

# Plantar fasciitis in physicians and nurses: a nationwide population-based study

Kuo-Chang SUNG<sup>1a</sup>, Jui-Yuan CHUNG<sup>2a</sup>, I-Jung FENG<sup>3</sup>, Shu-Han YANG<sup>4</sup>,  
Chien-Chin HSU<sup>1,5</sup>, Hung-Jung LIN<sup>1,6</sup>, Jhi-Joung WANG<sup>3,7</sup> and Chien-Cheng HUANG<sup>1,8,9\*</sup>

<sup>1</sup>Department of Emergency Medicine, Chi-Mei Medical Center, Taiwan

<sup>2</sup>Department of Emergency Medicine, Cathay General Hospital, Taiwan

<sup>3</sup>Department of Medical Research, Chi-Mei Medical Center, Taiwan

<sup>4</sup>Department of Physical Medicine and Rehabilitation, Chi-Mei Medical Center, Taiwan

<sup>5</sup>Department of Biotechnology, Southern Taiwan University of Science and Technology, Taiwan

<sup>6</sup>Department of Emergency Medicine, Taipei Medical University, Taiwan

<sup>7</sup>Allied AI Biomed Center, Southern Taiwan University of Science and Technology, Taiwan

<sup>8</sup>Department of Senior Services, Southern Taiwan University of Science and Technology, Taiwan

<sup>9</sup>Department of Environmental and Occupational Health, College of Medicine, National Cheng Kung University, Taiwan

*Received May 1, 2019 and accepted September 13, 2019*

*Published online in J-STAGE September 20, 2019*

**Abstract:** Physicians and nurses in Taiwan have heavy workload and long working hours, which may contribute to plantar fasciitis. However, this issue is unclear, and therefore, we conducted this study to delineate it. We conducted a nationwide population-based study by identifying 26,024 physicians and 127,455 nurses and an identical number of subjects for comparison (general population) via the National Health Insurance Research Database. The risk of plantar fasciitis between 2006 and 2012 was compared between physicians and general population, between nurses and general population, and between physicians and nurses. We also compared the risk of plantar fasciitis among physician subgroups. Physicians and nurses had a period prevalence of plantar fasciitis of 8.14% and 13.11% during the 7-yr period, respectively. The risk of plantar fasciitis was lower among physicians (odds ratio [OR]: 0.660; 95% confidence interval [CI]: 0.622–0.699) but higher among nurses (OR: 1.035; 95% CI: 1.011–1.059) compared with that in the general population. Nurses also had a higher risk than the physicians after adjusting for age and sex (adjusted odds ratio [AOR]: 1.541; 95% CI: 1.399–1.701). Physician subspecialties of orthopedics and physical medicine and rehabilitation showed a higher risk. Female physicians had a higher risk of plantar fasciitis than male physicians. This study showed that nurses, physician specialties of orthopedics and physical medicine and rehabilitation, and female physicians had a higher risk of plantar fasciitis. Improvement of the occupational environment and health promotion are suggested for these populations.

**Key words:** Plantar fasciitis, Occupation, Physician, Nurse

<sup>a</sup>These authors contributed equally.

\*To whom correspondence should be addressed.

E-mail: chienchenghuang@yahoo.com.tw

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## Introduction

Plantar fasciitis is one of the most common etiologies

of heel pain, which affects approximately two million people in the United States<sup>1</sup>), making up 11–15% of the foot symptoms requiring professional care<sup>2</sup>). About 10% of people have been reported to develop plantar fasciitis in their life time<sup>3</sup>), with 83% of these patients being active working adults aged between 25 and 65 yr<sup>4</sup>). In the United Kingdom, about 8% of ankle consultations and musculoskeletal foot were plantar fasciitis<sup>5</sup>). In a large cohort study in the Australia, 17.4% of adult participants had foot pain<sup>6</sup>).

Plantar fasciitis may be caused by several preliminary factors, including occupational prolonged weight-bearing, rapid increases in activity levels, hard surfaces, inadequate stretching, inappropriate footwear, limited ankle dorsiflexion, Achilles tendon tightness, age, excessive foot pronation, and obesity<sup>1, 3, 7–13</sup>). These factors would create pathologic overload over the calcaneal insertion of the plantar fascia, causing microtears in the fascia that may eventually lead to perifascial edema and increased heel pad thickness<sup>3, 8, 12, 13</sup>). Heel pad thickening would further increase the inflexibility of the posterior structures of the foot, resulting in disruption of the normal biomechanics of the foot that leads to decreased efficiency of force absorption<sup>14</sup>). This decrease in force absorption would consequently lead to overloading of the plantar fascia and increase the degenerative changes, including collagen necrosis, angiofibroblastic hyperplasia, chondroid metaplasia, and matrix calcification<sup>15</sup>).

The occurrence of plantar fasciitis is usually associated with work-related prolonged weight-bearing. People involved in occupations that require continual standing or walking, such as waiters, maids, kitchen workers, athletics, and military personnel, are at a higher risk of developing plantar fasciitis<sup>16–18</sup>). Several studies have focused on the relationship between the risk of plantar fasciitis and specific occupations<sup>17, 18</sup>). Physicians and nurses in Taiwan have heavy workload, long working hours with standing or walking particularly since the launch of the National Health Insurance in 1995, which might increase the risk of musculoskeletal diseases (e.g., cervical and lumbar herniated intervertebral discs)<sup>19, 20</sup>) including plantar fasciitis. However, to our knowledge, no study has yet analyzed the risk of plantar fasciitis as well as other lower extremity injuries in physicians and nurses in comparison with that in the general population. Therefore, the aim of this study was to investigate the risk of plantar fasciitis among physicians, nurses, and general population. We hypothesized that physicians and nurses might have a higher risk of plantar fasciitis than the general population.

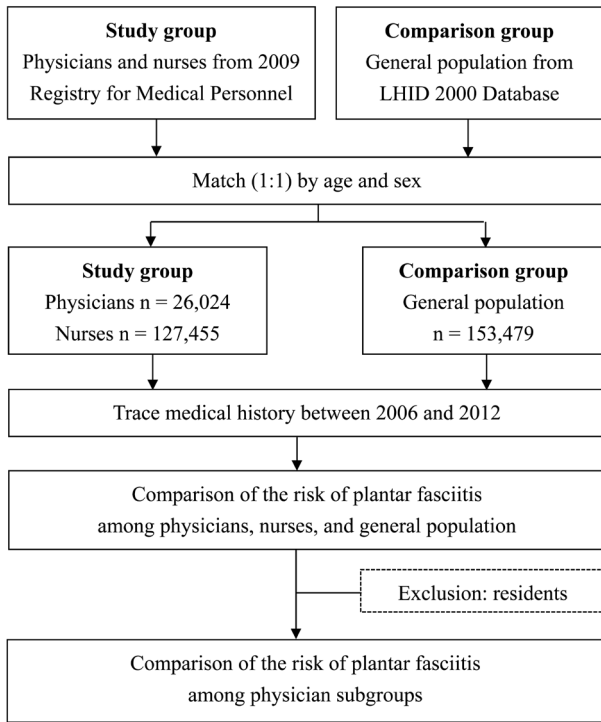
## Subjects and Methods

### *Data sources*

The 2009 Registry for Medical Personnel and the Longitudinal Health Insurance Database 2000 (LHID 2000), two sub-datasets of the National Health Insurance Research Database (NHIRD), were used in this study. The 2009 Registry for Medical Personnel contains information about the specialty, date licensed, work area, hospital level, types of employment, and encrypted identification number of physicians, nurses, pharmacists, and other healthcare providers, which can be linked to the aforementioned claims data<sup>19–28</sup>). The LHID 2000 contains all claims data of 1 million (4.34% of the total population) beneficiaries who were randomly selected from the NHIRD<sup>29</sup>). The NHIRD is derived from Taiwan National Health Insurance Program, a universal healthcare system that covers almost 100% of the country's population<sup>29</sup>). The database of this program contains registration files and original claims data for reimbursement. Large computerized databases derived from this system by the National Health Insurance Administration, Ministry of Health and Welfare, Taiwan, and maintained by the National Health Research Institutes, Taiwan, are provided to scientists in Taiwan for research purposes<sup>29</sup>).

### *Study design*

We identified physicians and nurses from the 2009 Registry for Medical Personnel and general population (excluding healthcare providers) from the LHID 2000 registered in 2009 by matching age and sex at 1:1 ratio for this study (Fig. 1). Plantar fasciitis was defined by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes of 727.06, 727.9, 728.71, or 729.4. Diagnosis of plantar fasciitis is a clinical impression according to history (e.g., work-related prolonged weight-bearing) and physical examination (e.g., heel pain with first steps in the morning or after prolonged sitting and sharp pain with palpation of the medial plantar calcaneal region)<sup>3, 7–13, 30</sup>). Exclusion criteria were lacks of the information of age, sex, and occupation. Medical comorbidities were not included into this study because they are not suggested to be the risk factors and potential confounders for plantar fasciitis<sup>30</sup>). We compared the period prevalence of plantar fasciitis between physicians and general population, between nurses and general population, between physicians and nurses, and among physician subgroups by tracing their medical histories between January 1, 2006, and December 31, 2012. In the comparison among physician subgroups, we excluded residents



**Fig. 1. The flowchart of this study.**  
LHID 2000, Longitudinal Health Insurance Database 2000.

because they did not have a specialty board, which makes it difficult to categorize them into individual physician specialty. Age was classified as four subgroups (<35, 35–49, 50–64, and ≥65) according to previous studies in healthcare professionals<sup>22, 23</sup>. We classified the physicians into the following 15 specialties for the analysis: ear, nose, and throat (ENT), anesthesiology, orthopedics, emergency medicine, ophthalmology, family medicine, internal medicine, psychiatry, obstetrics and gynecology (Ob/gyn), pediatrics, physical medicine and rehabilitation (PM&R), radiology, dermatology, surgery, and others.

*Ethics statement*

This study was conducted according to the Declaration of Helsinki. The Institutional Review Board at the Chi-Mei Medical Center approved this study and waived the need for informed consents from participants because the dataset consists of de-identified data. This waiver does not affect the rights and welfare of the participants.

*Statistical analysis*

We used  $\chi^2$  test for categorical variables and independent *t*-test for continuous variables to compare the demographic characteristics between the two groups. Conditional logistic regression was used to compare the risk of plantar fasciitis between physicians and general population and between nurses and general population. The risks of plantar fasciitis between physicians and nurses and among different physician subgroups were compared by unconditional logistic regression with adjustment of age and sex. In addition to overall risk of plantar fasciitis, stratified analyses according to age and sex were also performed to evaluate the effect modification. SAS (version 9.4 for Windows, SAS Institute, Inc., Cary, NC, USA) was used for all the analyses in this study. Significance was set at 0.05 (two-tailed).

**Results**

We identified a total of 153,479 healthcare providers, including 26,024 physicians and 127,455 nurses, as the study group and 153,479 age- and sex-matched participants selected from the general population as the comparison group (Table 1). The mean age of the physicians and nurses was 47.56 and 33.20 yr, respectively. Among the physicians, those aged 35–49 yr comprised the largest age subgroup (50.09%), followed by those aged 50–64 yr (29.46%), <35 yr (13.14%), and ≥65 yr (7.31%). Among

**Table 1. Demographic characteristics of physicians, nurses, and matched general population**

Variable	Physicians	General population	<i>p</i> -value	Nurses	General population	<i>p</i> -value
	(n=26,024)	(n=26,024)		(n=127,455)	(n=127,455)	
Age (yr)	47.56 (11.28)	47.56 (11.28)	>0.999	33.20 (8.69)	33.20 (8.69)	>0.999
Age (yr)			>0.999			>0.999
<35	3,419 (13.14)	3,419 (13.14)		85,296 (66.92)	85,296 (66.92)	
35–49	13,036 (50.09)	13,036 (50.09)		35,564 (27.90)	35,564 (27.90)	
50–64	7,667 (29.46)	7,667 (29.46)		6,398 (5.02)	6,398 (5.02)	
≥65	1,902 (7.31)	1,902 (7.31)		197 (0.15)	197 (0.15)	
Sex			>0.999			>0.999
Male	22,265 (85.56)	22,265 (85.56)		1,197 (0.94)	1,197 (0.94)	
Female	3,759 (14.44)	3,759 (14.44)		126,258 (99.06)	126,258 (99.06)	

Data are number (%) or mean ± standard deviation.

**Table 2. Comparison of the risk of plantar fasciitis between physicians and general population by conditional logistic regression**

	Number (%)	OR (95% CI)
Overall analysis		
Physicians	2,118 (8.14)	0.660 (0.622–0.699)
General population	3,079 (11.83)	1 (reference)
Stratified analyses		
Age subgroup		
<35		
Physicians	272 (7.96)	0.765 (0.648–0.904)
General population	347 (10.15)	1 (reference)
35–49		
Physicians	1,116 (8.56)	0.713 (0.658–0.774)
General population	1,512 (11.60)	1 (reference)
50–64		
Physicians	613 (8.00)	0.583 (0.524–0.648)
General population	994 (12.96)	1 (reference)
≥65		
Physicians	117 (6.15)	0.486 (0.385–0.613)
General population	226 (11.88)	1 (reference)
Sex		
Male		
Physicians	1,771 (7.95)	0.672 (0.630–0.716)
General population	2,538 (11.40)	1 (reference)
Female		
Physicians	347 (9.23)	0.603 (0.523–0.697)
General population	541 (14.39)	1 (reference)

OR: odds ratio; CI: confidence interval.

the nurses, those aged <35 yr comprised the largest age subgroup (66.92%), followed by the nurses aged 35–49 yr (27.90%), 50–64 yr (5.02%), and ≥65 yr (0.15%). Male participants predominated among the physicians (85.56%), whereas female participants predominated among the nurses (99.06%).

Physicians and nurses had a period prevalence of plantar fasciitis of 8.14% and 13.11% during the 7 yr period, respectively (Table 2). Conditional logistic regression analysis showed that physicians had an overall lower risk of plantar fasciitis than that in the general population (odds ratio [OR]: 0.660; 95% confidence interval [CI]: 0.622–0.699) and stratified analyses according to age and sex. Plantar fasciitis was more likely to occur in the nurses than in the general population (OR: 1.035; 95% CI: 1.011–1.059). Stratified analysis showed that nurses had a higher risk of plantar fasciitis only in the subgroups of age <35 yr (OR: 1.170; 95% CI: 1.136–1.205) and female population (OR: 1.035; 95% CI: 1.011–1.059) (Table 3). The unconditional logistic regression analysis showed that nurses had a higher risk of plantar fasciitis than that among

**Table 3. Comparison of the risk of plantar fasciitis between nurses and general population by conditional logistic regression**

	Number (%)	OR (95% CI)
Overall analysis		
Nurses	16,705 (13.11)	1.035 (1.011–1.059)
General population	16,212 (12.72)	1 (reference)
Stratified analyses		
Age subgroup		
<35		
Nurses	10,793 (12.65)	1.170 (1.136–1.205)
General population	9,393 (11.01)	1 (reference)
35–49		
Nurses	4,801 (13.50)	0.868 (0.833–0.906)
General population	5,418 (15.23)	1 (reference)
50–64		
Nurses	1,071 (16.74)	0.741 (0.678–0.810)
General population	1,365 (21.33)	1 (reference)
≥65		
Nurses	40 (20.30)	1.139 (0.690–1.879)
General population	36 (18.27)	1 (reference)
Sex		
Male		
Nurses	126 (10.53)	1.046 (0.804–1.362)
General population	121 (10.11)	1 (reference)
Female		
Nurses	16,579 (13.13)	1.035 (1.011–1.059)
General population	16,091 (12.74)	1 (reference)

OR: odds ratio; CI: confidence interval.

the physicians after adjusting for age and sex (adjusted odds ratio [AOR]: 1.541; 95% CI: 1.399–1.701) (Table 4). Among physician subgroups, the risk was higher among the physician specialties of PM&R and orthopedics than that among the subgroups of other specialties after adjusting for age and sex (AOR: 1.547; 95% CI: 1.208–1.981 and AOR: 1.404; 95% CI: 1.008–1.955, respectively), however, the specialties of emergency medicine, internal medicine, radiology, and surgery had a lower risk of plantar fasciitis. In terms of sex, the risk of plantar fasciitis was higher among female physicians than that among male physicians (AOR: 1.454; 95% CI: 1.011–1.297) (Table 5).

## Discussion

In this study, we found that the risk of plantar fasciitis was lower in physicians than that among the general population. In contrast, the risk of plantar fasciitis was higher among nurses in the subgroups of age <35 yr and female population than that among the general population. Nurses also showed a higher risk than the physicians. Physician

**Table 4. Comparison of the risk of plantar fasciitis between physicians and nurses by unconditional logistic regression**

	Number (%)	OR (95% CI)	AOR (95% CI)*
Overall analysis			
Physicians	2,118 (8.14)	1 (reference)	1 (reference)
Nurses	16,705 (13.11)	1.704 (1.623–1.786)	1.541 (1.399–1.701)
Stratified analyses			
Age subgroup			
<35			
Physicians	272 (7.96)	1 (reference)	1 (reference)
Nurses	10,793 (12.65)	1.675 (1.479–1.901)	1.613 (1.372–1.894)
35–49			
Physicians	1,116 (8.56)	1 (reference)	1 (reference)
Nurses	4,801 (13.50)	1.667 (1.558–1.786)	1.414 (1.232–1.623)
50–64			
Physicians	613 (8.00)	1 (reference)	1 (reference)
Nurses	1,071 (16.74)	2.315 (2.083–2.571)	1.572 (1.184–2.083)
≥65			
Physicians	117 (6.15)	1 (reference)	1 (reference)
Nurses	40 (20.30)	3.891 (2.618–5.780)	1.675 (0.703–3.984)
Sex			
Male			
Physicians	1,771 (7.95)	1 (reference)	1 (reference)
Nurses	126 (10.53)	1.363 (1.126–1.647)	1.285 (1.035–1.595)
Female			
Physicians	347 (9.23)	1 (reference)	1 (reference)
Nurses	16,579 (13.13)	1.484 (1.328–1.661)	1.575 (1.408–1.764)

OR: odds ratio; CI: confidence interval. \*Adjusted for age and sex.

specialties of PM&R and orthopedics and female physicians had a higher risk of plantar fasciitis than that among their counterparts.

The possible reason for the lower risk of plantar fasciitis among physicians than that among the general population and nurses is that physicians may have better medical knowledge, which protects them suffering from the disease. There is no study comparing the risk of plantar fasciitis in this regard in the literature. However, previous studies have shown that physicians had lower risks of certain diseases, including stroke<sup>21)</sup>, urolithiasis<sup>24)</sup>, all cancers<sup>26)</sup>, and acute myocardial infarction<sup>28)</sup>. Due to several activities in general population, there might be more risk than the physicians.

Prolonged walking, standing, and excess physical activity including lifting heavy object and sports, especially in the young and female nurses, may explain the higher risk of plantar fasciitis found in this study. Plantar fasciitis has been reported to be more prevalent in the occupations involving continual standing or walking<sup>31)</sup>. According to a systematic review, the proportion of time standing on hard

surfaces and walking is associated with an increased risk of plantar fasciitis<sup>17)</sup>. A study reported that nurses walked for a long distance during the work, with an average of 4.20 miles (6.7 km) across a 12-h day shift and 3.95 miles (6.3 km) during a 12-h night shift<sup>32)</sup>. Another study reported that nurses spent their working time with different intensities of physical activity, ranging from light-intensity physical activities, standing, or slow walking to moderate-intensity physical activities, turning the patient without assistance, or showering a patient<sup>33)</sup>. Although nurses spent only 7% of their time across a 12-h shift engaged in moderate-intensity physical activity<sup>34)</sup>, it is possible that completing light-intensity tasks across a long duration can elicit a higher energy expenditure than that by moderate-intensity tasks, due to a lack of recovery time between shifts or tasks<sup>35)</sup>. These factors may contribute to an increased risk of plantar fasciitis in nurses.

The association between sex and plantar fasciitis is still unclear. A study of running athletes reported that there was a male predominance of plantar fasciitis in the participants (male: 54% vs. female: 46%)<sup>36)</sup>. However, another study

**Table 5. Comparison of the risk of plantar fasciitis among physician subgroups by unconditional logistic regression**

Variable	Number (%)	OR (95% CI)	AOR (95% CI)*
<b>Specialty</b>			
ENT	127 (8.16)	0.945 (0.766–1.164)	0.912 (0.738–1.126)
Anesthesiology	60 (8.08)	0.934 (0.704–1.241)	0.881 (0.662–1.174)
Orthopedics	45 (12.03)	1.455 (1.048–2.021)	1.404 (1.008–1.955)
Emergency medicine	21 (4.42)	0.492 (0.314–0.771)	0.472 (0.299–0.745)
Ophthalmology	121 (8.78)	1.024 (0.827–1.268)	0.956 (0.770–1.188)
Family medicine	228 (9.28)	1.088 (0.917–1.292)	1.083 (0.910–1.289)
Internal medicine	216 (7.57)	0.871 (0.733–1.036)	0.823 (0.689–0.983)
Psychiatry	73 (7.67)	0.883 (0.681–1.146)	0.827 (0.634–1.077)
Ob/gyn	149 (7.39)	0.849 (0.698–1.034)	0.824 (0.676–1.004)
Pediatrics	232 (8.45)	0.981 (0.828–1.163)	0.915 (0.768–1.090)
PM&R	94 (13.72)	1.692 (1.329–2.153)	1.547 (1.208–1.981)
Radiology	67 (5.51)	0.620 (0.474–0.810)	0.586 (0.447–0.768)
Dermatology	54 (7.86)	0.907 (0.674–1.221)	0.838 (0.620–1.132)
Surgery	243 (7.21)	0.827 (0.699–0.977)	0.813 (0.687–0.963)
Others	388 (8.59)	1 (reference)	1 (reference)
<b>Age subgroup</b>			
<35	272 (7.96)	1 (reference)	1 (reference)
35–49	1,116 (8.56)	1.081 (0.943–1.244)	1.114 (0.968–1.281)
50–64	613 (8.00)	1.005 (0.866–1.167)	1.049 (0.900–1.223)
≥65	117 (6.15)	0.759 (0.606–0.950)*	0.797 (0.634–1.001)
<b>Sex</b>			
Male	1,771 (7.95)	1 (reference)	1 (reference)
Female	347 (9.23)	1.176 (1.043–1.328)	1.454 (1.011–1.297)

AOR: adjusted odds ratio; CI: confidence interval; ENT: ear, nose, and throat; Ob/gyn: obstetrics and gynecology; PM&R: physical medicine and rehabilitation. \*Adjusted for age and sex.

including athletes of varying skill levels showed a higher percentage of women in the heel pain group than that in the control group (66.1% vs. 42.6%;  $p=0.015$ )<sup>11</sup>. Running and soccer athletes had the highest risk for plantar fasciitis<sup>38</sup>. There was an 11% incidence of plantar fasciitis in the ultra-marathon runner<sup>37</sup>.

Our study also showed that the risk of plantar fasciitis was higher among the specialties of orthopedics and PM&R than that among their counterparts. Weight-bearing and prolonged working time might be associated with a higher risk of plantar fasciitis in the orthopedists. Orthopedists also have weight burden as they wear heavy lead aprons during operations to reduce the exposure of ionizing radiation while using the C-arm X-ray machine to guide surgical procedures and verify the results of surgical repair<sup>38</sup>. Furthermore, orthopedists tend to have a prolonged working time. According to a research in China, most orthopedists work for more than 8 h per day for 6–7 days a week, while some physicians worked for more than 12 h per day for 6–7 d a week without additional compensation<sup>39</sup>.

The major strength of this study is that it is the first to delineate the risk of plantar fasciitis in physicians and nurses in comparison with the general population, which is an unclear issue in the literature. The other strength is its nationwide design and the large scale of sample size. Despite these strengths, there are some limitations in the study. First, there are no data regarding obesity, body mass index, occupational exposure, and level of activity in this study, which are also the risk factors for plantar fasciitis. Second, our findings may not be generalizable to other nations due to the differences in race, culture, workplace, and medical insurances. Finally, we could not identify the reason for the higher risk of plantar fasciitis among the physician specialties of PM&R and the lower risk among the specialties of emergency medicine, internal medicine, radiology, and surgery. However, the scope of this study was only to investigate this unclear issue using the nationwide population-based database. Further studies involving the detailed risk factors and other healthcare professionals such as physical therapists and occupation therapists are warranted to clarify the underlying mechanisms and validate our results.

## Conclusions

This study revealed that the risk of plantar fasciitis among physicians was lower than that among the general population, whereas nurses had a higher risk of plantar fasciitis than that among the general population and physicians. Among physician subgroups, the risk of plantar fasciitis was higher among the specialties of orthopedics and PM&R, and female physicians also had a higher risk of plantar fasciitis than that among their counterparts. Improvement of the occupational environment and health promotion are suggested for the nurses. However, further studies are warranted to validate the results of this study and clarify the underlying mechanisms.

## Conflict of Interest

The authors declare that there are no conflicts of interest.

## Authors' Contributions

KCS, JYC, and CC Huang designed the study, interpreted the data, and wrote the manuscript. IJF performed the statistical analysis. SHY, CC Hsu, HJL, and JJW provided clinical experience and helped in drafting the manuscript. JYC and CC Huang supervised the whole study and were responsible for all communication. All authors read and approved the final manuscript.

## Acknowledgment

This work was supported by Grant JCHCR10616 from the Chi-Mei Medical Center.

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