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Original Research Article

Prevalence of foot posture deformities using foot posture index in various intensive care unit nurses

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ABSTRACT

Background: This study aims to determine the prevalence of foot posture deformities among various intensive care unit nurses using the Foot Posture Index. Nurses working in ICUs often face long hours of standing and walking, which can contribute to the development of foot-related problems. Understanding the extent of these deformities can contribute to the development of preventive measures, such as ergonomic interventions and targeted exercises, to mitigate the risk of foot-related issues.
Methods: A study was conducted among 159 nurses from various Intensive Care Units. The Foot Posture Index, a validated tool for assessing foot posture was used to assess foot deviations in nurses.
Results: In total159 participants were evaluated, with 6 (4%) being males and 153 (96%) being females. The mean age of the participants was (Mean=40.67) and standard deviation (SD=9.6). Prevalence percentage of foot posture deviations were found to be bilateral as demonstrated by Foot Posture Index. Out of 159 participants 43% participants had pronated foot, 14% participants had highly pronated foot, 16% participants had supinated foot, 7% had normal highly supinated foot posture and 20% participants had normal foot.
Conclusions: To conclude the present study, pronated foot posture was the most common foot deviation. Moreover, when BMI was compared with the pronated foot deviation, there was a positive association between pronated foot and the nurses who were overweight.

Keywords: Foot posture deformities, Foot posture index, Intensive care unit nurses, Prevalence, Foot health

INTRODUCTION

The term musculoskeletal disorders (MSDs) refer to conditions that affect cartilaginous, ligamentous, tendinous, articular, and muscular tissues. As a result, they affect the normal anatomy, physiology, and kinematics of the human body. Any pain that is located distally to the fibula or tibia is referred to as foot and ankle pain. It oversees bringing about unpleasant physical, emotional, and sensory sensations. Many diverse professionals, including doctors, dentists, teachers, dancers, security guards, and traffic wardens, encounter this discomfort. One of the most common professions which experiences such kind of pain is the nurse. This is because of the tremendous demands placed on nurses.[1] Nursing is a physically demanding job that places a strain on the lower extremities. During the workday, the lower extremities bear the weight of the body. Long periods of standing and long-distance walking have an influence on the lower extremities.[2-4] Musculoskeletal pain particularly at the foot and ankle, is very prevalent. From the literature, it has been demonstrated that many musculoskeletal disorders in nurses were brought on by job stress, manual handling of patients, and severe workloads.[1]

Lower Limb Work Musculoskeletal disorders (WMSD) are the most prevalent among nurses. A cross-sectional survey study in rural Peshawar among nurses at Hayatabad Medical Complex. A total of 192 nurses participated in the survey, of which 70 were Male (36.45%) and 122 were Female (63.54%). The study concluded that the frequency of foot and ankle pain was common among the nurses.[1] In a self-administered survey done by Reed et al in a paediatric hospital in Brisbane, Australia on nurses. The prevalence of MSDs for each of the Nordic Musculoskeletal Questionnaire (NMQ) body regions was determined. The study showed a prevalence of foot and ankle musculoskeletal disorders during the past years to be 55.3%. Of the nurse and work characteristics investigated, obesity, poor general physical health, existing foot conditions, and working in the intensive care unit emerged as statistically significant ($p<0.05$) independent risk factors for activity-limiting foot/ankle.[5]

Foot problems are related to several characteristics, including female gender, older age, and a higher body mass index (BMI).[2] Moreover, obesity is also a risk factor for foot problems; obese nurses had a higher prevalence of activity-limiting foot and ankle WMSDs.[5] There are different types of ICU settings such as The Neonatal ICU (NICU) focuses on premature and severely ill new-born infants. Caring for their basic needs such as feeding and changing diapers. The Paediatric ICU (PICU) focuses on severely sick or injured children and adolescents who need constant monitoring and interventions. The Surgical ICU (SICU) focuses on critically ill patients recovering from surgeries. The Intensive Coronary Care Unit (ICCU) focuses on patients suffering from heart-related diseases which are life-threatening. The Medical ICU (MICU) provides interdisciplinary care in a technologically advanced setting for patients suffering from severe medical conditions. The ICU is associated with a high workload and stressful environment which can lead to physical and emotional exertion of the nurses. It can be due to a shortage of staffing, working for longer durations, or because of the patient-to-nurse ratio.[6]

Nurses working in different ICUs are required to stand for a prolonged period, generally between 10 and 12 hours. Nurses spend a great deal of time on their feet. The capacity of our feet is three times that of our body weight with each step we take. Nursing is a physically demanding job, that is lifting subjects, lifting equipment, and running to a code. Furthermore, most of the work involves prolonged standing and walking. The weight is carried on concrete surfaces, such as hospital floors and concrete steps, which does not help much with shock absorption.[7] The ideal foot posture can be described as the distal one-third of the leg is vertical, the subtalar joint resting in the neutral position and the calcaneal bisection being vertical during bipedal stance. The foot should be equidistant to each other, and the weight is equally distributed. There are studies that have revealed that persons with pes planus are more vulnerable to tissue stress injuries caused by aberrant joint rotation, or joint coupling. Those with pes cavus, on the other hand, are said to have less foot mobility and are more prone to injuries caused by decreased shock absorption or increased peak plantar pressures.[8]

The skeleton is subjected to impulsive stress because of the foot's engagement with the ground. This stress must be relieved as soon as possible and without causing harm to the body's more vulnerable structures. Shock is gradually diminished as it passes proximally through the body. This has been linked to low back pathology if it is compromised in the lower extremities. The structural and postural abnormalities in the foot are linked to mechanical Low Back Pain (LBP) because they can disrupt the normal muscle and joint biomechanics in the lower back, causing tension and pressure on the lumbopelvic joints and resulting in LBP.[9] Foot varieties such as club feet and cavus feet are frequently thought to be inherently incapable of appropriately absorbing stress. Furthermore, certain foot forms are thought to be a risk factor for the development of LBP.[9]

Almutairi et al in their study found that regardless of age, gender, BMI, occupation, and being a non-smoker or physically active, flat feet were a significant factor associated with both acute and chronic low back pain.[10] Letafatkar et al stated that because of the extreme internal rotation of the tibia, overpronated or other foot positions additionally impose additional stress on the Q angle. They concluded that, according to the kinetic chain system, flat feet can lead to increased Q angle and patella lateral rotation, which ultimately caused knee pain.[11] According, to Neal et al Pronated foot posture increases the risk of Medial Tibial Stress Syndrome and patellofemoral pain.[12]

Ankle instability, varus ankle arthrosis, peroneal tendon disorders, lateral foot overload, including stress fractures in the fifth metatarsal, anteromedial ankle impingement syndromes, plantar fasciitis, claw toe deformities, and pathology that extends proximally with knee derangement are additional complications that may arise from the subtle cavus foot. Chronic ankle instability and cavovarus alignment are additional risk factors for the onset of ankle joint arthritis.[13] Yang et al showed in terms of test-retest reliability, the FPI-6 total score had an ICC of 0.95, with all six items ranging between 0.80 and 0.90. Moreover, findings revealed that the FPI-6 had excellent test-retest reliability in assessing foot posture in persons with LBP. In terms of validity the KMO test result was 0.62 (>0.6), and Bartlett's sphericity test result ($p<0.01$) confirmed that the correlation matrix was an identity matrix.[14]

Redmond et al in their study concluded that the FPI has been found to be sufficiently trustworthy in a variety of clinical contexts in multiple independent reliability evaluations. The Foot Posture Index assessment is rapid and easy to execute, and it provides for a multi-segment, multi-plane evaluation, which has certain advantages over other clinical assessments of foot posture.[15] Little is known regarding the prevalence of foot posture deviations in the nursing staff in India, particularly for nurses working in

various intensive care settings, our study was undertaken in India.

METHODS

Inclusion criteria

The inclusion criteria for this study target both female and male nurses with a minimum of five years of experience in the field. The participants should be working in nursing profession that require them to work long shifts of 10 to 12 hours. The age range of the participants should fall between 25 and 55 years. These criteria are designed to ensure that the study includes experienced nurses of both genders who have been exposed to the demands and challenges associated with longer work hours.

Exclusion criteria

The exclusion criteria for this study involve specific health conditions and the factors that may affect the participants ability to engage in the study. Individual with deep vein thrombosis, physical trauma to the foot or ankle, musculoskeletal conditions of the foot, lower limb surgeries, varicose veins, and congenital flat foot are excluded from the study. Additionally, individuals who are psychologically unstable or have neurological conditions are also excluded. These criteria aim to ensure that the study focuses on participants who do not have pre-existing conditions that could potentially confound the results or hinder their ability to perform their nursing duties effective.

Study design, duration and location

Observational study conducted for 12 months (November 2021 to October 2022) at Tertiary care hospitals in Thane and Mumbai (High Land Hospital, Pramila Hospital, Prakruti Hospital, Phoenix Hospital and ICU, Lion Tarachand Bappa Hospital, Shivaji Hospital, Vedant Hospital)

Sample design

Convenient sampling method was used, sample size was taken as 175. Sample size calculation was done by using OpenEpi where anticipated frequency was (p) was 13.1 %, confidence limit was 5% and design effect was 1.0.

$$n = [DEFF * Np(1-P)]/[(D2/Z21-\alpha/2 * (N-1) + p * (1-p)]$$

Procedure

In this study, 159 out of 175 participants were included after obtaining ethical clearance and written informed consent. The study focused on assessing foot posture deviations using the Foot Posture Index (FPI) on nurses from various intensive care units. The assessment took place in the standard nursing room based on nurse availability. The standardized procedure involved nurses standing in a relaxed stance position with double limb support, arms at their sides, and looking straight ahead. Foot deviations were observed from the posterior aspect, and the data was recorded for further analysis.

RESULTS

Data was obtained and encoded in Microsoft Excel (version 2019). Data was analysed with the help of descriptive statistics (Mean±SD). Out of 175 different ICU nurses, 159 were evaluated, with the remaining being dropouts, with 6 (4%) being males and 153 (96%) being females. The mean age of the participants was (M=40.67) and standard deviation (SD=9.6) (Table 1).

Table 1: Demonstrates demographic characteristics of the participants.

Demographic data	Mean±SD
Age (years)	40.67±9.6
Gender	Male-6, Female-153
Years of experience	20.54±9.6
Working hours	11.04±1.00
Pain intensity	6.08±1.40

Table 2: Demonstrates the count of left and right foot posture deviations.

Interpretations	Right foot	Left foot
Pronated	68	68
Supinated	25	25
Normal	32	32
Highly pronated	22	22
Highly supinated	12	12
Grand Total	159	159

Table 3: Demonstrates the count of left and right foot posture deviations in nurses working in ICU.

Interpretations	Right foot	Left foot
Pronated	25	25
Supinated	10	10
Normal	5	5
Highly pronated	8	8
Highly supinated	4	4
Grand Total	52	52

Prevalence percentage of foot posture deviations were found to be bilateral as demonstrated by Foot Posture Index. Out of 159 participants 43% participants had pronated foot, 14% participants had highly pronated foot, 16% participants had supinated foot, 7% had normal highly supinated foot posture and 20% participants had normal foot (Table 2). The count of left and right foot posture deviations in nurses working in Intensive Care Unit are demonstrated in (Table 3). Data collected from the nurses working in the ICU was 52 out of which, 48% had a pronated right foot, 15% had a highly pronated right foot,

19% had a supinated right foot posture, 8% had a right highly supinated foot posture, and 10% had a normal right foot. 48% had a pronated left foot, 15% had a highly pronated left foot, 19% had a supinated left foot posture, 8% had a left highly supinated foot posture, and 10% had a normal left foot. The count of left and right foot posture deviations in nurses working in Neonatal Intensive Care Unit are demonstrated in (Table 4).

Table 4: Demonstrates the count of left and right foot posture deviations in nurses working in NICU.

Interpretations	Right foot	Left foot
Pronated	9	9
Supinated	3	3
Normal	11	11
Highly pronated	8	8
Highly supinated	1	1
Grand Total	32	32

Table 5: Demonstrates the count of left and right foot posture deviations in nurses working in PICU.

Interpretations	Right foot	Left foot
Pronated	15	15
Supinated	2	2
Normal	9	9
Highly pronated	1	1
Highly supinated	3	3
Grand Total	30	30

Data collected from the nurses working in the NICU was 32 out of which, 28% had a pronated right foot, 25% had a highly pronated right foot, 9% had a supinated right foot posture, 3% had a right highly supinated foot posture, and 35% had a normal right foot. 28% had a pronated left foot, 25% had a highly pronated left foot, 9% had a supinated left foot posture, 3% had a left highly supinated foot posture, and 35% had a normal left foot.

Table 6: Demonstrates the count of left and right foot posture deviations in nurses working in MICU.

Interpretations	Right foot	Left foot
Pronated	12	12
Supinated	6	6
Normal	6	6
Highly pronated	3	3
Highly supinated	4	4
Grand Total	31	31

The count of left and right foot posture deviations in nurses working in Paediatric Intensive Care Unit are demonstrated in (Table 5). Data collected from the nurses working in the PICU was 30 out of which, 50% had a pronated right foot, 3% had a highly pronated right foot, 7% had a supinated right foot posture, 10% had a right highly supinated foot posture, and 30% had a normal right foot. 50% had a pronated left foot, 3% had a highly pronated left foot, 7% had a supinated left foot posture, 10% had a left highly supinated foot posture, and 30% had a normal left foot. The count of left and right foot posture deviations in nurses working in Medical Intensive Care Unit are demonstrated in (Table 6). Data collected from the nurses working in the MICU was 31 out of which, 39% had a pronated right foot, 10% had a highly pronated right foot, 19% had a supinated right foot posture, 13% had a right highly supinated foot posture, and 19% had a normal right foot. 39% had a pronated left foot, 10% had a highly pronated left foot, 19% had a supinated left foot posture, 13% had a left highly supinated foot posture, and 19% had a normal left foot. The count of left and right foot posture deviations in nurses working in Intensive Coronary Care Unit are demonstrated in (Table 7).

Table 7: Demonstrates the count of left and right foot posture deviations in nurses working in ICCU.

Interpretations	Right foot	Left foot
Pronated	7	7
Supinated	4	4
Normal	1	1
Highly pronated	2	2
Highly supinated	0	0
Grand Total	14	14

Data collected from the nurses working in the ICCU was 14 out of which, 50% had a pronated right foot, 14% had a highly pronated right foot, 29% had a supinated right foot posture and 7% had a normal right foot. 50% had a pronated left foot, 14% had a highly pronated left foot, 29% had a supinated left foot posture and 7% had a normal left foot. As obesity is considered as one of the contributing factors for abnormal foot postures, when analysed for results, it was demonstrated that out of 159 participants, 22 had a highly pronated foot bilaterally. Of these, 15 are found to be overweight as per the BMI scores.

Similar results were found which demonstrated that 68 participants had bilaterally pronated foot, out of which 25 participants were found to be overweight as per the scores of BMI. Our study results on foot posture and BMI demonstrated this. Among participants, 22 showcased a highly pronated foot with an average BMI of 15, while 68 had a pronated foot with an average BMI of 25. To conclude the results, the present study demonstrates the prevalence of pronated foot posture to be more pronounced when compared to other foot posture deformities in nurses working in different ICU settings.

Moreover, we also found that there is a positive correlation between scores of BMI and foot posture. It was demonstrated that nurses who were overweight had more prevalence of pronated foot posture.

DISCUSSION

In the present study, we used Foot Posture Index to examine the prevalence of foot posture deviations in

various intensive care unit nurses. It is a valid, reliable, and multidimensional approach for evaluating foot posture in a variety of clinical settings.[15] In total, 159 participants were evaluated, with 6 (4%) male and 153 (96%) being female. Prior to the research, consent was obtained. According to the Foot Posture Index, the prevalence proportion of foot posture deviations is bilateral.

Out of 159 participants, 43% had pronated feet, 14% had highly pronated feet, 16% had supinated feet, 7% had highly supinated foot posture, and 20% had normal feet. As a result of our research, pronation is found to be the most common deviation observed in various intensive care unit nurses. It is indicated that pronated foot posture was more prevalent than other foot posture deformities in nurses working in different ICU settings. Furthermore, we discovered a link between BMI and foot posture. Overweight nurses were shown to be more prone to pronated foot positions. Foot posture deviations in various types of intensive care units have never been studied before.

An intensive care unit (ICU) is a hospital department that specializes in the care of critically ill patients. Patients in intensive care units typically have a limited ability to care for themselves and are severely debilitated. Their lives are kept constantly under observation. Nurses in the ICU do a variety of procedures on a regular basis, including infusion, oral care, airway management, and frequent night shifts. Also, staff shortages put nurses in a long-term stressful working environment.[16-18] Nurses are working longer shifts with fewer breaks and, in many cases, little time for rest between shifts. Shifts can be eight, twelve, or even sixteen hours long and do not follow the typical pattern of day, evening, and night shifts. Nurses working in specialized units such as intensive care, surgery, and dialysis are frequently obliged to work overtime (on call) in addition to their regularly scheduled shifts.[19]

A study was conducted to determine the prevalence of foot and ankle pain and discomfort in nurses in Lahore, Pakistan. A cross-sectional investigation was started to find out the prevalence in nurses. This study demonstrated that foot and ankle pain is associated with prolonged standing and total time which is spent in the hospital.[20] Most nurses (65%) reported suffering from foot pain, which is more than in previous studies (Molgaard, Lundbye-Christensen, & Simonsen, 2010; Thomas et al., 2011). The high prevalence of foot pain in this sample may be the result of occupational factors or poor footwear.[21]

Nurses who were assessed in the present study and worked in various ICU settings were more likely to have pronated feet because of prolonged standing and being overweight. Extended standing leads to excessive weight bearing on the medial aspect of the foot, putting strain on the ligaments and tendons that sustain a proper foot arch. While working in a hospital, body weight is supported by concrete surfaces such as hospital floors and concrete steps, which do not provide much shock absorption. According, to Shibuya et al., patients with flat feet acquired in adulthood often appear with an insidious beginning of vague discomfort in the medial area of the foot and behind the medial malleolus along the path of the tibialis posterior tendon. As the disorder worsens, these patients complain more about loss of function and changes in foot shape. In the later phases, stiffness, degenerative changes, and ankle valgus may be noticed.[22] A study conducted by Hooper et al. revealed that obese patients experienced foot pain. As a result of a malalignment such as pes planus, metatarsalgia, or plantar fasciitis, foot pain was experienced.[23] Excessive body weight may also be a crucial causal factor in various abnormalities encountered in the feet, i.e., abnormal foot loads.[24,25] Shyamala Shree et al found that there has been a strong correlation between overweight or obese and flat foot presence, which indicates that there exists an association.[26] Overweight and obese individuals have lower arches or "flat feet" during stances. During the acceleration phase of walking, their feet are more flexible.[27] When a person is overweight their gait changes, causing the foot to pronate and raising the stress exerted beneath the foot, seen especially in women.[28,29]

The Foot Posture Index assessment is rapid and easy to execute, and it provides for a multi-segment, multi-plane evaluation, which has certain advantages over other clinical assessments of foot posture.[15] Results of the present study demonstrated the presence of flat feet more commonly in general ICUs as compared to other ICU settings. As the aim of the present study was to find prevalence, there is a future scope to overcome the flat foot and related pain by administering a wide range of physiotherapeutic approaches. Physiotherapy management like manual therapy, electrotherapeutic modalities, taping, and many more can help to rehabilitate a person with a flat foot. Exercises that strengthen and improve the flexibility of the affected structures can not only help ease the symptoms of overpronation but can also be employed as a prophylactic precaution. Orthotic and footwear interventions, particularly orthotic wedge insoles or customized insoles, can assist nurses in clinical settings in reducing pain and improving balance, and function. Customized foot insoles are also less expensive and simpler to manufacture. As well as maintaining a healthy weight through diet and exercise, can help to reduce the risk of injury associated with overpronation.

Limitations

Current study demonstrated a relatively small sample size. Secondly, data was limited to the equal distribution of participants in various ICU settings. Moreover, the ratio of women to men nurses did not meet the equality.

CONCLUSION

According to the findings of the present study, pronated foot posture was the most common foot deviation. As per the data analysed, we found that nurses who were working continuously in the general ICUs with fewer rest periods

in between had pronated feet. Moreover, when BMI was compared with the pronated foot deviation, there was a positive association between the pronated foot and the nurses who were overweight.

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