

PREVALENCE OF HALLUX VALGUS AND ITS RELATION TO FOOT FUNCTION IN HIGH-HEEL-WEARING GIRL STUDENTS AGED 18–25 YEARS: AN OBSERVATIONAL STUDY

1Sakshi Deshmukh, 2Dr. Pavan Chopade (PT), 3Dr. Jaywant Nagulkar

1Bachelor of Physiotherapy, 2Assistant Professor, Department of Musculoskeletal Physiotherapy, 3Principal, Department of Musculoskeletal Physiotherapy

1,2,3 Dr. Ulhas Patil College of Physiotherapy, Jalgaon, Maharashtra, India

Corresponding author: Dr. Jaywant Nagulkar | j4jaywant981@gmail.com

ABSTRACT

Background: Hallux valgus is a progressive deformity characterized by lateral deviation of the great toe and medial deviation of the first metatarsal. High-heeled footwear, particularly footwear that increases forefoot loading or restricts the toe box, may contribute to altered first metatarsophalangeal mechanics. The present study assessed the prevalence of hallux valgus and foot-function disability among female college students aged 18–25 years who regularly wore high heels.

Objective: To determine the prevalence of hallux valgus among high-heel-wearing female college students and to describe foot-function disability using the Foot Function Index (FFI).

Methods: A cross-sectional observational study was conducted in Jalgaon over six months. A purposive sample of 107 female students aged 18–25 years who regularly wore high heels was included. Hallux valgus angle (HVA) was assessed using a universal goniometer and foot-related symptoms and disability were assessed using the FFI.

Results: Out of 107 participants, 87 (81.31%) had hallux valgus and 20 (18.69%) did not. Bilateral involvement was observed in 60 participants (56.1%), left unilateral involvement in 29 (27.1%), and right unilateral involvement in 18 (16.8%). Wedge heels were the most frequently reported heel type (63; 58.9%). FFI classification showed minimal disability in 9 participants (8.41%), mild disability in 60 (56.07%), moderate disability in 38 (35.51%), and severe disability in none. Mean FFI subscale scores were 25.62 ± 8.26 for pain, 30.76 ± 9.74 for disability, and 25.42 ± 10.34 for activity limitation.

Conclusion: Hallux valgus was frequently observed in this sample of high-heel-wearing female college students, with bilateral and mild deformity predominating. Most participants demonstrated mild-to-moderate foot-related disability. The findings support early screening and footwear education in this population.

Keywords: foot function index, hallux valgus, high heels, hallux valgus angle.

I. INTRODUCTION

Hallux valgus commonly known as B union. This is a progressive deformity it is characterized by abnormal abduction of the first metatarsal with adduction of the phalanges. It is usually present during early life, it is the common condition among females.

Great toe deviates laterally towards other toes while first metatarsal bone deviates medially. The articular cartilage may get inflamed, eroded and atrophied. New bone formation [spur] Intrinsic muscles can't act effectively result in dropping of the arch and eversion of the foot. Causes was multifactorial Wearing of tight socks and footwear & Congenital.

Pain in great toe, Swelling on medial side of first MTP joint due to bunion, Skin ulceration due to friction, Adduction of phalanges, OA changes in first mtp joint., Hypertrophy of medial end of first metatarsal head, Redness, tenderness or inflammation around bunion. In advanced cases overlapping of great toe over 2nd toe.

Diagnosis by clinical examination includes observation of toe deviation & swelling, pain on palpation at 1st MTP joint. on X-ray diagnosis is confirmed by measuring hallux valgus and intermetatarsal angle on weight bearing foot.

Note: hallux valgus angle – angle between long axis of first metatarsal bone and proximal phalanx of great toe. Normal : <15 degree. Intermetatarsal angle is between long axis of 1st metatarsal and long axis of 2nd metatarsal. Footwear plays a significant role in development of hallux valgus. High heeled shoes, especially those with a narrow toe box alter weight distribution on foot by shifting body weight onto forefoot. This abnormal pressure on metatarsophalangeal joint can contribute to gradual deviation of big toe. The early stages of hallux valgus are usually painless and may go unnoticed, but as the deformity progresses it can lead to chronic pain, joint stiffness, inflammation of the bursa (bursitis), and functional limitations. The deformity also affects balance and gait parameters. Research on foot biomechanics indicates That individuals with hallux valgus show reduced postural stability and altered pressure distribution while walking.

This may eventually impact participation in physical activities and overall quality of life. From a preventive health perspective, identifying the prevalence of hallux valgus in younger age groups provides an opportunity for early intervention and education regarding healthy footwear choices.

Although numerous studies have explored hallux valgus in adults and elderly populations, there is limited data focusing on young women, especially students who wear high heels regularly.

Understanding the prevalence in this age group is crucial, as early detection can prevent progression and long-term complications.

Moreover, identifying the relationship between heel height, duration of wearing, frequency, and toe box width with the occurrence of hallux valgus can help in developing effective health education programs promoting foot care and appropriate footwear habits among young women.

Assessing the prevalence of hallux valgus among female students who wear high heels can also contribute valuable information to the field of preventive physiotherapy. Physiotherapists play an essential role in promoting foot health, educating about proper posture and footwear, and designing corrective exercise programs to maintain optimal foot alignment.

By determining how common this deformity is in young heel-wearing populations, preventive measures such as foot-strengthening exercises, stretching routines, ergonomic footwear education, and awareness programs can be better targeted.

Hence, this study aims to assess the prevalence of hallux valgus among girl students who habitually wear high-heeled footwear and to explore the association between different heel characteristics (height, duration, frequency, and toe box shape) and the occurrence of the deformity.

The foot plays a vital role in posture, balance, and locomotion. It bears the entire weight of the body and provides a stable base during walking and standing. Any alteration in the alignment or structure of the foot can lead to pain, deformity, and gait. The foot plays a vital role in posture, balance, and locomotion. It bears the entire weight of the body and provides a stable base during walking and standing. Any alteration in the alignment or structure of the foot can lead to pain, deformity, and gait disturbances.

Although several international studies have explored this relationship in adult and working women, there is limited research among younger populations, particularly female students, who increasingly wear high heels for fashion, social events, and confidence enhancement. Early identification of hallux valgus in this group is important because the deformity is progressive and, if left unaddressed, can lead to chronic foot pain, difficulty in walking, and degenerative joint changes later in life.

Different types of valgus deformity- The first type (congruous hallux valgus) is a simple exaggeration of the normal relation of the metatarsal to phalanx of the big toe. The deformity does not progress, and the valgus deformity is between 200 and 300. The second type (pathological hallux valgus) is a potentially progressive deformity, increasing from 200 to 600 this may further lead to subluxation. This type may occur in deviated (early) and subluxed (later) stages.

In recent years, the increasing trend of high-heel use among college and university students has raised concern about the potential long-term effects on foot health. Young women often wear high heels for extended durations during social, academic, or professional activities without being aware of the possible musculoskeletal consequences. Early detection of hallux valgus in this age group can help in implementing preventive strategies & creating awareness about proper footwear choices.

NEED OF THE STUDY

Young women particularly college going students frequently wear high heels for fashion, social or formal occasions without being aware of potential long term consequences on their foot structure and posture. Early detection of hallux valgus in this population is important because the deformity is progressive. Assessing this prevalence will help create awareness about proper footwear selection, foot care, and importance of preventive measures to avoid complications such as pain, gait abnormalities and reduced functional mobility.

Thus this study is needed to determine the occurrence and contributing factors of hallux valgus among high heel wearing girls students and to promote awareness and prevention strategies within this group.

Wearing high heels is a common practice among young women for aesthetic, social, and fashion purposes. However, frequent or prolonged use of such footwear causes mechanical stress on the first metatarso phalangeal joint and may predispose users to early development of hallux valgus. Several studies have demonstrated that individuals wearing high-heeled footwear for more than three times a week have significantly greater hallux valgus angles than those wearing flat shoes. Moreover, the deformity often begins in early adulthood and progresses with time if the causative factors are not addressed.

Despite growing awareness about musculoskeletal disorders associated with poor footwear design, there remains a gap in research focusing on young female populations who wear high heels regularly. Most available studies have examined middle-aged or occupational groups, leaving limited data on student populations. Understanding the prevalence of hallux valgus among girl students who wear high-heeled shoes is important because early identification allows timely education, prevention, and intervention.

As this age group represents a formative stage where footwear habits are established, awareness about foot health and preventive measures can have long-term benefits.

This study is therefore needed to determine the prevalence of hallux valgus among high-heels wearing girl students. The findings will help in establishing the early detection and preventive physiotherapy strategies can help reduce long-term complications, improve posture, and enhance quality of life.

AIM

- To determine the prevalence of hallux valgus among girl students who wear high heeled footwear.

OBJECTIVES

- To determine the prevalence of hallux valgus in high heels wearing girl students using foot function index
- To evaluate the level of foot function disability in high heels wearing girls students using assessing hallux valgus angle and foot function index.
- To assess the severity of foot disability among different variety of high heels wearing college girl students.

II. REVIEW OF LITERATURE

Namrata naik, et.al (2018): An Observational study comprising of 110 samples. The samples were assessed with the help of footboard and goniometer, 67% of Female and 44% of male out of total samples, 70% have bilateral hallux valgus and 30% have unilateral hallux valgus and majority of the samples have grade 1 hallux valgus then grade 2 and 3. It was concluded that women tend to affect more than male and out of total samples majority of samples have Grade 1 degree of hallux valgus and very few

samples have pain while walking and movement. Other intrinsic factors play a role as well, it is reported that pes planus has some influence on bunion formation also pronation of hindfoot is a major cause of this condition. The study was conducted to determine the prevalence of hallux valgus and intensity of pain in general population with the help of footboard measurement and goniometer.

EO Ekwere et.al (2016): this study was a observational study involving 100 volunteers aged between 18 years to 30 years with mean age of 24.6 years and standard deviation of 3.4 years informed consent was obtained and subjects were examined for presence or absence of hallux valgus adopting a standard photograph. Data obtained from this research study was analyzed using IBM SPSS version 20. Results: An overall prevalence of hallux valgus deformity in the studied population was 16% with a higher prevalence in females (11%) than their male counterparts (5%). There is a higher prevalence of hallux valgus deformity in the older age group than can be seen in the younger age group. Conclusion: Young women and indeed the general public need to be more aware of the Hallux Valgus deformity and its relationship to footwear and therefore take proactive measures to prevent this deformity.

HG Guren et.al (2010) This study was planned to investigate physical activity level and pain incidence in women who wear high heeled During the day The study included 40 women wearing shoes with heels of 5 cm and above, with average age of 30.95 ± 5.85 . Demographic data of the participants were recorded. Foot and low back pain during movement and at rest were evaluated using Visual Analog Scale (VAS). Physical activity level of the participants was measured with International Physical Activity Questionnaire-Short Form (IPAQ-SF). As a result, 67.5% and 50% of participants had low back pain at rest and during movement respectively (mean: 3.43 ± 3.18 at rest, 2.43 ± 3.05 in movement) and 60% and 75% of participants had foot pain at rest and during movement respectively (mean: 2.48 ± 2.30 at rest, 3.08 ± 2.47 in movement)

KB Gawande et.al (2011) observational study To find out the prevalence of hallux valgus in normal individuals. The lateral deviation of the big toe at the first mtp joint is also known as Hallux valgus and most common in womens. The primary function of the foot is to control the body weight and to serve as a part of lever for its proper functioning. Basically body weight and the strain falls along with the center of the foot and maintain the balance there by surrounding muscular activity. By any chance if this normal synchronization is disturbed in the performance of their function, in spite of accommodative power of nature to disease and deformity. Observational study 100female with or without foot pain were included. 38.59% and 31.46% of male and female have hallux valgus of right foot out of total samples. 45.61% and 39.15% of male and female have hallux valgus of left foot out of total samples. The result of the study concluded that the prevalence of hallux valgus deformity was greater young aged group and among which showed left foot was more commonly affected in females. It show That it doesn't affect normal functional activity.

Meshram et al. (2021) Meshram, Borkar, and Chaudhari (2021) conducted an evaluative study to assess the effectiveness of structured teaching regarding the harmful effects of wearing high heels among adolescent girls. Their findings revealed that before the intervention, a majority of participants had limited understanding of how high heels negatively impact the musculoskeletal system and foot alignment. The teaching program significantly improved knowledge levels during post-test evaluation, demonstrating the effectiveness of educational interventions in promoting healthier footwear practices. The authors emphasized that early awareness can reduce the risk of long-term deformities such as hallux valgus, callosities, and chronic forefoot pain.

Okuda et al. (2014) Okuda, Juman, Ueda, and Miki (2014) investigated the association between high-heel usage patterns and the prevalence of hallux valgus among adult women. Their study specifically focused on footwear characteristics, including toe-box width, heel height, and frequency of use. Results showed that women who frequently wore heels with narrow toe boxes had significantly higher hallux valgus angles and greater big-toe pain. The researchers concluded that chronic compression of the forefoot and increased load on the first metatarsophalangeal joint contribute to progressive structural deformity, highlighting footwear as a modifiable risk factor.

Basha et al. (2018) Basha, Devi, and Priya (2018) explored women's awareness of the negative health consequences of wearing high heels. The study included working women, homemakers, and university students. Despite having general awareness of discomfort and musculoskeletal strain caused by heels, many participants continued to use high heels regularly due to fashion preferences, occupational requirements, or social norms. The findings emphasize a gap between knowledge and behavioral change, suggesting that awareness alone may be insufficient without lifestyle modification programs or ergonomic footwear recommendations.

Nawaz et al. (2019) Nawaz, Hashmi, Qureshi, and colleagues (2019) conducted a cross-sectional study examining the prevalence of musculoskeletal pain among young females wearing various heel heights. The results demonstrated that higher heel heights significantly increased pain in the foot, knee, and lower back due to altered biomechanical loading. The researchers reported that heel-induced anterior weight shift increases forefoot pressure and disrupts normal posture. These findings highlight the association between heel height and overall musculoskeletal stress, reinforcing the need for preventive strategies in young populations.

Nix et al. (2010) Nix, Smith, and Vicenzino (2010) carried out a systematic review and meta-analysis to determine global hallux valgus prevalence. Their analysis revealed that women are disproportionately affected, with footwear practices identified as a major contributing factor. The study concluded that narrow, pointed, or high-heeled footwear significantly increases the risk of deformity by altering toe alignment and increasing stress at the first metatarsophalangeal joint. The authors emphasized that modifying footwear habits could substantially reduce hallux valgus prevalence in at-risk groups.

Perera et al. (2011) Perera, Mason, and Stephens (2011) examined the underlying pathogenesis of hallux valgus and described the mechanical and anatomical changes contributing to its progression. Their findings highlighted that repeated forefoot loading from improper footwear, particularly high heels, weakens the medial supporting structures of the first metatarsophalangeal joint.

Yoon et al. (2014) Yoon, Jung, and Park (2014) conducted a biomechanical study analyzing the effect of heel height on forefoot loading and hallux valgus angle. Their findings showed that higher heel elevation resulted in substantial increases in forefoot pressure, causing lateral deviation of the hallux during gait. This increased valgus angle over time contributes directly to deformity progression. The authors concluded that heel height is a critical variable influencing forefoot biomechanics, with greater heights posing higher deformity risk.

Barnish & Barnish et.al (2016) reviewed the health implications of fashionable footwear commonly worn by women. They found strong evidence that prolonged high-heel use not only increases the risk of hallux valgus but also contributes to foot pain, impaired balance, ankle instability, and a greater incidence of falls. The review emphasized that despite awareness of these risks, aesthetic and cultural preferences often drive continued use. The authors advocated for public health initiatives promoting safer footwear choices.

Cronin et.al (2014) examined the biomechanical consequences of high-heel walking. The study identified that high heels alter gait patterns by shortening the stride length, increasing plantar pressure, and reducing stability during walking. These changes result in greater stress on the first metatarsophalangeal joint and surrounding ligaments, which over time can contribute to structural deformities such as hallux valgus. The research highlighted how repeated biomechanical disturbances eventually lead to chronic foot problems in habitual high-heel users.

III. MATERIALS AND METHODS

3.1 Study design and setting

Study design: A cross-sectional study. Study type: An observational study. Study setting: Jalgaon. Study population: Females. Study duration: 6 months. Sampling method: Purposive method. Sample size: 107.

Sample size information reported in the project: $n = Z^2pq/d^2$; M (your guess of population) = 0.77; S (standard deviation of M) = 0.23; $1-\alpha = 0.95$; $Z = 1.96$; d (absolute precision) = 0.08; minimum sample size = 107.

3.2 Materials

- Pen
- Paper
- Goniometer
- Consent form
- Data collection sheet
- Foot Function Index (FFI)

3.3 Selection criteria

Inclusion criteria

- Female students are included.
- Regular wearer of high heels.
- Age group: 18 to 25 years.
- Patient who are willing to participate.
- Heel height up to 5 inch.

Exclusion criteria

- Flat foot.
- Subjects with congenital foot deformities.
- Pathological disorders such as RA, OA.
- Previous fractures.

3.4 Outcome measures

1) Goniometer. 2) Foot Function Index.

Universal goniometer: It is used to assess hallux valgus angle. The participant is seated with the knee extended and the ankle in a neutral position, or alternatively may stand with weight evenly distributed for a functional assessment. The foot is placed flat on the floor or on the examination table to maintain stability. Anatomical landmarks—including the midpoint of the first metatarsal shaft, the midpoint of the proximal phalanx of the great toe, and the first metatarsophalangeal (MTP) joint—are identified and marked on the dorsal aspect of the foot using a skin marker or pencil. The goniometer is then aligned by placing the fulcrum over the first MTP joint, the stationary arm along the long axis of the first metatarsal bone, and the movable arm along the long axis of the proximal phalanx. The angle formed between the arms of the goniometer is read in degrees and recorded as the Hallux Valgus Angle (HVA). To increase reliability, three readings are taken and the mean value is calculated, with measurements recorded separately for the right and left foot.

Interpretation of the HVA values is as follows: Normal: $<15^\circ$ – No deformity; Mild: 15° – 20° – Early deviation; Moderate: 21° – 40° – Visible deformity; Severe: $>40^\circ$ – Significant lateral deviation.

Foot Function Index: The FFI is a questionnaire used to assess foot pain, disability and activity limitation caused by foot problems. It consists of question divided into 3 subscales pain disability and activity limitation. Each question is scored from 0 to 10, where 0 indicates no pain or difficulty and 10 indicates severe pain or complete difficulty. The scores are added and converted into percentage by dividing the total score by maximum possible score and multiplying by 100. A Higher percentage indicates greater impairment of foot function. It is commonly used to evaluate the severity if symptoms and monitor improvement after treatment.

FFI interpretation: 0–20% – minimal disability/Good foot function; 21–40% – mild disability; 41–60% – moderate disability; 61–80% – extreme disability/very poor foot function.

3.5 Procedure

Ethical clearance was taken from the Institutional Ethics Committee of Dr. Ulhas Patil College of Physiotherapy, Jalgaon prior to commencement of the study.

The study was undertaken in Jalgaon city. Participants were included on the basis of the inclusion and exclusion criteria mentioned earlier.

A brief demographic data of all patients was obtained, and written consent was taken from all participants. The procedure was explained by the therapist.

Baseline assessment was taken, which included ROM assessment using a goniometer.

Informed consent was obtained from 107 participants. Demographic and footwear-related data, including age, high-heel use, type, frequency, and duration of high-heel use, were collected. The hallux valgus angle was assessed using a goniometer, and the Foot Function Index questionnaire was used to assess disability.



Figure 1. Goniometer assessment of hallux valgus

3.6 Statistical analysis

In this study, a total of 107 participants were included.

Statistical analysis for the present study was done using Statistical Package of Social Sciences (SPSS) version 16 so as to verify the results obtained.

For this purpose the data were entered, coded, verified, using into Excel spreadsheet, tabulated and subjected to statistical analysis.

Descriptive statistics, including frequency, percentage (frequency distribution tables), mean, standard deviation, median, were applied as appropriate to the type and distribution of the data.

IV. RESULTS

A total of 107 participants were included in the study. The following tables and graphs reproduce the numerical results reported in the project.

Table 1. age-wise distribution

Age (years)	Frequency	Percentage
18–21	31	28.97%
22–25	76	71.03%
Total	107	100%

Out of 107 participants 31 (28.97%) participants belonged to 18–21 year age group, whereas 76 (71.03%) participants belonged to 22–25 years age group. Hence majority of participants (71.03%) were in 22–25 years age group.

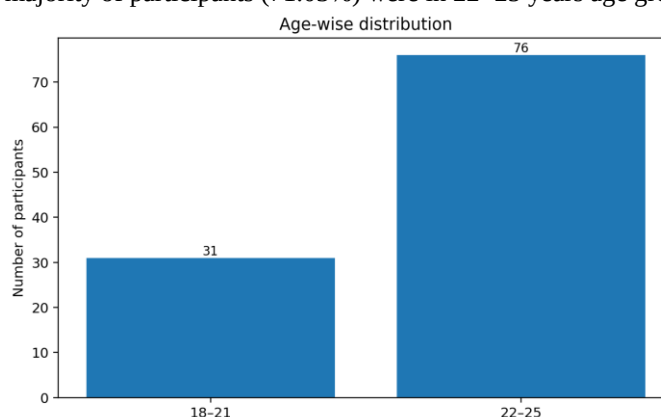


Figure 2. age-wise distribution

Table 2. heel type distribution

Heel type	Participant count	Percentage
Wedge	63	58.9%
Kitten wedge	26	24.3%
Block heel	18	16.8%
Total	107	100.0%

Out of 107 participants, 63 (58.9%) wore wedge heels, 26 (24.3%) wore kitten wedge heels and 18 (16.8%) wore block heels. Wedge heels were the most commonly reported heel type, followed by kitten wedge and block heels.

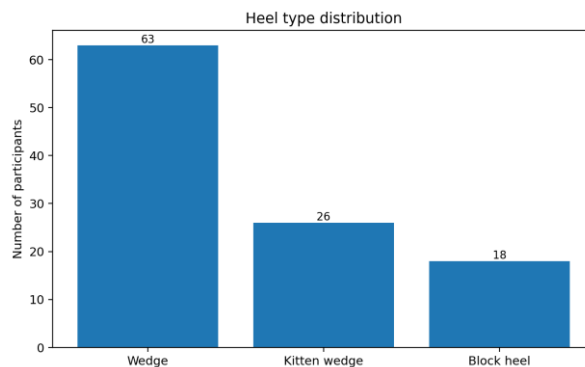


Figure 3. heel type distribution

Table 3. according to severity level

Disability level	Participant count	Percentage
Mild disability	60	56.10%
Moderate disability	38	35.50%
Minimal disability	9	8.40%
Total	107	100.0%

Out of 107 participants, 60 (56.10%) had mild disability, 38 (35.50%) had moderate disability and 9 (8.40%) had minimal disability. Hence mild disability was the most frequently observed severity level.

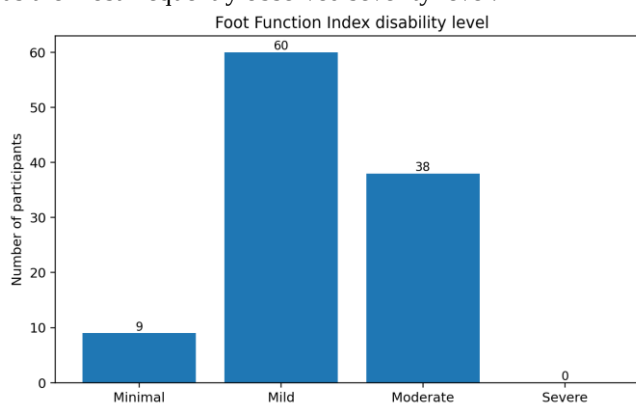


Figure 4. according to severity level

Table 4. type of hallux valgus distribution

Type of hallux valgus	Participant count	Percentage
Bilateral	60	56.1%
Unilateral (left)	29	27.1%
Unilateral (right)	18	16.8%
Total	107	100.00%

Out of 107 participants, 60 (56.1%) presented with bilateral hallux valgus, 29 (27.1%) had unilateral involvement on the left side and 18 (16.8%) had unilateral involvement on right side. Bilateral type was most common.

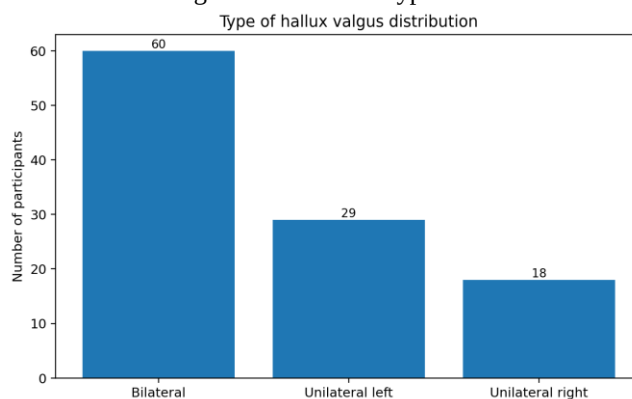


Figure 5. type of hallux valgus distribution

Table 5. foot grade severity distribution

Foot grade	Right n	Right %	Left n	Left %
Normal	30	27.8%	18	16.8%
Mild	47	43.5%	60	56.1%
Moderate	30	28.7%	24	22.4%
Severe	0	0.0%	5	4.7%
Total	107	100.0%	107	100%

Among right foot 30 (27.8%) participants had a normal foot grade, 47 (43.5%) had mild foot grade, 31 (28.7%) had moderate and none had severe foot grade. Among left foot 18 (16.8%) participants had normal foot grade, 60 (56.1%) had mild, 24 (22.4%) had moderate and 5 (4.7%) had severe foot grade; hence mild foot grade was most commonly reported category for both right and left feet.

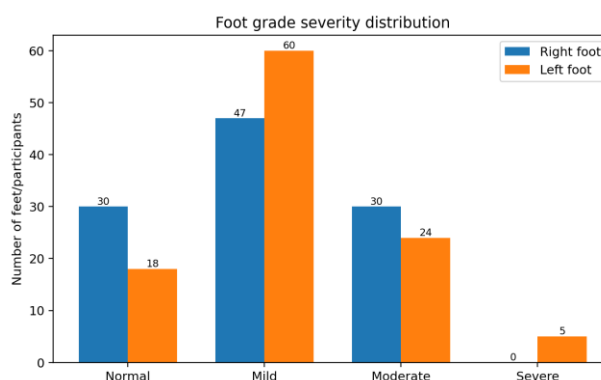


Figure 6. foot grade severity distribution

Table 6. foot function index subscale score

FFI subscale	Mean $\pm$ SD
Pain	25.62 $\pm$ 8.26
Disability	30.76 $\pm$ 9.74
Activity limitation	25.42 $\pm$ 10.34

The graph shows that the mean disability subscale score was 30.76 $\pm$ 9.74 followed by pain subscale score 25.62 $\pm$ 8.26 and activity limitation subscale score of 25.42 $\pm$ 10.34. Among three reported, disability subscale had the highest mean score. This indicates that hallux valgus affects normal foot function.

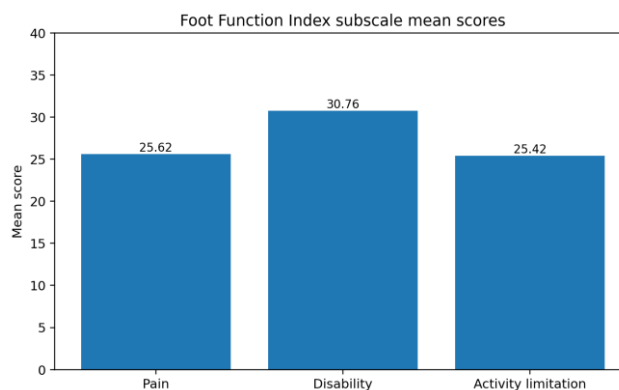


Figure 7. foot function index subscale score

Table 7. foot function index score

Disability level	Count	Percentage
Minimal disability	9	8.41%
Mild disability	60	56.07%
Moderate disability	38	35.51%
Severe disability	0	0.00%

This graph indicates that mild disability was seen mostly, then moderate disability was seen. Hence hallux valgus cause mild to moderate disability.

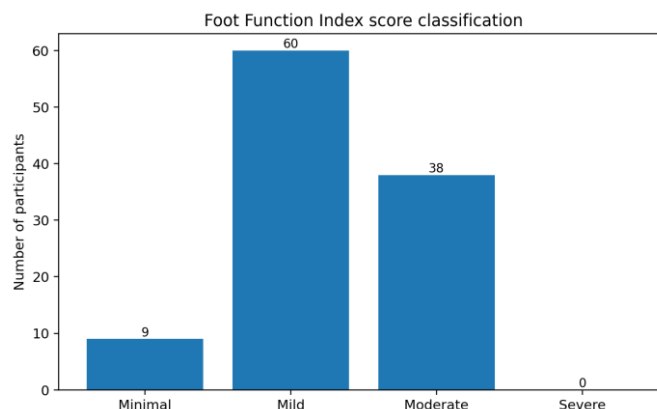


Figure 8. foot function index score

Table 8. total prevalence of hallux valgus

Hallux valgus status	Frequency	Percentage
No hallux valgus	20	18.69%
Hallux valgus	87	81.31%
Total	107	100%

Out of 107 participants 87 (81.31%) participants had hallux valgus whereas 20 (18.69%) participants did not have hallux valgus. Thus the majority of participants (81.31%) demonstrated the presence of hallux valgus.

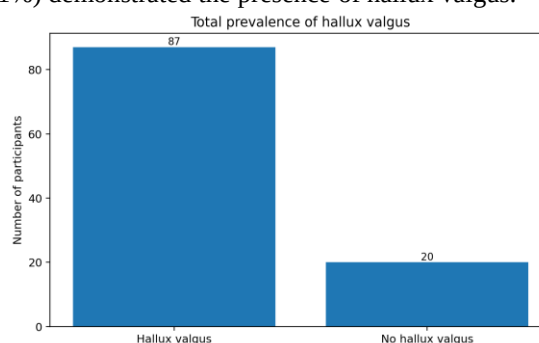


Figure 9. total prevalence of hallux valgus

V. DISCUSSION

The present cross-sectional study was conducted to determine the prevalence of hallux valgus in high heels wearing girl students aged 18-25 years and to evaluate the level of foot function disability using the Foot function index scale (FFI). A total of 107 participants were included in the study. The findings revealed that bilateral hallux valgus was the most commonly observed type, with 60 participants (56.1%), followed by unilateral hallux valgus on the left side in 29 participants (27.1%) and on the right side in 18 participants (16.8%). Thus, bilateral involvement was more frequently observed than unilateral involvement. These findings are comparable with the study by Namrata Naik et al. (2018), which reported that 70% of affected participants had bilateral hallux valgus and 30% had unilateral involvement. Their study also reported that women were more commonly affected and that Grade 1 hallux valgus was the most frequent grade. This similarity supports the observation in our study that bilateral and milder forms of hallux valgus are commonly encountered. These findings are comparable with the study by Namrata Naik et al. (2018), which reported that 70% of affected participants had bilateral hallux valgus and 30% had unilateral involvement. Their study also reported that women were more commonly affected and that Grade 1 hallux valgus was the most frequent grade. This similarity supports the observation in our study that bilateral and milder forms of hallux valgus are commonly encountered.

Regarding footwear, wedge heels were the most commonly used type, reported by 63 participants (58.9%), followed by kitten wedge heels in 26 participants (24.3%) and block heels in 18 participants (16.8%). Okuda et al. (2014) reported that frequent use of high heels, particularly narrow toe-box footwear, was associated with greater hallux valgus angles and increased great-toe pain.

Similarly, Yoon et al. (2014) reported that increased heel height increases forefoot loading and may contribute to lateral deviation of the great toe. In the present study, the right foot showed 43.5% mild, 28.7% moderate and 27.8% normal grades, with no severe cases. On the left foot, 56.1% had mild, 22.4% moderate, 16.8% normal and 4.7% severe hallux valgus. Therefore, mild hallux valgus was the most frequently observed grade in both feet. This finding is consistent with Naik et al. (2018), who reported that the majority of participants had Grade 1 hallux valgus, followed by higher grades. The predominance of mild deformity in our young population may indicate that the deformity is being identified at an early stage.

The Foot Function Index findings showed that the disability subscale had the highest mean score, with a mean of 30.76 ± 9.74 , followed by pain with a mean of 25.62 ± 8.26 and activity limitation with a mean of 25.42 ± 10.34 . This indicates that disability related to foot function was more prominent than pain or activity limitation in the studied participants. Overall FFI classification showed that 56.07% had mild disability, 35.51% had moderate disability and 8.41% had minimal disability, while none had severe disability.

Perera et al. (2011) explained that repeated mechanical loading can contribute to changes in the soft tissues and supporting structures around the first metatarsophalangeal joint. High heels shift body weight towards the forefoot, while restrictive footwear can increase pressure around the great toe. Over time, these factors may contribute to progression of hallux valgus.

Regarding age distribution, the present study included female college students aged 18–25 years, with the majority of participants belonging to the 22–25-year age group (76 participants, 71.03%), while 31 participants (28.97%) were aged 18–21 years. This age distribution indicates that most participants were young adults who may have regular exposure to fashion-oriented footwear. Similarly, Okuda et al. (2014) investigated hallux valgus among young female university students and emphasized that the transition into university may increase opportunities to wear high-heeled and fashion-oriented footwear.

Regarding the type of footwear, wedge heels were the most commonly used footwear in the present study, reported by 63 participants (58.9%), followed by kitten wedge heels in 26 participants (24.3%) and block heels in 18 participants (16.8%). The significant difference in HVA among the three heel-type groups in the present study suggests that heel design may be associated with variation in hallux alignment.

The present study showed that mild hallux valgus was the most frequently observed grade in both feet. On the right side, 43.5% had mild, 28.7% had moderate and 27.8% had normal alignment, with no severe cases. On the left side, 56.1% had mild, 22.4% had moderate, 16.8% had normal and 4.7% had severe hallux valgus. These findings indicate that milder forms of deformity were more commonly observed than severe deformity. This is comparable with Okuda et al. (2014), who reported that mild hallux valgus was more common among young female university students and observed no severe cases in their population.

The findings regarding hallux valgus and footwear are also supported by biomechanical evidence. Yoon et al./the heel-height study reported that increasing heel height can alter the position of the proximal phalanx and first metatarsal. In particular, a 6-cm heel produced significant increases in proximal-phalanx valgus and abduction during dynamic testing. These findings suggest that increased heel height can alter first MTP-joint alignment and may contribute to biomechanical changes associated with hallux valgus.

Similarly, Cronin et al. (2014) reported that high-heeled footwear can alter gait by changing stride characteristics, plantar pressure and stability. These biomechanical changes may increase stress on the forefoot and first metatarsophalangeal joint.

Thus, the present study demonstrates that hallux valgus was commonly observed in this group of high-heel-wearing female students, with bilateral involvement and mild deformity being predominant, and that most participants had mild-to-moderate foot-related disability.

VI. CONCLUSION

The present study concluded that hallux valgus was commonly observed among high-heel-wearing female college students aged 18–25 years. Among the participants, bilateral involvement (56.1%) was more common than unilateral involvement, and mild hallux valgus was the most frequently observed grade in both feet.

Wedge heels were the most commonly used footwear type (58.9%), followed by kitten wedge heels (24.3%) and block heels (16.8%). A statistically significant difference in HVA was found among the different heel-type groups ($p = 0.018$), suggesting that heel type may be associated with differences in hallux alignment.

Overall, the study emphasizes the importance of early screening, appropriate footwear selection, footwear education, and preventive physiotherapy to maintain foot function and address modifiable factors associated with hallux valgus in young female college students.

VII. LIMITATIONS

Restricted study population: Only female college students who wore high heels were included, so the findings may not be applicable to males, older women, or women from different occupational or age groups.

Clinical measurement of HVA: Hallux valgus angle was assessed using a goniometer rather than radiographic measurement. Although goniometry is practical for clinical assessment, measurement accuracy may vary depending on positioning and technique.

The study considered selected high-heel types; therefore, the findings may not represent the effects of all footwear designs, heel heights, or toe-box characteristics.

Factors such as genetic predisposition, family history, foot structure, joint laxity, body weight, previous foot injuries, and daily physical activity may also influence hallux valgus and foot function but were not fully controlled.

VIII. FUTURE SCOPE

Future studies can be conducted with a larger sample size to improve the generalizability of the findings.

Future research can consider additional footwear-related factors such as toe-box width, shoe size, type of footwear and duration of wearing restrictive footwear.

Interventional studies can be conducted to assess the effectiveness of footwear modification, physiotherapy exercises, intrinsic foot muscle strengthening, toe spreading exercises in preventing or reducing the progression of hallux valgus.

Future studies can develop and evaluate college based foot health awareness and screening programs for young female students who regularly wear high heels.

IX. ETHICAL CONSIDERATIONS

The study was approved by the Ethics Committee of Dr. Ulhas Patil College of Physiotherapy, Jalgaon. Informed consent was obtained from all 107 participants. The project consent form states that participants consented to data collection and storage for research purposes and were assured anonymity and confidentiality.

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