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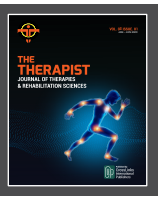

Original Article

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Assessment of Foot Pronation and Lower Limb Injuries Among Recreational Runners: A Cross-Sectional Study

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ABSTRACT

Recreational runners may be at risk for lower limb injuries due to foot pronation. **Objective**: To assess the association between foot pronation and lower limb injuries in recreational runners. **Methods:** A cross-sectional analytical study was conducted on 142 recreational runners (both sexes, aged >18) who ran at least three times weekly. Individuals with walking impairments or undergoing rehabilitation were excluded. Ethical approval was obtained, and informed consent was collected. Post-hoc power analysis confirmed 82% power ($\alpha = 0.05$, Cohen's $h = 0.3$) for chi-square testing. Foot posture was assessed using the Foot Posture Index (FPI), and foot mobility via the Sit-to-Stand Navicular Drop Test (SSNDT). Lower limb function was evaluated using the Lower Extremity Functional Scale (LEFS). Statistical analysis was performed using SPSS version 28.0. Descriptive statistics summarized participant data. Chi-square and Fisher's exact tests assessed injury prevalence across foot posture categories. T-tests or Mann-Whitney U tests compared navicular drop and LEFS scores between injured and non-injured groups. Logistic regression analyzed associations between FPI scores and injury risk, adjusting for BMI and age. **Results:** Most participants were young adults, with more females. Common injuries involved the groin (52.8%), knee (54.9%), and ankle (ligamentous: 56.3%; non-ligamentous: 49.3%). Pronated feet were found in 38.7% of runners. Mean FPI score was 5.04 ± 3.67; navicular drop was 11.31 ± 3.66 mm. Mean LEFS score was 42.61 ± 20.39. **Conclusion:** Foot pronation is significantly associated with lower limb injuries. Clinical tools like FPI and SSNDT are effective for identifying at-risk individuals.

INTRODUCTION

Running is a popular sport all over the world that is well known for its health advantages. But it's also regarded as a physically taxing activity that calls for a great deal of endurance, especially from the structures that support the morphology of the foot [1]. Numerous musculoskeletal ailments, including as fasciitis, ankle sprains, knee pain, and low back pain, have been linked to foot hyperpronation, which is defined by an abnormal inward rolling of the foot [2]. The foot's Medial Longitudinal Arch (MLA), which is actively supported by the foot muscle and passively maintained by the bone and ligamentous structures, is essential to preserving the foot's structure [3]. Running-related foot issues are thought to affect 85% of runners annually [4]. Running has been thought to put people with misaligned feet at higher risk for foot injuries [5]. Because of their intricate anatomy, the ankle and foot the farthest limbs on the human body are essential for keeping the body upright while it is in touch with the ground [6]. The arch formed by the foot's bones serves a variety of purposes, such as propulsion, stability, flexibility, energy production, weight distribution support, and joint surface protection for the knees, ankles, and feet [7]. One common issue that can have a big impact on running biomechanics is foot hyperpronation [8]. The risk of lower limb injuries is increased by this excessive pronation, which frequently results in impaired foot function [9]. People with hyperpronation are more likely to sustain ailments including plantar fasciitis, ankle sprains, and knee pain when they run recreationally [10]. The significance of identifying risk variables for injury prevention is highlighted

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by the fact that factors including excess body weight, muscle exhaustion, and inappropriate running styles all lead to an increased frequency of injuries [11]. Excessive foot pronation and the higher risk of musculoskeletal problems in runners are caused by a number of risk factors [12]. Muscle exhaustion brought on by prolonged running might cause or exacerbate foot pronation [13]. Overweight and obese people are more likely to experience increased strain on their lower limbs, which can change their running mechanics and increase their risk of injury [14]. The development of ailments such low back pain, tibial stress syndrome, and patellofemoral discomfort is significantly influenced by foot malalignment, especially severe foot pronation [15]. Inappropriate running methods, such as overstriding or inadequate support, can also increase the risk of foot pronation-related injuries [16]. The foot and lower limb mechanics are changed by this pronation, which puts more strain on joints like the knees, hips, and lower back [17]. The higher mechanical load increases the risk of damage in people who are overweight [18]. Interventions like focused strengthening exercises and appropriate running technique can help lower injury risks and improve running performance by recognizing the connection between muscle fatigue, foot pronation, and injury development [19]. Foot posture abnormalities, including pes planus (flat foot) and pes cavus (high-arched foot), are known to be intrinsic risk factors for injuries to the lower limbs [20]. Foot posture often referred to as foot type in the literature—contributes to injury vulnerability by affecting lower extremity motion [21]. Compared to people with pes cavus, people with pes planus typically have more foot movement [22]. Accordingly, research on people with pes planus who run or walk has shown that they are more vulnerable to tissue stress injuries because of aberrant joint rotation or coupling [23]. Foot pronation at the subtalar joint is important for functional functions such body propulsion and shock absorption during the active periods of walking [24]. Due to increased torques on the lower extremities and greater medial tibial rotation, severe foot hyperpronation is linked to an increased risk of injury [25]. This has long been thought to be the main cause of many kinds of injuries to the lower limbs. Running athletes' posture and balance can be affected by foot pronation, which can affect their performance as a whole [26]. Changes in lower limb alignment, including increased subtalar pronation, tibial internal torsion, internal rotation of the tibia, greater knee hyperextension (genu recurvatum), anterior knee laxity, forward pelvic tilt (anteversion), and curvature of the lower spine (lumbar lordosis), are linked to a decrease in the height of the Medial Longitudinal Arch (MLA) [27]. A prevalent condition among runners, foot pronation has been connected to a number of lower limb issues. On the other hand, little was known about the precise connection between recreational runners' injury risk and foot pronation. There was a substantial research gap regarding leisure runners, who frequently displayed a range of training intensities and injury patterns, even though many studies had examined this association in elite athletes.

In order to fill this knowledge gap, this study evaluated foot pronation and its relationship to lower limb injuries in recreational runners.

METHODS

A practical sample technique was used to do a cross-sectional analytical research from February 2024- May 2024 on 142 recreational runners. The University of Lahore in Lahore provided the statistics in four months. Prior to data collection, ethical approval was acquired, and each participant's informed consent was obtained. Particular inclusion and exclusion criteria were used in the selection of participants. Males and females between the ages of 18 and 45 who willingly agreed to participate met the inclusion criteria. Healthy recreational runners between the ages of 18 and 45 who run at least three times a week for at least an hour were eligible, regardless of their foot position. Individuals who were pregnant, receiving ongoing rehabilitation treatment, having alterations or deformities that could interfere with normal walking, refusing to give informed consent, or experiencing pain in any part of their body that could affect the navicular drop test such as pain when getting out of a chair were all excluded. The Foot Posture Index (FPI) and the Sit-to-Stand Navicular Drop Test (SSNDT) were used in this cross-sectional analytical study to evaluate foot pronation and its relationship to lower limb injuries in recreational runners. During the FPI evaluation, participants' foot position was categorized using six criteria were assessed by the examiner: talus palpation, medial longitudinal arch congruence, calcaneus location in the frontal plane, talo-scaphoid prominence, inframalleolar and supramalleolar curvature, and forefoot adduction or abduction. The overall score ranged from -12 to +12, with each criterion receiving a score between -2 and +2. Pronation was indicated by a score over +6, supination by a score below -6, and neutral foot posture by a score between -5 and +5. Each foot of this operation took about two minutes [22].

RESULTS

The majority of the 142 participants (40.1%) were between the ages of 23 and 27, followed by those between the ages of 18 and 22 (35.2%), according to the descriptive statistics of the study variables. Sixty-six percent of the sample was female. The participants' weights ranged from 47.10 to 100 kilograms, with an average of 72.74 ± 12.82 kilos, while their

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heights ranged from 1.55 to 1.85 meters, with a mean of 1.69 ± 0.089 meters. According to BMI, 61.3% of participants were overweight (BMI 25.0–29.9), while 38.7% were considered normal weight (BMI 18.5-24.9). With 52.8% of participants reporting groin injuries, 45.8% reporting quadriceps injuries, 44.4% reporting hamstring injuries, 54.9% reporting knee injuries, 56.3% reporting ligamentous ankle injuries, and 49.3% reporting non-ligamentous ankle injuries, the injury prevalence was significant. The Foot Posture Index ranged from 4 to 10, with an average of 5.04 ± 3.67 and a mean score of 11.31 ± 3.66 mm for the Navicular Drop Test. 43.0% of people had normal foot posture, 38.7% had pronated feet, 12.0% had highly pronated feet, and 6.3% had supinated feet. Lastly, the Lower Extremity Functional Scale scores ranged from 6 to 74, with a mean of 42.61 ± 20.39, reflecting variability in lower limb function within the sample. Bar chart summary showing most respondents aged 23–27 years (40.1%), majority female (60.6%), and 61.3% classified as overweight (Table 1).

Table 1: Qualitative Statistics of Age (n=142)

Variables		Frequency (%)
Age	18-22 Years	50 (35.2)
	23-27 Years	57 (40.1)
	28-31 Years	29 (20.4)
	32-35 Years	6 (4.2)
Gender	Male	56 (39.4)
	Female	86 (60.6)
BMI	Normal	55 (38.7)
	Overweight	87 (61.3)

Bar chart showed the age distribution of respondents, with the highest frequency in the 23–27 years group (Figure 1).

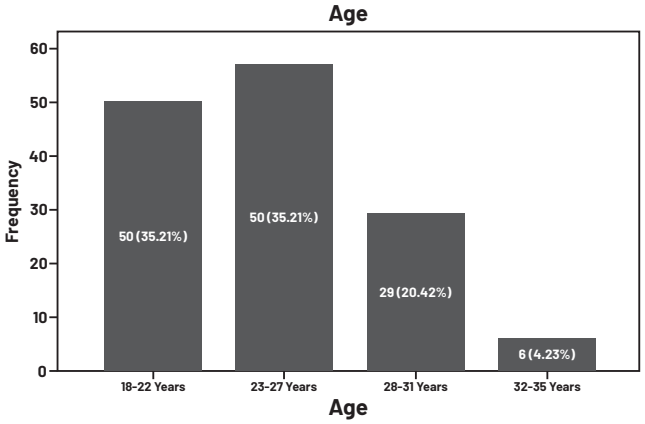

Figure 1: Age Distribution of Respondents

Bar chart showing the BMI distribution of respondents, with 61.27% overweight and 38.73% normal (Figure 2).

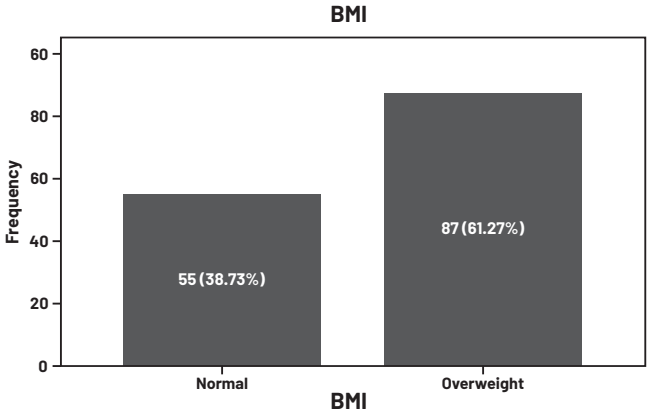

Figure 2: BMI Distribution of Respondents

Table 2 summarizes the prevalence of injuries and range of physical assessment scores among respondents.

Table 2: Prevalence of Injuries and Physical Assessment Measures Among Respondents

Variables		Frequency (%)
Groin Injury	Absent	67 (47.2)
	Present	75 (52.8)
Quadricep injury	Absent	77 (54.2)
	Present	65 (45.8)
Hamstring Injury	Absent	79 (55.3)
	Present	63 (44.6)
Knee Injury (Ligamentous)	Absent	64 (45.1)
	Present	78 (54.9)
Ankle Injury	Absent	62 (43.7)
	Present	80 (56.3)
Ankle Injury (non-Ligamentous)	Absent	70 (49.2)
	Present	72 (50.2)
Navicular drop test	Min	1.49
	Max	15
Foot posture index	Min	4
	Max	10
LEFS	Min	6
	Max	74

Prevalence of Injuries and Physical Assessment Scores Among Respondents (Figure 3).

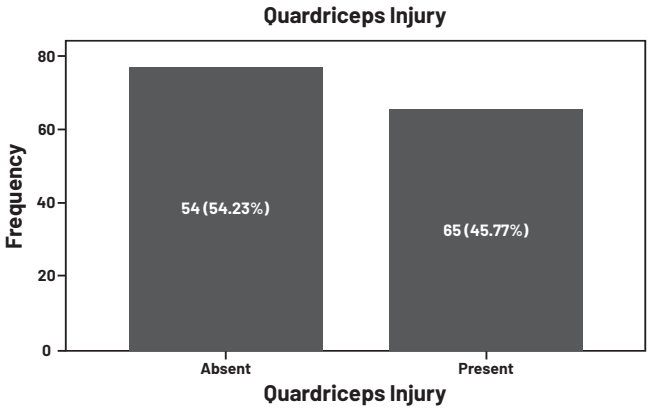

Figure 3: Prevalence of Quadriceps Injury Among Respondents

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Bar chart showing that groin injury was present in 52.8% of respondents and absent in 47.2% (Figure 4).

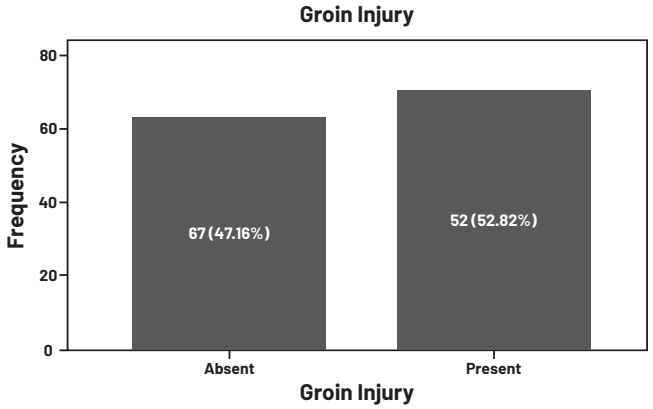

Figure 4: Prevalence of Groin Injury among Respondents

DISCUSSION

A notable incidence of lower limb the current study was conducted on recreational runners at the University of Lahore and found injuries, particularly in the groin, knee, and ankle regions. This is consistent with previous Brazilian studies that found injury rates ranging from 37% to 65.9%. This range and the current findings are supported by the Brazilian study's injury prevalence of 58.5%, which indicates that most populations have high rates of musculoskeletal injuries among recreational runners [28]. Sports injury research is quite challenging since various people have varied ideas about what constitutes an injury. Previous research has defined injury as self-reported incidents that result in decreased training capacity or as musculoskeletal pain that limits running for at least one week. The current study, on the other hand, used a more expansive definition, taking into account any lower limb pain or injury that restricted or eliminated training or competition participation for a minimum of one day [29]. The variation in injury prevalence reported between studies may be partially explained by this disparity in injury criteria. The more inclusive injury criteria used in this study, along with standardized evaluation instruments such as the Lower Extremity Functional Scale, Foot Posture Index, and Navicular Drop Test, improve the consistency and comparability of results and aid in resolving methodological discrepancies that have historically made injury research challenging [30]. According to demographics recorded in prior research, the majority of amateur runners in the previous study were male, primarily between the ages of 30 and 40, with an average age of 38.6, and had more than five years of running experience. According to a study, injury incidence was not significantly correlated with age or running experience. This is supported by evidence from recent assessments suggesting these parameters have minimal impact on injury risk [31]. The majority of amateur runners in the previous study were male, mainly between the ages of 30 and 40, with an average age of 38.6, and had more than five years of running experience, in accordance with demographics documented in other studies. A study found no significant correlation between injury occurrence with running experience or age. This is supported by data from recent assessments that indicate these characteristics have minimal impact on injury risk. While some research suggests gender-specific risk profiles, with younger male runners at higher risk, lower running experience increases the risk of injury for both sexes. These findings highlight the complexity of injury risk variables and suggest that demographic factors may not be enough to explain trends in injuries among recreational runners [32]. The majority of participants (60.6%) are female, and 40.1% are between the ages of 23 and 27, per the descriptive statistics of the current study. The injury prevalence was significant in a number of lower limb regions, such as the groin (52.8%), knee (54.9%), and ankle (up to 56.3%), which is consistent with other studies that demonstrate a high frequency of musculoskeletal injuries among recreational runners. More than half of individuals had some degree of pronation, according to assessments of foot posture (38.7% were pronated, and 12% were highly pronated), which is in line with established links between foot mechanics and injury risk. The Lower Extremity Functional Scale, which measures functional ability, revealed significant diversity, reflecting the various ways that injuries affect lower limb performance [33, 34].

CONCLUSIONS

Recreational runners frequently exhibit foot pronation, which is linked to an increased risk of lower limb injuries, especially those affecting the groin, knee, and ankle. Abnormal foot posture and greater foot mobility, which may increase the risk of injury, were successfully identified using the Foot Posture Index and the Sit-to-Stand Navicular Drop Test. Additionally, variations in lower limb function, as measured by the Lower Extremity Furthermore, the influence of foot posture on overall functional performance is highlighted by differences in lower limb function as assessed by the Lower Extremity Functional Scale. External factors such as footwear type, running surface, and training intensity were not accounted for, which may have influenced injury patterns.

Authors Contribution

Conceptualization: SS
Methodology: AU, TA, RMAY, MQ
Formal analysis: AU, TA, RMAY, MQ
Writing, review and editing: AU, TA, RMAY, MQ

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All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

The authors declare no conflict of interest.

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