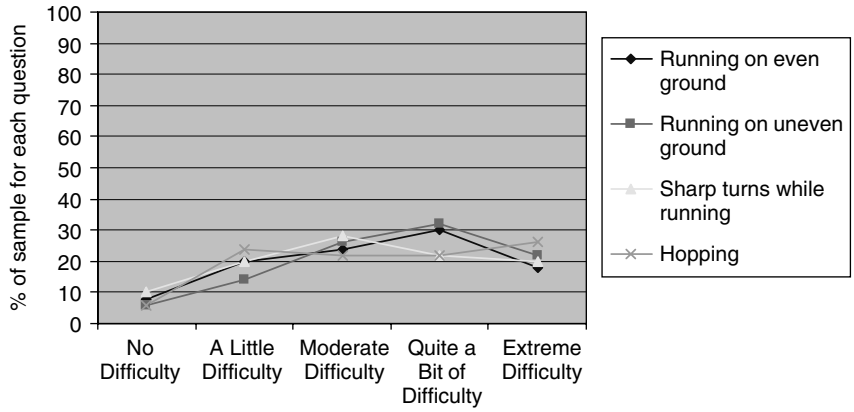

Fig. 5: Summary of proportion of answers to each question describing running-related activities.

not found to be related to extent of disability. While ankle dorsiflexion has recently been demonstrated to be an important risk factor for plantar fasciitis,[21] our data suggest that the extent of dorsiflexion loss has little to do with how much functional loss a patient with plantar fasciitis may have. BMI, on the other hand, appears to be not only an important risk factor for plantar fasciitis,[20,21] but also an important predictor of the extent of functional loss reported by patients. The slope of the regression line predicting LEFS score from BMI was −1.0 (SE = .32), suggesting that for every point increase in body mass index, the average increase in disability (lower score) is 1 point on the LEFS. For example, patients with a BMI of 40 will, on average, have a LEFS score that is 10 points less (i.e., more severe disability by 10 points) than patients with a BMI of 30. Obesity has a strong association with many disorders and it appears that plantar fascitis is no

exception.[11,14,31] It appears that interventions designed for obese patients with plantar fasciitis should address the obesity.

The magnitude of functional loss as measured by the LEFS ranged from 12 to 80 with a mean of 53.8 (SD = 15.3). One limitation to using measures like LEFS is that interpretation of the score is difficult because no standards have been developed to allow for an interpretation of the meaningfulness of the score. However, scores from one patient group can be compared to scores from another patient group to develop a sense of what the disability score indicates. The mean LEFS score for 50 patients who had 4 weeks of physical therapy following knee or hip arthroplasty was 36 (SD = 13).[26] Remembering that higher scores indicate higher function, patients with plantar fasciitis generally are less disabled than patients who have had 4 weeks of therapy following hip or knee arthroplasty. However, 20% ($n = 8$) of our sample had LEFS scores below the mean for patients who had 4 weeks of therapy following hip or knee arthroplasty, suggesting that approximately 20% of patients with plantar fasciitis have disability that reaches the moderate or severe range.

In 52 patients with ankle sprains of 2 weeks' duration or less, the mean LEFS score was 40 (SD = 18) and after 1 week of physical therapy the mean score was 53 (SD = 16).[1] Patients with plantar fasciitis have a level of disability that is comparable to patients who have had acute ankle sprains and 1 week of physical therapy. These data suggest to us that in most cases the disability associated with plantar fasciitis is relatively mild.

The pattern of disability was also explored in this study and distinctive patterns were found depending on the domain of function that was examined. Running-related activities were most severely affected, which is consistent with published reports.[13,24] However, our sample only included four persons who reported that they were recreational joggers. Running-related activities are among the most difficult not only for patients who are recreational or competitive runners, but also for patients with plantar fasciitis who are relatively sedentary.

Usual work or hobbies was the next most affected domain of function. We did not collect detailed information on the specific work or hobby activities that were problematic, so we cannot identify those activities related to work or hobbies that were impacted. It appears, however, that plantar fascitis impacts not only recreational activities but also work-related activities in approximately 70% or more of people diagnosed with plantar fasciitis.

Walking-related activities were also affected in 60–70% of the sample. In most cases, the difficulty was reported to be mild or moderate. Walking-related activities are clearly affected in most patients with plantar fasciitis but the extent of involvement is severe (quite a bit or extreme) in only approximately 20% of the sample.

Nonweightbearing activities and household activities of daily living are affected only minimally if at all in the majority of patients with plantar fasciitis. Approximately 30% of the patients reported at least moderate difficulty with heavy household activities but, in general, household and nonweightbearing activities are the least affected domains of function.

Our study has some limitations. Our sample was comprised mostly of patients who reported that they were not recreational joggers. Results are likely not generalizable to patients with plantar fasciitis who are recreational or competitive joggers. Our sample size was relatively small. A larger sample may demonstrate different associations with demographic and impairment variables or different patterns of disability in the functional domains. We only examined the physical impairments of pain intensity and reduced dorsiflexion. Other physical impairment measures or measures of psychological impairment may show a stronger relationship with disability. Further research in this area is needed.

SUMMARY AND CONCLUSIONS

In summary, we identified only one variable that is associated with the extent of disability in patients with plantar fasciitis. A patient's BMI appears not only to increase the risk of plantar fasciitis but also to contribute to the severity of the patient's disability. The pattern of disability varies depending on the domain of function. Of the five functional domains described, running-related activities and usual work or hobbies appear to be most severely affected by plantar fasciitis.

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