

FASHION AT A COST: INVESTIGATING FOREFOOT PAIN IN HIGH-HEELED SHOE USERS AMONG FEMALE STUDENTS OF COMSATS UNIVERSITY ABBOTTABAD: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: High-heeled shoes are a widespread fashion accessory among females specially in young age, but are associated with abnormal biomechanics of the lower limb, leading to pain in forefoot. Despite the popularity of high heeled shoes, limited data exist on the occurrence of forefoot pain in usual high-heel shoes user females in university settings.

Objective: To investigate the prevalence of forefoot ache among high-heeled shoe user females of COMSATS University Abbottabad Campus.

Methods: A descriptive cross-sectional study was conducted on 155 female students and teachers age range from ≥ 18 to 40 years, who wore heels of at least 2.5 cm height for a minimum of 1 hour per day and three days per week. Data were collected using a structured questionnaire evaluating heel usage patterns and forefoot pain intensity measured with the Numerical Pain Rating Scale (NPRS). Data analysis was performed on SPSS version 25.

Results: Out of 155 female participants, 61.94% reported experiencing pain in their forefoot. The occurrence of pain was higher amongst those who wore high-heeled shoes with heel of ≥ 3 inches (78.66%) compared to those females who wore heels of 1–2 inches (46.25%). Extended duration of high-heeled shoes usage per day (≥ 3 hours) and per week (≥ 5 days) significantly increased the prevalence and severity of pain in forefoot. Furthermore, 63.9% of the participants in this study reported aching calf muscle with a degree of tightness associated with high-heeled shoes usage.

Conclusion: High-heeled shoe usage is significantly associated with forefoot pain in female university students and teachers. Height of the Heel, daily duration of usage, and duration per week are critical factors worsening the pain. Approaches for awareness and alertness, precautionary measures, and ergonomic footwear recommendations are crucial to decrease foot-related complications in this population.

Keywords: High-Heeled Shoes, Fashion at a Cost, Forefoot Pain, Metatarsalgia, Prevalence, Biomechanics, Female University Students.

INTRODUCTION

Forefoot pain or metatarsalgia is the localized pain within the ball of the foot [1]. Forefoot pain is a

symptom, not a disease additionally it is referred as pain underneath the forefoot or pain related to region

of metatarsal bones [2]. Forefoot pain is not an uncommon foot complaint among females [3]. Forefoot pain in female can occur due to variety of reasons out of them one is donning high-heeled shoe [4],[5]. High-heeled shoe is a class of the shoe which is predominantly worn by females in which foot's heel comparatively higher than toes or which places the foot under plantar flexed position [6]. To gain a height advantage, to appear professional, or to live with the trend of fashion, it is not always entirely an uncommon for females to wear high-heeled shoes. Carrying such footwear regularly can often have detrimental irreversible biomechanical effects. For 250 years clinical scientists are addressing the health threats associated with high-heeled shoe usage [8]. High-heeled shoe is regarded as foe of foot health as it has capability to induce foot pathologies or simply pain by interfering with normal gait biomechanics [9]. Type of footwear has a huge effect on musculoskeletal health. Poor footwear or poorly designed footwear such as high-heeled shoes can affect the spine, pelvis, and whole lower limb. Among all anatomical regions forefoot is most commonly affected. In fact, destructive changes due to high-heeled shoe usage primarily occur at the level of the foot which instigates changes at the level of the knee, pelvis, and spine. If one part of the bio kinematic chain is interrupted then the whole chain will be affected likewise if the foot is affected it will induce changes in the other anatomical regions [10]. The outcomes of the latest study shows that high-heeled shoes produces more pain within the fore-foot in comparison with other regions of the foot due to which weight distribution of the body is altered while putting on high-heeled shoes that changes the normal distribution of the body weight at the entire foot, the forefoot area is extra liable to get strain in comparison to the center of the foot and heel [11]. The high-heeled shoe increases the stress values on the first metatarsal bone by approximately 54 percent as compared to the flat shoes which means the area of peak stress while walking or standing in a high-heeled shoe is a region of the first metatarsal [12]. High-heeled footwear had been suggested as a key factor for foot pain dominance among females [13]. On the basis of etiology there are two main categories 1. Metatarsalgia caused by anatomical factor 2. Metatarsalgia caused by biomechanical factor. Primary, secondary and iatrogenic are further subtypes of metatarsalgia. Among metatarsalgia cases 90 percent are induced by biomechanical factors. The fundamental reason of metatarsalgia is the repetitive imposition of forces

and plantar pressures to the forefoot during the gait cycle [13]. The regular use of the high-heeled shoes is the widespread reason for metatarsalgia condition in females due to the justification that high-heeled shoes impose greater weight and stress on the forefoot [14]. If the length of the heel is elevated by two and half inch pressure on the forefoot is raised up to seventy-five percent [11]. Size, style, form, and production fabric utilized in designing foot outwear are responsible for determining the impact of shoes on foot health [3]. High-heeled shoes are designed in such a way that it results in alteration of the normal gait and biomechanics of the wearer hence resulting in pain [15]. Shoes with a slender toe box or having inadequate padding or support also can contribute to metatarsalgia [16]. Athletes who participate in high-impact sports are at higher hazard for acute and chronic forefoot conditions. Metatarsalgia may be seen in those athletes that take part in sports that have a high impact on the lower limb like football, running, and basketball. People that wear poorly fitted shoes such as narrow-toe boxes, high-heeled shoes, or are overweight also tends to develop metatarsalgia [17]. Metatarsalgia may additionally develop in patients with RA, gout, or other inflammatory conditions [18]. It is commonly mechanical and it is related with a number of risk factors, including female gender, anatomical alterations of forefoot and joint laxity [19]. With increase in age chances of developing metatarsalgia increases [20]. Forefoot problems receive little attention in medical literature, despite their high prevalence and impaired mobility [21]. According to the latest study, 77.5% of females claim to have forefoot discomfort, while 6 percent of women grievance mid foot pain and 2.5% reported about heel pain due to the regular use of the high-heel shoe [11]. Foot pain is the most frequently reported complaint (60%) and mostly foot pain occurs in the fore foot [21]. Another review shows prevalence of pain that was majorly seen in foot, lower appendage because of high-heel shoes are 29.6 percent and 24.7 percent respectively [22]. Females have a higher prevalence which means 1 out of 4 females have this condition where as in males 1 out of 7 presents with this complaint [21]. As reported by another study forefoot pain is most common grievance among high-heeled shoe user females [23]. According to another piece of literature, forefoot ache is a widespread phenomenon amongst high-heeled shoe females and also a contributing factor to forefoot ache and callosities instead of forefoot deformities [13]. Metatarsalgia impacts normally females (87 percent)

and frequently preceded by enormous usage of excessive heels height and standing activity, in other words, we can say that metatarsalgia attacks a greater portion of the total female population due to high-heeled shoe usage[5]. The manner or fashion in which an individual walk is recognized as gait. Walking is the most widely recognized type of the human motion. From motor control point of view, human two feet makes mechanism of the walking very intricate. During the gait cycle there is merely a single foot on ground, so both stability & propulsion function of the foot occurs to allow smooth gait. One circumstance to be known to intensify the complexity of the walking mechanism is use of high heeled shoe, which alters the normal gait cycle, and consequently produces a chain negative response that moves up the lower appendage and spine[27]. Hence, understanding then normal human walk cycle & biomechanical conduct of lower appendages during movement is clinically of crucial importance to detect abnormalities. One gait cycle can be defined as: starting when 1 foot makes contact with ground & terminates when the similar foot contacts ground again. Each gait cycle has 8 phases: Heel strike, Loading Response, Mid-Stance, Terminal Stance, Pre Swing, Initial Swing, Mid Swing, Terminal Swing[28]. During weight-bearing motor tasks or physical activities, the feet are presented to huge forces, especially when the activity is dynamic, like walking. The stress under the plantar surface during walking fluctuates per foot region in light of various variables connected with the typical rollover during the different positions in the gait cycle [29]. The design of shoe as part of the person's gait turns out to be particularly significant during the strike of heel (IC), level foot (LR) and toe-off stage (PSW), when lower leg, hip and knee joints are moved from their normal positions because of height of the high heeled shoe. In other words, we can say that height of shoe determines degree of angle and amount of movement available at the joints during the gait [28].

The plantar surface of the foot is presented to ground reaction forces while performing weight-bearing movements like standing and walking. These forces produce the stress that results in tissue deformation. Stress is defined as force per unit area whereas a strain is the result of stress applied i.e. tissue deformation. The stress-strain relation describes the connection between force and deformation. Stress and strain have direct relation which means the higher the stress higher the strain produced and vice versa. The size of the Ground reaction force when a person is standing is equal to body weight. With minor forces in the

horizontal (shear) directions, this force is primarily vertically directed. As a result, there are modest peak plantar pressures, with the heel experiencing greater pressure than the forefoot whereas in walking forefoot and toes are in contact with the ground for the last fifty-nine percent of the toe-off or push-off stage of the stance phase. In this phase ground reaction forces progress toward the anterior aspect of the foot known as the forefoot hence peak pressure is high at the forefoot or mainly at the medial metatarsophalangeal region which includes big toe or hallux [29]. In order to satisfy fashion needs or to gain height advantage females wear high-heeled shoe even though it causes considerable discomfort. Previous literature has shown significant relation of foot conditions with high-heeled shoes, but very limited studies have been conducted on the prevalence of forefoot pain among high-heeled user female. Purpose of the current study is to figure out the prevalence of forefoot pain among high heel user females. If this study shows positive results, then it can spread awareness for the prevention of forefoot pain among high-heeled shoe user females.

OBJECTIVE: The objective of this study is to find out the prevalence of the forefoot pain among high-heeled shoe user females at Comsats university Abbottabad campus.

LITERATURE REVIEW: The cross-sectional study named prevalence of the forefoot pain among high heel-wearing female teachers and college students of many Universities in Faisalabad, Pakistan carried out by way of Jabbar S, Sabir S, Irum S, Raza H, and Wassi in 2022. The study's goal was to find out metatarsalgia among women that put on high-heels at the everyday foundation at some stage in work or a study setting. Keywords that were utilized in this article were Forefoot ache; excessive heeled shoes; Gait; Forefoot pressure. Simple random sampling technique was used. The number of Participants that were included in this take study were 200. Results showed that seventy seven and half percent of the entire study population was ruled for forefoot pain due to regular wearing of high-heeled footwear. Others complain of either ache in mid foot and heel or no ache in any respect [11]. K. Mannikko and J. Sahlman conducted an observational study named the effect of metatarsal padding on pain and functioning ability in metatarsalgia Scandinavian Journal of Surgery. One of the goals of the study was to elaborate the cause or predisposing elements for metatarsalgia. 45 people received a letter inviting them to a phone interview,

and 25 of them took part. All 45 patients' X-rays and case histories' diagnoses were examined. Study procedure has been approved by ethics committee Kuopio University Hospital of Finland and participants provided their free and informed permission. According to this study, metatarsalgia typically affects women (87 percent) and commonly brought on by excessive usage of high-heeled shoes and standing work. In other words, we can claim that high-heeled shoe usage causes metatarsalgia to affect a larger percentage of the overall female population. Among the 87 percent of female patients diagnosed with metatarsalgia, 40 percent wore high heels. They have been wearing high heels every day for years. Their heels were over 2 cm high. Due to foot pain in the ball of the foot, several people had to stop wearing high heels[5]. A cohort study consisting 197 females that was conducted by Borchgrevink and coworkers in Norway Olvas university hospital December 2016. The key words used in this article are Footwear, High heeled shoes, Foot deformities, Hallux valgus and Foot pain. This study aimed to see whether women who report wearing high heels to work is more prone to have foot discomfort, have more foot abnormalities, and have worse foot work than females who don't ever wear heels to work. 197 participants took part in the study. There were two groups of females included in this study; a high heeled group (95) and control group (105). Blinding of evaluators were done. 45 out of 95 (47 percent) were ruled for metatarsalgia in cohort group where in control group 40 out of 102 (39 percent) were affected. The results suggested that wearing high heels on a regular basis increases forefoot pain and callosities because the forefoot experiences a higher peak pressure, but there is no proof that wearing high heels causes deformities[13]. A study by Lorkowski J & coworkers in Poland January 2013. Key words that were used in this article are business dress code and high-heeled shoe. The purpose of study was to look at evaluation of the results of excessive-heeled pointed shoes at the fitness circumstance of ladies' toes, carrying them at work, according to the existing regulations of the business dress code. 82 females were included in this study. In the office, more than 60% of the women wore heels. People who wear high heels while commuting to work have been seen to: 1) A deterioration in quality of life that occurs in 70% of cases due to recurrent discomfort and decreased foot function; 2) a twofold rise in pressure on the underside of fore foot; that causes metatarsalgia and 3) the ongoing consequences of forces that are deforming the forefoot. The study's conclusion said that 1) an

evolutionary shift in the "dress code" for footwear is required if a non-physiological overload of the feet and the resulting impairment are to be reduced. 2. Patients with what is referred to as "sensitive feet" need these modifications the most urgently [33].

In 2005 there was cross sectional study conducted by Morris M.E on topic foot wear Characters & foot pathologies in olders at Australia. The goal of the study was to look at the connection between footwear qualities and prevalence of normal forefoot issues in older individuals. The key words that were used in this article are Foot deformities, Shoes ,Callosities Hallux valgus. The existence of foot condition & disfigurement were distinguished in 176 individuals (56 men and 120 ladies) matured 62 to 96 years utilizing the questionnaire and clinical evaluation. The shoe design was determined by the width, length and region estimations of shoes with foot estimations. Over a significant time, span utilization of high-heeled shoes in ladies was recorded, and the heel height was estimated. The findings suggested Wearing a high-heeled shoe with a height higher than 25 mm or 1 inch was related to hallux valgus and plantar calluses in ladies which causes forefoot pain [34]. a review study that was directed by Kevin Blakley and Annamarie Kepple in February 2013 on a topic named Women high heel discomfort analysis and prototype solution. The reason for the review was to explore about client inclinations and uneasiness or agony brought about by wearing high heels. The overview was finished by using an internet studying webpage and disseminated to in excess of 200 females through Facebook. Altogether, the review created around 145 reactions. As per the aftereffect of the review, Comfort was the third purchase decision priority. The style was first, trailed by cost. The toes or the ball of the foot were the main regions of the foot where most ladies experienced pain [23]. Systematic Review and Meta-Analysis in Indonesia 2022 states that effects of putting on high heels on foot discomfort are still a unclear, according to a number of research that have been conducted. In order to determine if wearing high heels had an impact on foot discomfort, the author conducted a thorough evaluation of the available research and produced an evidence-based summary using a meta-analysis. Havva Gül Güren et al. record of the participants' demographic information was made. Using the Visual Analog Scale, foot and low back pain were assessed both while moving and when at rest (VAS). The subjects' level of physical activity was assessed (IPAQ-SF). Consequently, 67.5 percent and 50 percent of participants experienced LBP at rest and while

movement, respectively and 60 percent and 75 percent of individuals experienced foot pain, respectively [36]. case-control study that was conducted by Cronin on a topic Long term usage of high heeled footwear alters the biomechanics of human gait. The key term used in this article are Long term high-heeled shoe, biomechanics and Neuromechanics. This study looked at how habitual High heel (HH) use affected the triceps surae muscles' walking-related neuromechanical activity. The study sample included ten control subjects who typically wore heels for less than ten hours in a week as well as nine habitual high heel users who had used footwear with atleast heel height of 5cm for at least fourty hours in a week for at least two years. Ground response forces, knee and ankle joint kinematics, leg muscles activity, and gastroc length data were measured as participants walked at their natural speed over leveled ground. Walking in High heel caused significant increases in muscle fascicle stresses and muscle activations during stance phase/stage in comparison with bare foot walking in long term high heel wearers. The findings are in line with observations that people who wear high heels frequently complain of discomfort & muscular fatigue and they imply that long term usage of them may reduce muscle efficiency in walking. Strain injuries may be more likely with prolonged High heel use [38].

METHODOS

STUDY DESIGN: Descriptive cross-sectional survey

STUDY SETTING: This study was conducted at the BBA (Bachelors in business administration), BES (Bachelors in Environmental sciences) and PHM (pharmacy) departments of Comsats university Islamabad Abbottabad campus.

SAMPLE SIZE: The sample size was 155, calculated by Rao soft calculator.

SAMPLING TECHNIQUE: For this study, we used the non-probability convenience sampling technique

Inclusion criteria: Teachers and students, 18-40 years of age, Heel height at least 2.5cm and above and standing or walking with a high-heeled shoe on for at least 1 hour per day / 3 days per week.

Exclusion criteria: post-traumatic foot, recently operated lower limb, Gout, Any other foot deformities or pathologies and those who were not willing to participate

DATA COLLECTION TOOLS: Data was collected by using a modified form of the questionnaire used in most latest research related to this study [11]. Measuring tape was used for measuring height of the heels.

DATA ANALYSIS: Data were analyzed through SPSS version 26 after collection. Positive responses from the selected population were 100 Percent.

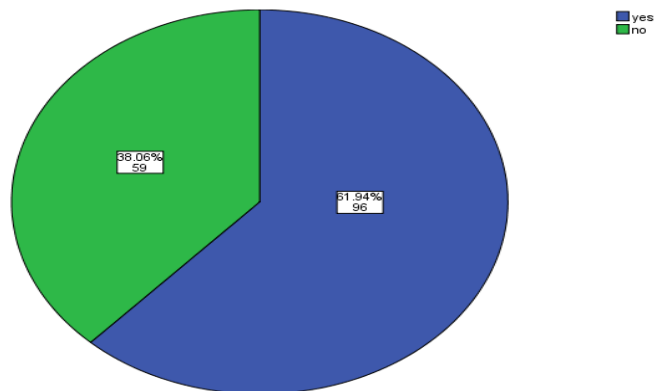
ETHICAL CONSIDERATION: Before the collection of data, permission was taken from the university administration and participants. The participants were informed about the goals, purposes and procedure of our study.

RESULTS

Descriptive statistics: The minimum age was 18 and the Maximum age was 40 and the mean age of the participants was 22 years. the minimum value of BMI was 18.50; the maximum value was 30.00 mean was 19. Among 155 participants, 24 were underweight 112 were normally weighted, 18 were overweight and 1 participant was obese. 150 were student and 5 were teachers.

Forefoot pain: According to the graph shown below, 96 females (61.9%) out of 155 were experiencing forefoot pain, while 59 (38.1%) individuals were presented with no pain

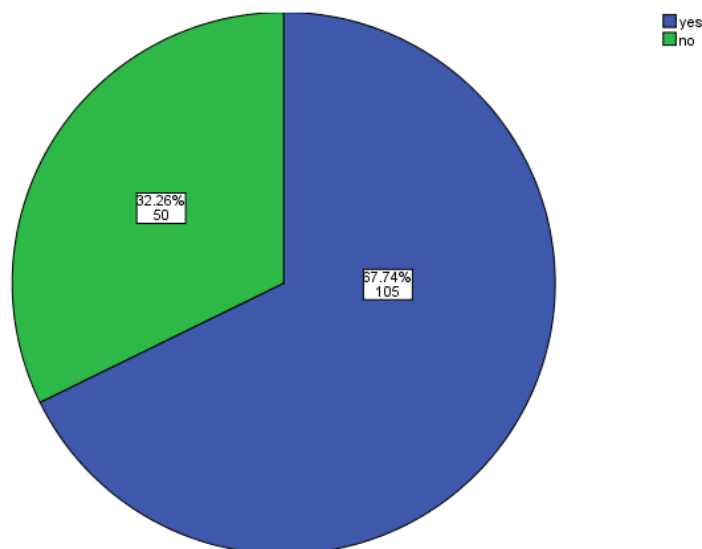
Do you have pain in the forefoot?



62 females were wearing high-heeled shoes for less than 1 year, 31 participants are wearing high-heeled shoes for 1-2 years, 31 are wearing high-heeled shoes for 3-4 years and 31 participants are wearing high-heeled shoes for 5 or more years out of 155 participants. 80 participants use two inches height heels while 75 participants use a heel height of three

inches or above. 50 participants do not experience forefoot pain while wearing high heels, but 105 participants reported pain.

Do your fore-feet hurt in high-heels?



Tightness in calf muscles were also reported by majority of the ladies the table shows that 99 participants reported calf muscle tightness while 56 participants reported that they do not experience calf muscle tightness.

Tightness in calf muscles

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	99	63.9	63.9	63.9
	No	56	36.1	36.1	100.0
	Total	155	100.0	100.0	

on nprs (numerical pain rating scale) 59 females reported no pain, 60 mild pain and 27 participants experience moderate pain while 09 individuals reported severe pain.

Rate your forefoot pain from Zero to Ten.				
No Pain	Mild	Moderate	Severe	Total
38	17	9	3	67
21	43	18	6	88
59	60	27	9	155

Discussions:

In 2022, jabbar et al. Conducted a study titled "prevalence of forefoot pain among high heel-wearing female professors and college students of different universities in faisalabad, pakistan." 200 individuals were part of the sample. According to the study's findings 150 out 200 were affected. 77.5 percent of the study population complaint of forefoot pain others report either no pain at all or a pain in the mid-foot and heel [11]. There were 155 participants in our study named "prevalence of forefoot pain among high-heeled shoe users among females at comsats university islamabad abbottabad campus." according to our study's findings, 105 out of 155 women report having forefoot pain due to use of high-heeled shoes. The percentage of forefoot pain among participants was 61.94. The disparity in sample size, study setting and sampling technique can explain the result differences. A study conducted by mannikko et al. On the topic of the effect of metatarsal padding on pain and functional ability in metatarsalgia scandinavian journal of surgery. Sample size of this study was 45. According to this study findings metatarsalgia typically affected women (87%) and is commonly brought on by excessive use of high-heeled shoes and standing work. In other words, we can claim that high-heeled shoe usage causes metatarsalgia to affect a larger percentage of the overall female population. Among the 87 percent of female patients diagnosed with metatarsalgia, 40 percent wore high heels. They have been wearing high heels every day for years [5]. A study named "does the use of high-heeled shoes lead to forefoot pathology? A controlled cohort study" comprising 197 women that was conducted by borchgrevink, grethe e viset, annja t witsø, eivind schei, berit foss, norway olavas in december 2016. 197 participants took part in the study. There were two groups of females included in this study; a high-heeled group and a control group, and based on statistical power calculation 95 females were added to cohort group while 102 were added to control group. Single blinding technique was used to control according to

this study, big toe pain in the forefoot, specifically in the medial metatarsophalangeal region, affects 45 females out of 95 females. The results suggested that 47 percent females among high heel shoe users were affected by forefoot pain[13]. The difference in sample size, study design and study setting can explain the differences in the results of the study that is mentioned above and our study. A study by lorkowski j, mrzygłód m, kotela i, kiełbasiewicz-lorkowska e, in poland january 2013. 82 females were included in this study. In the office, more than 60% of the women wore heels. People who wear high heels while commuting to work have been seen to: 1) a deterioration in quality of life that occurs in 70% of cases due to recurrent discomfort and decreased foot function; 2) a twofold rise in pressure on the plantar side of the forefoot; that causes metatarsalgia [33]. The difference in the prevalence of forefoot pain in the study mentioned above and our study can be due to different sample size, study design and study setting. in 2005 there was cross sectional study conducted by morris et al. In australia. The goal of the study was to look at the connection between footwear qualities and the prevalence of normal forefoot issues in older individuals. The presence of foot pain and disfigurement were distinguished in 176 individuals (56 men and 120 ladies) matured 62-96 years (mean 80.09, sd 6.42) utilizing a questionnaire and clinical evaluation. The findings suggested 57 percent (67) females were affected by forefoot pain due to high heels usage. The difference in the prevalence of forefoot pain in the study mentioned above and our study can be due to different sample size, study setting and study population [34].

Conclusion:

according to the findings of this study, 61.94% of females who wear high heels experience forefoot pain. Females who wear high heels often get forefoot pain. As the height of the heels rises, forefoot pain increases. Forefoot pain increases the longer you wear high heels.

Limitations: limited literature on experimental studies available regarding high heel and forefoot pain, therefore we are lacking sufficient literature review for a comparison with our study. Low sample size may also limit our results

RECOMMENDATIONS: Modifications to the dress code are necessary to lessen the non-physiological strain on the feet, such as limiting heels taller than 2 cm. Reduce the use of high heels, Use of TCI (total contact inserts), Use of insert pads and Performing of calf muscle stretching and toe spreading exercises.

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