International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Effects of Physical Activity on Foot Characteristics and Plantar Pressure Distribution among College Students

Taranum Pandhi (PT)[1], Dr. Pragya Kumar[2], Sameer Chhikara (MPT)[3]

[1]Amity Institute of Physiotherapy, Amity University, Noida, 201313, Uttar Pradesh, India
Author: tpandhi2014[at]gmail.com

[2]Amity Institute of Physiotherapy, Amity University, Noida, 201313, Uttar Pradesh, India
*Corresponding Author: *pkumar[at]amity.edu*

[3]Bhagwan Mahavir hospital, Pitampura, New Delhi, 110034, India
Email: *sameer_chhikara[at]hotmail.com*

Abstract: ***The aim of this study was to find the effects of physical activity on foot characteristics and plantar pressure distribution. The objective is to determine the effects of physical activity on plantar pressure distribution and to determine the effects of physical activity on foot characteristics. N=100 individuals were evaluated for their physical activity level and plantar pressure distribution. Interventions were given in the form of questionnaire that was taken from 100 subjects with their dominant foot imprint while in dynamic motion and their FPI was also measured and gait velocity (4m) was recorded. To investigate data collected chi square test was used for the analysis. The results were significant for females gait velocity with FPI was significant (χ2 =6.48) while the results were insignificant for males gait velocity with FPI(χ2=2.33), and for 2nd, 3rd, 4th metatarsals phalangeal and 1st metatarsal with FPI were significant (χ2 =16.42, χ2=15.82, χ2= 12.88, χ2=19.28 respectively) whereas 1st, 5th MTP and 2nd , 3rd , 4th, 5th MT and TC joint with FPI were insignificant (χ2=9.72, χ2=11.99, χ2=11.96, χ2= 10.95,χ2 =11.23, χ2=5.22, χ2= 11.30 respectively and GPPAQ with FPI was insignificant (χ2= 6.06). In the present study, out of 100 subjects, 72% subjects were physically inactive whereas only 28% were physically active. Out of 100 subjects, 55% had normal followed by 31% had pronated and 14% had supinated foot posture. No significant association was seen between different type of foot postures with physical activity level. Significant association was found between plantar pressure exerted at 2nd, 3rd & 4th metatarsal phalangeal joint and 1ST MT metatarsal with foot posture. Significant association was found in gait velocity and foot posture in females whereas in males it was insignificant.***

Keywords: plantar pressure distribution, dominant foot, physical activity level, gait velocity, pronated foot, supinated foot posture.

1. Introduction

The foot is a highly unique and flexible structure which is required to perform very diverse functions particularly during weight bearings activities which is why individuals lose their interest in being physically active and adapt the sedentary Feet act as the base of support for the body of an individual and continuously endure high ground reaction forces generated while performing ADL's. Foot pain and discomfort felt was caused due to high plantar pressure on foot which has been speculated as one of the factor or reason lifestyle and spend more time in doing sedentary activities. This study will help in the effects of lifestyle on the dynamic plantar pressure distribution and it will include college going students. Whilst structurally normal foot can adequately perform required tasks, deviations from its normal posture placing it under excessive stress. Altered foot dynamics can cause in abnormal distribution of the plantar pressure leading to discomfort or pain. Information about the pressure distribution and active foot contact area during walking is considered important for the practice in medicine. It is known that high pressure in the forefoot area occurs during the push-off phase of gait when the heel leaves the ground, and entire body weight is borne on the forefoot and toe. Participation in physical activity provides numerous benefits for children, adults as well as for older adults helps in improving cardiovascular risks factors, muscular strength and endurance, skeletal health, mental health and academic performance. Physical activity in adolescence may contribute to the development of healthy adult lifestyle, helping reduce chronic disease incidence. Physical activity is an important aspect of daily life, and numerous studies have examined the effect that being active has on one's perceived quality of life. College students may be more susceptible to decreased physical activity due to new life stressors including higher academic demands, financial concerns, and social uncertainty. In the recent years, the plantar pressure has widely been accepted as a vital biomechanical parameter to evaluate human walking. In recent years, the plantar pressure has widely been accepted as a vital biomechanical parameter to evaluate human walking. Plantar pressure measurements during standing, walking or other activities can demonstrate the pathomechanics of the abnormal foot and yield objectives measure to track progression. Plantar pressure measurements during standing, walking or other activities can demonstrate the pathomechanics of the abnormal foot and yield objective measures to track disease progression. A callus formation on the plantar surface of the foot can elevate the plantar pressure. The distribution and magnitudes of plantar pressure have been measured to identify the functional manifestations of foot disorders. It is found that dynamic plantar pressure provides co-important information about the human gait

The foot is a highly unique and flexible structure which is required to perform very diverse functions particularly during weight bearings activities [2] which is why individuals lose their interest in being physically active and adapt the sedentary lifestyle. Feet act as the base of support for the body of an individual and continuously endure high ground reaction forces generated while performing ADL's [3]. Foot pain and discomfort felt was caused due to high plantar pressure on foot which has been speculated as contributing factors toward sedentary lifestyle and spend more time in doing sedentary activities. This study will help in the effects of lifestyle on the dynamic plantar pressure distribution, and it will include college going students. Whilst structurally normal foot can adequately perform required tasks, deviations from its normal posture place it under excessive stress. Altered foot dynamics can accentuate stress due in abnormal distribution of the plantar pressure leading to discomfort or pain [5-6].

Author & year	*Study design*	*Conclusion*
Karen J Mickel et al. J Sci Med Sport. 2011	Relationship study.	It has been speculated that high plantar pressure might cause discomfort to foot in turn may discourage children from being physically active and result in them spending more time in sedentary activities
Yayin Plumaron, worarachanee Imjaijit, Nusorn Chaiphrom, 2014	Comparative study	The Staheli Index obtained from the Harris mat footprint could be considered as the screening or diagnostic method for flatfoot.
DS Teyhen 2011		The multivariate model associated with FPI-6 scores comprised clinically plausible variables which inform the association between static and dynamic foot postures. Different cutoff values may be required when using the FPI-6 to screen for individuals with supinated feet, given the limited number of high-arched participants identified by FPI-6 classifications.
Shaleen Ahmad, Tess Harris		GPPAQ has reasonable reliability but results from this study measuring validity in older adults indicates poor agreement with objective accelerometry for accurately identifying physical activity levels. Including brisk walking in GPPAQ increased sensitivity, but reduced specificity and did not improve overall screening performance. GPPAQ's use in National Health Service health checks in primary care in this age group cannot therefore be supported by this validity study comparing to accelerometry.
Sae Yong Lee, Jay Hertel		Rear-foot alignment was found to be a significant predictor of maximum plantar pressure and pressure-time integral in the medial rear-foot and midfoot regions. This indicates that control of rear-foot alignment may help decrease plantar pressure on the medial region of the foot, which may potentially prevent injuries associated with excessive rear-foot eversion.
YaninPlumarom, Worarachanee Imajaijit		The Staheli Index obtained from the Harris mat footprint could be considered as the screening or diagnostic method for flatfoot.

In the recent years, the plantar pressure has widely been accepted as a vital biomechanical parameter to evaluatehuman walking. It is known that high pressure in the forefoot area occurs during the push-off phase of gait when the heel leaves the ground, and entire body weight is borne on the forefoot and toe [7]. Plantar pressure measurements during standing, walking or other activities can demonstrate the pathomechanics of the abnormal foot and yield objective measures to track disease progression [10]. The distribution and magnitudes of plantar pressure have been measured to identify the functional manifestations of foot disorders.

Participation in physical activity provides numerous benefits for children, adults as well as for older adults helps in improving cardiovascular risks factors, muscular strength and endurance, skeletal health, mental health and academic performance. Physical activity in adolescence may contribute to the development of healthy adult lifestyle, helping reduce chronic disease incidence [7-8]. College students may be more susceptible to decreased physical activity due to new life stressors including higher academic demands, financial concerns, and social uncertainty [8]. Numerous studies have examined the effect that being active has on one's perceived quality of life but how physical activity levels are going to impact foot posture and plantar pressure distribution is less researched. Thus purpose of present study was to understand the effect of physical activities performed and its effects on foot characteristics as well as plantar pressure distribution among college going students.

2. Materials and Methods

2.1 Sample Size Estimation

2.2 Participants

Data Analysis

The data collected was analyzed using Microsoft excel. The General subjective characteristics were analyzed using descriptive statistics. Furthermore, to find the association of the effects of physical activity on foot characteristics and dynamic plantar pressure distribution among the college going students Chi square test was used.

Result 5.1: Demographic characteristics

Demographic details(n=100)	*Values*
Age (years)	20.5±1.21 (Mean±SD)
No. of pronated feet	31
No. of supinated feet	17
No. of normal feet	52
Total participants	100

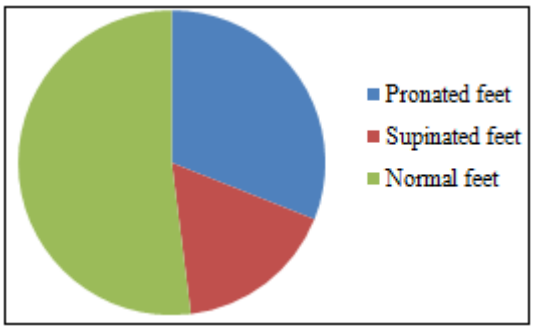

Figure 5.1: Pie chart showing distribution of subjects according to foot posture

Figure 1 is showing that 52% of individuals fall under the category of normal feet and 31% individuals fall under the category of pronated feet and 17% individuals fall under the category of supinated feet.

Table 5.2 showing association of gait velocity with males and females with FPI

	Males (n=36)		Females (n=64)	
	Affected (n=29)	Normal (n=7)	Affected (n=45)	Normal (n=19)
Normal	18(17.7%)	4(4.2%)	17(21%)	13(8.9%)
Supinated	5(4%)	0(0.9%)	6(6.3%)	3(2.6%)
pronated	6(7.2%)	3(1.7%)	22(17.5%)	3(7.4%)
Chi square	P=0.3107 (NS)	P=0.0392 (S)		
Value	(χ^2=2.33)	(χ^2=6.48)		

that males (n=36), row 1 displays 17.7% individuals gait speed is affected that had normal feet and 4% individuals with supinated feet have affective gait velocity and 7.2% individuals with pronated feet have affected gait speed and row 2 displays 4.2% individuals with normal gait speed and normal feet, 0.9% individuals with supinated feet and normal gait speed, 1.7% individuals with normal gait but pronated feet. Insignificant result (P=0.31)

Females(n=64) 21% with affected gait speed and normal foot posture while 6.3% with affected gait speed and supinated foot posture and 17.5% with affected gait speed and pronated foot posture and 8.9%,2.6%,7.4% with normal gait speed and normal, supinated and pronated foot posture respectively. And the result showed significant association of gait velocity with foot posture. (χ2=6.48; p < 0.05).

Table 5.3 showing association of physical activity with foot posture (left)

Foot Posture / No. of grau	GPPAQ with left FPI			
	Inactive (n=25)	moderately inactive (n=47)	moderately active (n=26)	Active (n=2)
Normal	14 (13.70%)	25 (25.80%)	15 (14.30%)	1 (1.10%)
Supinated	1 (3.50%)	7 (6.50%)	5 (3.60%)	1 (0.20%)
Pronated	10 (7.70%)	15 (14.50%)	6 (8%)	0 (0.60%)
Chi square value	P=0.416 (χ^2=6.06) (NS)			

Table showing out of 100, 13.7% with normal foot posture are inactive and 3.5% with supinated foot posture and 7.7% with pronated feet. Second row shows 25.8% individuals with normal foot type are moderately inactive and 6.5% with supinated type and 14.5% with pronated type. Third row shows individuals with moderately active 14.3% with normal foot posture and 3.6% with supinated foot type and 8 with pronated foot type. Fourth row shows that individuals with active were 1.1% with normal foot posture and 0.2% with supinated foot type and 0.6% with pronated foot type. Result observed was insignificant (χ2=6.06; P<0.05)

Table 5.4 showing association of physical activity with foot posture (right)

Foot Posture / No. of grau	GPPAQ with Right FPI			
	Inactive (n=25)	moderately inactive (n=47)	moderately active (n=26)	Active (n=2)
Normal	14 (13.70%)	25 (25.80%)	15 (14.30%)	1 (1.10%)
Supinated	1 (3.50%)	7 (6.50%)	5 (3.60%)	1 (0.20%)
Pronated	10 (7.70%)	15 (14.50%)	6 (8%)	0 (0.60%)
Chi square value	P=0.416 (χ2=6.06) (NS)			

Table showing out of 100, 13.7% with normal foot posture are inactive and 3.5% with supinated foot posture and 7.7% with pronated feet. Second row shows 25.8% individuals with normal foot type are moderately inactive and 6.5% with supinated type and 14.5% with pronated type. Third row shows individuals with moderately active 14.3% with normal foot posture and 3.6% with supinated foot type and 8 with pronated foot type. Fourth row shows that individuals with active were 1.1% with normal foot posture and 0.2% with supinated foot type and 0.6% with pronated foot type. Result observed was insignificant (χ2=6.06;p<0.05)

Table 5.5 showing association of pressure exerted at 1MTP with foot type

Foot Posture / No. of grau	1 MTP (metatarsal phalangeal)			
	grau 1 (n=1)	grau 2 (n=34)	grau 3 (n=6)	grau 4 (n=5)
Normal	0 (0.5%)	23 (19%)	32 (33.60%)	1 (2.80%)
Supinated	0 (0.10%)	6 (4.70%)	7 (8.40%)	1 (0.7%)
Pronated	1 (0.3%)	5 (10.2%)	21 (18%)	3 (1.5%)
Chi square value	P=0.13 (χ2=9.72) (NS)			

Table showing at 3MTP, grau1 (0.27kg/cm2) 0.5% individuals exerted pressure with normal foot posture while 0.1% with supinated foot type and 0.3% with pronated foot type. Grau2 (1.25kg/cm2) 19% exerted pressure with normal foot posture, 4.7% with supinated foot type, 10.2% with pronated foot type. Grau3 (2.6kg/cm2) 33.6% exerted pressure with normal foot posture,8.4% with supinated foot posture,18% with pronated foot posture. Grau4 (4.8kg/cm2) 2.8% exerted pressure with normal foot type, 0.7% with supinated foot type, 1.5% with pronated foot type. Insignificant result (χ2=9.72;P<0.05).

Table 5.6 showing association of pressure exerted at 2MTP with foot type among study population.

Foot Posture / No. of grau	2 MTP (metatarsal phalangeal)			
	grau 1 (n=5)	grau 2 (n=88)	grau 3 (n=5)	grau 4 (n=2)
Normal	2 (2.70%)	52 (48%)	0 (2.7%)	0 (0.5%)
Supinated	2 (0.6%)	10 (10.6%)	0 (0.6%)	0 (0.1%)
Pronated	1 (1.6%)	26 (29.3%)	5 (1.6%)	2 (0.3%)
Chi square value	P=0.0117 (χ2=16.42) (S)			

Table5.6 showing at 2MTP, grau1(0.27kg/cm2) 2.7% individuals exerted pressure with normal foot posture while 0.6% with supinated foot type and 1.6% with pronated foot type. Grau2 (1.25kg/cm2) 48% exerted pressure with normal foot posture, 10.6% with supinated foot type, 29.3% with pronated foot type. Grau3(2.6kg/cm2) 2.7% exerted pressure with normal foot posture,10.6% with supinated foot posture,1.5% with pronated foot posture. Grau4(4.8kg/cm2) 0.5% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Significant result (χ2=16.42;P<0.05)

Table 5.7 showing association pressure exerted on 3MTP with foot type among study population

Foot Posture / No. of grau	3 MTP (metatarsal phalangeal)			
	grau 1 (n=28)	grau 2 (n=70)	grau 3 (n=1)	grau 4 (n=1)
Normal	13 (15.10%)	41 (37.8%)	0 (0.5%)	0 (0.5%)
Supinated	7 (4.2%)	6 (10.5%)	1 (0.1%)	1 (0.1%)
Pronated	8 (8.6%)	23 (21.7%)	0 (0.3%)	0 (0.3%)
Chi square value	P=0.0147 (χ2=15.82) (S)			

Table5.7 showing at 3MTP, grau1(0.27kg/cm2) 15.1% individuals exerted pressure with normal foot posture while 4.2% with supinated foot type and 8.6% with pronated foot type. Grau2 (1.25kg/cm2) 37.8% exerted pressure with normal foot posture, 10.5% with supinated foot type, 21.7% with pronated foot type. Grau3(2.6kg/cm2) 0.5% exerted pressure with normal foot posture,0.1% with supinated foot posture,0.3% with pronated foot posture. Grau4(4.8kg/cm2) 0.5% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Significant result (χ2=15.82; P<0.05).

Table 5.8 showing association of pressure exerted on 4MTP with foot type among study population

Foot Posture / No. of grau	4 MTP (metatarsal phalangeal)			
	grau 1 (n=58)	grau 2 (n=40)	grau 3 (n=1)	grau 4 (n=1)
Normal	32 (32.40%)	24 (22.4%)	0 (0.5%)	0 (0.5%)
Supinated	8 (8.10%)	4 (5.6%)	1 (0.1%)	1 (0.1%)
Pronated	18 (17.4%)	12 (12%)	0 (0.3%)	0 (0.3%)
Chi square value	P=0.044 (χ2=12.88)			

This table 5.8 shows the amount pressure induced on the foot at 4MTP. Grau 1(0.27kg/cm2)32.4% individuals exerted pressure with normal foot posture while 8.1% with supinated foot type and 17.4% with pronated foot type. Grau2 (1.25kg/cm2) 22.4% exerted pressure with normal foot posture, 5.6% with supinated foot type, 12% with pronated foot type. Grau 3 (2.6kg/cm2) 2.7% exerted pressure with normal foot posture,0.5% with supinated foot posture,0.1% with pronated foot posture. Grau4(4.8kg/cm2) 0.3% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Significant result (χ2=12.88; P<0.05)

Table 5.9 showing association of pressure exerted on 5MTP with foot type among study population

Foot Posture / No. of grau	5 MTP (metatarsal phalangeal)			
	grau 1 (n=14)	grau 2 (n=70)	grau 3 (n=14)	grau 4 (n=2)
Normal	7 (7.42%)	40 (37.1%)	6 (7.42%)	0 (1.06%)
Supinated	5 (1.96%)	7 (9.8%)	2 (1.96%)	0 (0.28%)
Pronated	2 (4.62%)	23 (23.1%)	6 (4.62%)	2 (0.66%)
Chi square value	P=0.062 (χ2=11.99) (N)			

Table5.9 showing at 5MTP, grau1(0.27kg/cm2) 7.42% individuals exerted pressure with normal foot posture while 1.96% with supinated foot type and 4.6% with pronated foot type. Grau2 (1.25kg/cm2) 37.1% exerted pressure with normal foot posture, 9.80% with supinated foot type, 23.10% with pronated foot type. Grau3(2.6kg/cm2) 7.42% exerted pressure with normal foot posture,1.96% with supinated foot posture,4.62% with pronated foot posture. Grau4(4.8kg/cm2) 1.06% exerted pressure with normal foot type, 0.28% with supinated foot type, 0.66% with pronated foot type. Insignificant result (χ2=11.99; P<0.05)

Table 5.10 showing association of pressure exerted on 1MT with foot type among study population

Foot Posture / No. of grau	1 MT (metatarsal)			
	grau 1 (n=12)	grau 2 (n=70)	grau 3 (n=14)	grau 4 (n=2)
Normal	6 (6.3%)	41 (37.1%)	5 (7.4%)	0 (1.06%)
Supinated	6 (2.08%)	8 (12.1%)	3 (2.4%)	0 (0.3%)
Pronated	0 (3.50%)	21 (20.7%)	6 (4.1%)	2 (0.5%)
Chi square value	P=0.003 (χ2=19.28) (S)			

Table5.10 showing at 1MT, grau1 (0.27kg/cm2) 6.3% individuals exerted pressure with normal foot posture while 2.08% with supinated foot type and 3.5% with pronated foot type. Grau2 (1.25kg/cm2) 37.1% exerted pressure with normal foot posture, 12.1% with supinated foot type, 20.7%

with pronated foot type. Grau3(2.6kg/cm2) 7.4% exerted pressure with normal foot posture,2.4% with supinated foot posture,4.1% with pronated foot posture. Grau4(4.8kg/cm2) 1.06% exerted pressure with normal foot type, 0.3% with supinated foot type, 0.5% with pronated foot type. Significant result ($\chi2$=19.28;P<0.05).

Table 5.11 showing association of pressure exerted on 2MT with foot type among study population foot posture

Foot Posture / No. of grau	2 MT (metatarsal)			
	grau 1 (n=2)	grau 2 (n=80)	grau 3 (n=17)	grau 4 (n=1)
Normal	1 (1.1%)	50 (44.8%)	5 (9.5%)	0 (0.5%)
Supinated	0 (0.2%)	12 (11.2%)	2 (2.3%)	0 (0.1%)
Pronated	1 (0.6%)	18 (24%)	10 (5.1%)	1 (0.3%)
Chi square value	P=0.062 ($\chi2$=11.96) (NS)			

Table5.11 showing at 2MT, grau1(0.27kg/cm2) 1.1% individuals exerted pressure with normal foot posture while 0.2% with supinated foot type and 0.6% with pronated foot type. Grau2 (1.25kg/cm2) 44.8% exerted pressure with normal foot posture, 11.2% with supinated foot type, 24% with pronated foot type. Grau3(2.6kg/cm2) 9.5% exerted pressure with normal foot posture,2.3% with supinated foot posture,5.1% with pronated foot posture. Grau4(4.8kg/cm2) 0.5% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Insignificant result (($\chi2$=11.96; P<0.05).

Table 5.12 showing association of pressure exerted on 3MT with foot type among study population foot posture

Foot Posture / No. of grau	3 MT (metatarsal)			
	grau 1 (n=2)	grau 2 (n=80)	grau 3 (n=17)	grau 4 (n=1)
Normal	1 (1.1%)	50 (44.8%)	5 (9.5%)	0 (0.5%)
Supinated	0 (0.2%)	12 (11.2%)	2 (2.3%)	0 (0.1%)
Pronated	1 (0.6%)	18 (24%)	10 (5.1%)	1 (0.3%)
Chi square value	P=0.062 ($\chi2$=11.96) (NS)			

Table5.6 showing at 3MT, grau1(0.27kg/cm2) 1.04% individuals exerted pressure with normal foot posture while 0.3% with supinated foot type and 0.6% with pronated foot type. Grau2 (1.25kg/cm2) 41.6% exerted pressure with normal foot posture, 13.6% with supinated foot type, 24.8% with pronated foot type. Grau3(2.6kg/cm2) 8.8% exerted pressure with normal foot posture,2.8% with supinated foot posture,5.2% with pronated foot posture. Grau4(4.8kg/cm2) 0.5% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Insignificant result (x2=10.95; P<0.05)

Table 5.13 showing association of pressure exerted on 4MT with foot type among study population foot posture

Foot Posture / No. of grau	4 MT (metatarsal)			
	grau 1 (n=3)	grau 2 (n=82)	grau 3 (n=14)	grau 4 (n=1)
Normal	0 (1.6%)	49 (45.1%)	6 (7.7%)	0 (0.5%)
Supinated	1 (0.4%)	11 (12.3%)	2 (2.1%)	1 (0.15%)
Pronated	2 (0.9%)	22 (24.6%)	6 (4.2%)	0 (0.3%)
Chi square value	P=0.0814 ($\chi2$=11.23) (NS)			

Table5.13 showing at 4MT, grau1(0.27kg/cm2) 1.6% individuals exerted pressure with normal foot posture while 0.4% with supinated foot type and 0.9% with pronated foot type. Grau2 (1.25kg/cm2) 45.1% exerted pressure with normal foot posture, 12.3% with supinated foot type, 24.6% with pronated foot type. Grau3(2.6kg/cm2) 7.7% exerted pressure with normal foot posture,2.1% with supinated foot posture,4.2% with pronated foot posture. Grau4(4.8kg/cm2) 0.5% exerted pressure with normal foot type, 0.1% with supinated foot type, 0.3% with pronated foot type. Significant result ($\chi2$=11.23; P<0.05).

Table 5.14 showing association of pressure exerted on 5MT with foot type among the study population foot posture

Foot Posture / No. of grau	4 MT (metatarsal)			
	grau 1 (n=28)	grau 2 (n=58)	grau 3 (n=11)	grau 4 (n=3)
Normal	14 (15.1%)	31 (31.3%)	8 (5.9%)	1 (1.6%)
Supinated	2 (3.9%)	10 (8.1%)	1 (1.5%)	1 (0.4%)
Pronated	12 (8.96%)	17 (18.5%)	2 (3.5%)	1 (0.9%)
Chi square value	P=0.0814 ($\chi2$=11.23) (NS)			

Table5.14 showing at 5MT, grau1(0.27kg/cm2) 15.1% individuals exerted pressure with normal foot posture while 3.9% with supinated foot type and 8.96% with pronated foot type. Grau2 (1.25kg/cm2) 31.3% exerted pressure with normal foot posture, 8.1% with supinated foot type, 18.5% with pronated foot type. Grau3(2.6kg/cm2) 5.9% exerted pressure with normal foot posture,1.5% with supinated foot posture,3.5% with pronated foot posture. Grau4(4.8kg/cm2) 1.6% exerted pressure with normal foot type, 0.4% with supinated foot type, 0.9% with pronated foot type. Insignificant result ($\chi2$=5.22; P<0.05).

Table 5.15 table showing association of pressure exerted on TC joint with foot type among study population foot posture

Foot Posture / No. of grau	5 MT (metatarsal)			
	grau 1 (n=1)	grau 2 (n=79)	grau 3 (n=19)	grau 4 (n=1)
Normal	0 (0.57%)	49 (45.03%)	8 (10.83%)	0 (0.57%)
Supinated	0 (0.14%)	9 (11.06%)	4 (2.66%)	1 (0.14%)
Pronated	1 (0.29%)	21 (22.91%)	7 (5.51%)	0 (0.29%)
Chi square value	P=0.0814 ($\chi2$=11.23) (NS)			

Table5.15showing at TC joint, grau1(0.27kg/cm2) 0.57% individuals exerted pressure with normal foot posture while 0.14% with supinated foot type and 0.29% with pronated foot type. Grau2 (1.25kg/cm2) 45.03% exerted pressure with normal foot posture, 11.06% with supinated foot type, 22.91% with pronated foot type. Grau3(2.6kg/cm2) 10.83% exerted pressure with normal foot posture,2.66% with supinated foot posture,5.51% with pronated foot posture. Grau4(4.8kg/cm2) 0.57% exerted pressure with normal foot type, 0.14% with supinated foot type, 0.29% with pronated foot type. Significant result ($\chi2$=11.30; P<0.05).

3. Discussion

The study was done to investigate the effects of physical activities on foot posture and plantar pressure distribution among the college students during walking or while the subject is dynamic motion and due to discomfort felt at the foot led the subjects to adapt sedentary lifestyle and leaving their regular routine which included physical activities and data of this exploratory study showed or found that foot posture has no significant association with the physical activity level of the college students. On the other hand, the

change in foot posture does affect the pressure exerted on some area of foot while the individual is in motion as seen in study conducted by Silvio and Waugh (2010).

Some analysis showed that pressure exerted is related to the foot posture which in turn may act as a barrier to physical activity and tend to adapt sedentary behavior. Information about the distribution of pressure and active area of foot contact at time of walking for the practice of physical medicine is considered important. It is a known fact that high pressure in forefoot area occurs during push off phase as hell leaves the ground and abnormal high pressure on foot has been linked with foot complications. In the present study also significant association was found between plantar pressure exerted at 2nd, 3rd & 4th metatarsal phalangeal joint and 1 metatarsal with foot posture. Thus these findings emphasized the need to modify footwear not only w.r.t. to foot posture but also according to plantar pressure exerted by different foot types to prevent any future complications.

It is common observation that has been recorded with certain methods that people walking freely choose a certain velocity and gait speed and pattern. At any given speed people can have variations in their step length and step frequency tending to walk with optimal velocity and cadence with minimal energy expenditure. The present study analyzed gait velocity and estimated its association with different foot postures amongst males and female subjects. The findings showed significant association between gait velocity and foot posture in females as compared to males. This study revealed that foot posture does affect the gait velocity of the individual while walking in their steady speed and the pressure exerted on foot area while changing their step length or frequency and cadence affects some specified areas of foot and foot type plays a bigger role in this as well.

Plantar pressure is associated to walking speed with change in velocity and the vertical ground reaction forces increase at heal strike and toe off and does decrease during mid stance and with help of foot imprints attained with the help of mat helped in measuring the foot pressure on the specified areas which was recorded in kg/cm2 and ranged from lowest to highest on different kind of foot including individuals with normal foot which was measured by FPI-6 index or whether the foot is pronated or supinated.

Limitations of the study

- Sample size was quite small
- The gait pattern of every individual was different
- BMI was not normalized for study population.
- A single individual was tested at a single time.

4. Future Scope

Further research can be conducted to determine the potential efficacy of interventions designed to reduce plantar pressures in these individuals on time spent in physical activity and sedentary behaviour.

5. Conclusion

- In the present study, out of 100 subjects, 72% subjects were physically inactive whereas only 28% were physically active.
- Out of 100 subjects, 55% had normal followed by 31% had pronated and 14% had supinated foot posture.
- No significant association was seen between different type of foot postures with physical activity level.
- Significant association was found between plantar pressure exerted at 2nd, 3rd & 4th metatarsal phalangeal joint and 1 metatarsal with foot posture.
- Significant association was found in gait velocity and foot posture in females whereas it is non-significant among males.

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Author Profile

Dr. Taranum Pandhi (PT), Bachelor in Physiotherapy, Amity University, Noida
Email: tpandhi2014@gmail.com

Dr. Pragya Kumar (Phd), Professor at Amity Institute of Physiotherapy, Amity University, Noida
Email: pkumar24@amity.edu

Dr. Sameer Chhikara (MPT), (pursuing Phd), HOD of Physiotherapist department at Bhagwan Mahavir Hospital, Pitampura
Email: Sameer_chhikara@hotmail.com