



## Original Article

## Risk Factors Causing Ankle Sprain among undergraduate female students

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## ABSTRACT

High heeled shoes align the foot in plantar flexion, modifying the relative orientation of the skeletal structures of ankle, metatarsal, and metatarsophalangeal joints, and alter the insertion angles of the foot and gliding joint muscles, therefore increasing the risk factor for ankle sprain.

**Objective:** Study conducted to determine Risk Factors Causing Ankle Sprain among undergraduate female students. **Method:** Cross-Sectional study was conducted among 500 female students (Between ages 18-26 years) at Sargodha Medical College and completed in 06 months (June 2019-December 2019). Non-probability convenient sampling technique was used to collect data and then entered to SPSS-25 for further statistical analysis. **Result:** Among 500 participants, Age  $19.65 \pm 1.416$  years. Mean height (m)  $1.61 \pm 0.073$ , mean weight (kg)  $57.37 \pm 10.4$ , Mean BMI was  $22.02 \pm 3.6$ . Female experience ankle sprain (54%), not experienced ankle sprain (46%) Significant association found between Ankle Sprain and body mass index (BMI) as the P-value was 0.014 which was  $< 0.05$ . Females wearing high heels have a 1.082 times greater chance of developing ankle sprain (OR 1.082). Females wearing high heels for a long duration (4-6 hrs.) have a 1.271 times greater chance of developing ankle sprain (OR 1.271), female wearing high heel (3-4 inches) have 1.072 times greater chance of developing ankle sprain (OR 1.072), female using Pencil heel have 1.281 times greater chance of developing ankle sprain (OR 1.281) **Conclusion:** Significant association found between Ankle Sprain and body mass index (BMI). Females wearing a high heel for a long duration (4-6 hrs.), high heel (3-4 inches height), using Pencil heel have a greater chance of developing ankle sprain.

## INTRODUCTION

High-heeled shoes are those with a heel that is higher than the forepart. High-heeled shoes frequently have a tiny toe box, a hard heel cap, and a bent plantar area, all of which obstruct normal foot mobility. High-heeled shoes have been used for centuries [1], and despite repeated warnings against their use, they are still widely worn. Since the 18th century [2], health experts have been concerned about women's penchant for high heeled footwear [3]. The earliest cautions that wearing high heeled footwear might lead to trips and falls were issued in the nineteenth century. Women have also been cautioned about the likelihood of

long-term foot changes from wearing high-heeled footwear, such as shortened calf muscles, clawed toes, sprained ankles, bunions, and foot discomfort, since this time [4]. According to surveys, between 37% and 69% of women wear them regularly, constituting a sizable share of the female population [5]. Wearing high-heeled shoes is known to enhance the chance of a lateral ankle sprain [6]. Ankle sprains account for between 3% and 5% of all Emergency Department visits in the UK, amounting to around 5,600 cases each day [7]. Previous research has shown that high-heeled shoes align the foot in

plantarflexion, changing the relative orientation of the skeletal structures of the ankle, mid-tarsal, and metatarsophalangeal joints, as well as altering the insertion angles of the foot and gliding joint muscles [8], increasing the risk factor for ankle sprain.

## METHODS

“Cross-sectional study conducted in the department of physical therapy, Sargodha Medical College, University of Sargodha. The study was finished within 6 months (June 2019-December 2019). Sample size was calculated by formula used in health studies:  $n = (Z^2 \times P \times (1 - P)) / e^2$  where Estimated Proportion=0.27, margin of error=5% and Confidence level=95% [9]. According to which 500 undergraduate female students were selected for data collection (those who were easily available and agree to deliver the information that was correct and sufficient). The non-Probability technique of consecutive sampling was utilized to acquire data. To collect data, standardized variables such as Body Mass Index (BMI) and Ankle Sprain Risk Factors were employed. After the synopsis was accepted by the University's ethical committee and the authorization of connected departments, subjects were interviewed to ensure that they met the study's inclusion criteria. The testing technique was clearly described to the participants. Participants in the research were females aged 18 to 26 years old, and those with medical conditions such as Hepatitis, High Blood Pressure, or Diabetes were excluded. Participants under the age of 18 and above the age of 26 were barred from participating. All individuals agreed to participate, were willing to be studied further, and completed the survey form. The survey questionnaire was gathered by the study's inclusion criteria. BMI was determined using the formula:  $\text{weight (kg)} / [\text{height (m)}]^2$  and was classified as underweight (18.5), normal or healthy weight (18.5 - 24.9), overweight (25.0 - 29.9), or obese (30.0). Participants' responses were collected and all data were entered in the SPSS file for statistical analysis and interpreted further results. Demographics are analyzed as numbers, percentages, and frequency. Qualitative variables were presented in the form of frequency and percentage (frequency tables and Bar charts). Chi-Square test was performed along with relative risk estimation to check the association between an ankle sprain and BMI of students. P value  $\leq 0.05$  was considered significant.

## RESULTS

Among 500 participants, Age  $19.65 \pm 1.416$  years (minimum 18, maximum 25 year), with 171(34.2%) in age limit 18-20 years, 163(32.6%) in age limit 21-23 years and 166(33.2%) in age limit 24-26 years. Mean height (m)  $1.61 \pm 0.073$ , mean weight (kg)  $57.37 \pm 10.4$ , Mean BMI was  $22.02 \pm 3.6$ . According

to BMI, participants were underweight 67(13.4%), normal or healthy weight 341(68.2%), overweight 70(14%) and obese 22(4.4%). Significant association found between Ankle Sprain and body mass index (BMI) as the P value was 0.014 which was  $< 0.05$ .

		Association between Ankle Sprain and Body Mass Index (BMI)				Total	P Value
		Body Mass Index (BMI) Categories					
Ankle Sprain	Yes	59(23.50%)	59(23.50%)	68(27.10%)	65(25.90%)	251(100.00%)	0.014
	No	79(31.70%)	53(21.30%)	68(27.30%)	49(19.70%)	249(100.00%)	
Total		138(27.60%)	112(22.40%)	136(27.20%)	114(22.80%)	500(100.00%)	

**Table 1:** Association between Ankle Sprain and Body Mass Index (BMI)

There was significant association between ankle sprain and body mass index as P value was 0.014 which was  $< 0.014$ .

		Wear High Heel		Total	Odds Ratio
		Yes	No		
Ankle Sprain	Yes	138(55.00%)	113(45.00%)	251(100.00%)	1.082
	No	132(53.00%)	117(47.00%)	249(100.00%)	
Total		270(54.00%)	230(46.00%)	500(100.00%)	

**Table 2:** Relative Odds for Ankle Sprain among females wearing different type of heels

		Duration of Wearing High Heel		Total	Odds Ratio
		4-6 Hrs	1-3 Hrs		
Ankle Sprain	Yes	137(54.60%)	114(45.40%)	251(100.00%)	1.271
	No	121(48.60%)	128(51.40%)	249(100.00%)	
Total		258(51.60%)	242(48.40%)	500(100.00%)	

**Table 3:** Relative Odds for Ankle Sprain among females with duration of wearing high heel

Association with relative risk between ankle sprain and female wearing high heels was checked according to which Odds Ratio was 1.082 which means that female wearing high heel have 1.082 times greater chance of developing ankle sprain as compared to female not wearing high heels. Relative Risk Estimation for Ankle Sprain among females with duration of wearing high heels was checked according to which Odds Ratio was 1.271 which means that female wearing high heel for long duration (4-6 hrs) have 1.271 times greater chance of developing ankle sprain as compared to wearing heel for 1-3 hrs.

Relative Odds for Ankle Sprain among females wearing different type of heels					
		Height of Heel		Total	Odds Ratio
		3-4 Inches	1-2 Inches		
Ankle Sprain	Yes	138(55.00%)	113(45.00%)	251(100.00%)	1.072
	No	132(53.00%)	117(47.00%)	249(100.00%)	
Total		270(54.00%)	230(46.00%)	500(100.00%)	

**Table 4:** Relative Odds for Ankle Sprain among females wearing a different type of heels.

Relative Risk Estimation for Ankle Sprain among females with Height of heels was checked according to which Odds Ratio was 1.072 which means that female wearing high heel(3-4 inches) have 1.072 times greater chance of developing ankle sprain as compared to heel(1-2 inches).

Relative Odds for Ankle Sprain among females wearing different type of heels					
		Type of Heel		Total	Odds Ratio
		Wedge heels	Pencil heels		
Ankle Sprain	Yes	137(54.60%)	114(45.40%)	251(100.00%)	1.281
	No	121(48.60%)	128(51.40%)	249(100.00%)	
Total		258(51.60%)	242(48.40%)	500(100.00%)	

**Table 5:** Relative Odds for Ankle Sprain among females wearing different type of heels.

Relative Risk Estimation for Ankle Sprain among females wearing different type of heels was checked according to which Odds Ratio was 1.281 which means that female using Pencil heel have 1.281 times greater chance of developing ankle sprain as compared to wedge heel

## DISCUSSION

The study was conducted in Sargodha medical college to determine the risk factor that can cause ankle sprain among female students. Our study was confined to specific age group i.e. 18-26. Our survey was evaluated through self-made questionnaire not by clinical analysis. "According to Lyola medicine high heels are the leading cause of ingrown toe nails. This occurs because the toes compress together, causing the big toe nails to grow into the skin. This can also lead to nail or fungal infections. High heels can cause bunions. Because use of high heels can tip your body weight forward, forcing the toes towards the front of the shoe [18]. This action pushes the big toes against the other toes, which can cause the bunion protrusion. According to our study, regular use of high heels causes ankle sprain. Among 500 girls, height of heels and type of heels is the most significant factors that are causing ankle sprain. Type of heels is the main factor which is causing the ankle sprain [19]. As we know that heel height greater than 1.5 inches

can cause changes in the body posture and so the girls using high heels regularly, more often suffer from ankle sprain than other girls. As the height of heels can change the mechanics of the body while walking, it can exert greater pressure on the ankle and other joints as well[10]. High heels can cause hip and knee pain. It is the most common problem that many girls experienced while using high heels. Walking with high heels increases the weight on the knee joints, as women tend to bend their knees more while walking in high heels shoes. This can strain knee joints as well as the hip, and exert pressure on these joints and due to its excessive use it can trigger fractures and compresses the nerves [17]. According to our study, regular use of high heels cause ankle sprain. Among 500 girls, height of heels and type of heels is the most significant factors that are causing ankle sprain. Type of heels is the main factor which is causing the ankle sprain. As we know that heel height greater than 1.5 inches can cause changes in the body posture and so the girls using high heels regularly, more often suffer from ankle sprain than other girls. As height of heels can change the mechanics of the body while walking, it can exert greater pressure on ankle and other joints as well. [11] Regular use of high heels increases the risk of osteoarthritis, which is the inflammatory joint condition in women of old age but the prolonged use of high heels can increase the risk of osteoarthritis. According to the study of Orthopedic journal women wearing heels higher than 3.5 inches can increase the lifetime risk of osteoarthritis [12]. "Muscle soreness and spasms are the most prevalent complaints from girls wearing high heels. According to the American Osteopathic Association, wearing high heels for an extended period of time can shorten the muscles in the calves and back, resulting in muscular soreness and spasms. Many ladies also complain of excruciating leg cramps after wearing high heels shoes. According to our research, wearing high heels while walking induces twisting of the foot, which can lead to ankle sprains owing to the larger pressures and strains placed on the foot." [16]"Age also plays an important factor in twisting of foot because with age the body is unable to maintain balance and while using high heels balance of person lost and person may fall and results in twisting of foot and ankle sprain while walking with high heels."[13]"High heels alter the normal curve of the spine. The lower back gets much more arched than usual when you wear high heels. The greater the height of heels are, the more the lower back needs to arch to maintain the positioned upright. This excessive bend is a cause of back discomfort in both the lower and upper back. According to our study the most significant cause of creating ankle sprain and hurting your ankles are kind of heels and height of heels. There were

numerous sorts of heels on the market and girls chose different heels according to their tastes. According to our data analysis, pencil heels are the most frequently used heels by girls and while using pencil heels the balance of girls is lost and the ankle is hurt mostly which in turn leads to spraining of the ankle. Young women in their 20s were most likely to get these injuries, which were usually sprains and strains to the foot or ankle [14]. The study should be analyzed through clinical analysis in the future. Seminars can be conducted to spread awareness among females. A study should also be conducted on females above 30 years of age in the future. Research should also include the aspect of brand and quality of shoes. [20] A longitudinal study should be conducted to evaluate the long-term effects of wearing high heels [15].

## CONCLUSION

A significant association was found between Ankle Sprain and body mass index (BMI). Females wearing, high heels for a long duration (4-6 hrs), high heels (3-4 inches height), using Pencil heels have a greater chance of developing ankle sprain.

## REFERENCES

- [1] Yu J, Cheung JT, Wong DW, Cong Y, Zhang M. Biomechanical simulation of high-heeled shoe donning and walking. *J Biomech.* 2013; 46:2067-74. [doi.org/10.1016/j.jbiomech.2013.05.009](https://doi.org/10.1016/j.jbiomech.2013.05.009)
- [2] Williams CM, Haines TP. An exploration of emergency department presentations related to high heel footwear in Victoria, Australia, 2006-2010. *Journal of foot and ankle research.* 2014; 7(1):4. [doi.org/10.1186/1757-1146-7-4](https://doi.org/10.1186/1757-1146-7-4)
- [3] Busey S. The influence of the constant use of high-heeled French shoes upon the health and form of the female, and upon the relation of the pelvic organs. *Trans Am Gynecol Soc.* 1882; 7:261-3. [doi.org/10.2190/GA2M-FLA2-17FB-V5PE](https://doi.org/10.2190/GA2M-FLA2-17FB-V5PE)
- [4] Farrag A, Elsayed W. Habitual Use of High-Heeled Shoes Affects Isokinetic Soleus Strength More Than Gastrocnemius in Healthy Young Females. *Foot Ankle Int.* 2016; 37:1008-16. [doi.org/10.1177/1071100716649172](https://doi.org/10.1177/1071100716649172)
- [5] Frey C, Thompson F, Smith J, Sanders M, Horstman H. American Orthopaedic Foot and Ankle Society women's shoe survey. *Foot & ankle.* 1993;14(2):78-81. [doi.org/10.1177/107110079301400204](https://doi.org/10.1177/107110079301400204)
- [6] Beynon BD, Renström PA, Alosa DM, Baumhauer JF, Vacek PM. Ankle ligament injury risk factors: a prospective study of college athletes. *Journal of Orthopaedic Research.* 2001;19(2):213-20.
- [7] Cooke M, Lamb S, Marsh J, Dale J. A survey of current consultant practice of treatment of severe ankle sprains in emergency departments in the United Kingdom. *Emergency medicine journal.* 2003;20(6):505-7. [doi:10.1136/emj.20.6.505](https://doi.org/10.1136/emj.20.6.505)
- [8] Basmajian J, Bentzon J. An electromyographic study of certain muscles of the leg and foot in the standing position. *Surgery, gynecology & obstetrics.* 1954;98(6):662. [doi:10.3827/faoj.2010.0303.0001](https://doi.org/10.3827/faoj.2010.0303.0001)
- [9] Jackson LA, Von Eye A, Fitzgerald HE, Witt EA, Zhao Y. Internet use, videogame playing and cell phone use as predictors of children's body mass index (BMI), body weight, academic performance, and social and overall self-esteem. *Computers in Human Behavior.* 2011;27(1):599-604. [doi.org/10.1016/j.chb.2010.10.019](https://doi.org/10.1016/j.chb.2010.10.019)
- [10] Hu P, Hu Y. Soft-Tissue Nail Fold Arc Resection Combined with a Shaped Dressing for Ingrown Toenails. *Journal of the American Podiatric Medical Association.* 2020;110(4). [doi.org/10.7547/17-199](https://doi.org/10.7547/17-199)
- [11] Mishra E, Jena S, Bhoi C, Arunachalam T, Panda SK. Effect of high heel gait on hip and knee-ankle-foot rollover characteristics while walking over inclined surfaces—A pilot study. *The Foot.* 2019;40:8-13. [doi.org/10.1016/j.foot.2019.03.004](https://doi.org/10.1016/j.foot.2019.03.004)
- [12] Paterson KL, Kasza J, Hunter DJ, Hinman RS, Menz HB, Peat G, et al. The relationship between foot and ankle symptoms and risk of developing knee osteoarthritis: data from the osteoarthritis initiative. *Osteoarthritis and cartilage.* [doi.org/10.1016/j.joca.2016.12.003](https://doi.org/10.1016/j.joca.2016.12.003)
- [13] Jabbar S, Sabir S, Irum S, Raza H, Wassi A, Subazwari AB. Prevalence of Forefoot Pain among High Heel Wearing Female Teachers and Students of Different Universities in Faisalabad. *Health Science Journal.* 2020;14(2):1-4. DOI:10.36648/1791-809X.14.2.710
- [14] Afzal F, Manzoor S. Prolong wearing of high heeled shoes can cause low back pain. *J Nov Physiother.* 2017;7(356):2. DOI:10.4172/2165-7025.1000356
- [15] Frey C, Coughlin MJ. Women's shoe wear: An orthopaedist's advice. *J Womens Health.* 1999; 8:45-9. [doi.org/10.1089/jwh.1999.8.45](https://doi.org/10.1089/jwh.1999.8.45)
- [16] Gefen A, Megido-Ravid M, Itzchak Y, Arcan M. Analysis of muscular fatigue and foot stability during high-heeled gait. *Gait Posture.* 2002; 15:56-63. [doi.org/10.1016/S0966-6362\(01\)00180-1](https://doi.org/10.1016/S0966-6362(01)00180-1)
- [17] Han D. Muscle activation of paraspinal muscles in different types of high heels during standing. *J Phys TherSci.* 2015; 27:67-9. [doi.org/10.1589/jpts.27.67](https://doi.org/10.1589/jpts.27.67)
- [18] Cowley EE, Chevalier TL, Chockalingam N. The effect of heel height on gait and posture: a review of the literature. *J Am Podiatr Med Assoc.* 2009; 99:512-8. [doi.org/10.7547/0990512](https://doi.org/10.7547/0990512)
- [19] Ko DY, Lee HS. The changes of COP and foot pressure

after one hour's walking wearing high-heeled and flat shoes. *J Phys Ther Sci.* 2013; 25:1309-12. [doi.org/10.1589/jpts.25.1309](https://doi.org/10.1589/jpts.25.1309)

- [20] Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics.* 1987; 18:233-7. [doi.org/10.1016/0003-6870\(87\)90010-X](https://doi.org/10.1016/0003-6870(87)90010-X)