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Correlation of Body Mass Index with Foot Posture Types Among Geriatric Population

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Abstract: ***Background:*** ***The main motive of this study was to investigate the presence of an association between Body Mass Index (BMI) and Foot Posture Type which was measured by the Foot Posture Index (FPI) Scale. The study also evaluates to compare Foot Posture Index (FPI) between left foot and right foot among geriatric population in different age groups.*** ***Methods:*** ***In total 102 subjects, 39 participants were Male group and 63 participants were Female group. The age of the subjects was recorded with their weight and height which were used to calculate body mass index (BMI). The different types of foot posture were measured by using Foot Posture Index (FPI) score. It includes age above 60 years, both Male and Female and subjects who are willing to participate in the study. It excludes Individual who has suffered from any trauma or injury or surgery to the lower extremity within past 6 months suffering from cognitive defects and not able to perform the study and diagnosed with any Musculoskeletal problem in the last 6 months.*** ***Results:*** ***According to this study, 50% of subjects were under age group of 61-70 years, 32.35% were under 71-80 years of age groups and 17.65% of subjects were above 80 years. The 44 participants were having Normal BMI, 41 participants were having overweight BMI and 12 of them were being Obesity Class I, 5 of them were belong to obesity class II and there were 0 subjects with obesity class III BMI. As compared to female, male was presented with high foot posture index score with normal FPI score in left foot as compare to right foot. Hence, there was no significance relation found out between BMI and Foot posture.***

Keywords: Geriatric, Body Mass Index (BMI), Foot Posture Index (FPI), Foot Posture types

1. Introduction

Obesity is a medical complication which consist of excess amount of body fats and affects individual's physical activity that leads to serious health issue [1, 2]. Obesity might be correlated with number of Musculoskeletal disorders such as Osteoarthritis, Low back pain, Gait Abnormalities, Osteoporosis, soft tissue injuries could be responsible for certain disabilities and affects quality of daily living [1]. Obesity is now known as a major health problem especially in urban areas which can leads to various complications, chronic disorders, and deformities [3, 4] Obesity in older people might be associated with planus (low arched) foot posture, pronated dynamic foot function, and increased plantar pressures when walking [5].

The body mass index (BMI) classification by Asian scale, which is calculated by dividing the body weight in kilograms (Kg) by the square of the height in metres (m), as a valuable tool for determining whether a person has an excess of body fat [6, 7, 8]. BMI do not require any expensive equipment and can be calculated easily [9]. In older population, less muscle mass and a lower metabolism might make it easier to gain weight [9, 10]. According to BMI classification of Asian scale criteria in India, a body mass index of 18.5 to 24.9 is considered normal, anything below is considered underweight while anything above is considered obese. The categories of BMI according to Asian classification are <18.5(underweight), 18.5-22.9(Normal), 23-24.9(overweight), 25-29.9 (pre-obese), ≥30(obese), 30-40(obese type 1), 40.1-50(obese type 2)-Morbid obese, >50(obese type 3)- super obese [3, 6, 7, 8, 11].Therefore, a high rate of BMI may appear to be modifiable risk factors and development of musculoskeletal disorder that affects lower extremities structures and soft tissues such as tendons, cartilages, fascia, foot posture, knee, hip, and spine areas [12]. A study done by Janssen and A. E. Mark in Cananda indicate that there is an increase in BMI in overweight and moderately obese elderly people which increase their mortality risk [13].

An increased BMI and the FPI may lead to excess bodyweight which cause greater mechanical loading of the foot and fat mass might cause due to outward appearance of a flat foot in obese induvial which usually leads to pronated foot posture. It also shows that the negative outcomes of higher BMI well beyond physiological characteristics, obese populations are less efficient and are at high risk for injury than normal weight population in work-related tasks and activities such as right standing up position [12].It is found that the adipose tissue accumulates at the intra-abdominal region in obese individuals. Increasing in body adiposity might lead to increase pressure on joints which may result in degeneration and pain [1]. It is also noticed in this study that the rectus abdominal muscles show the greatest fat molecules stored followed by the lateral abdominal muscle and erector spinae in overweight and obese individuals [14]. These higher levels of intramuscular fat might associate with reduced functional capacity in healthy older population. Obesity is also associated with high levels of lipid accumulation between and within skeletal muscles fibres which is associated with decreased physical activities and reduce physical function [1, 12]. Therefore, the BMI is most used general indicator of adiposity but it does not distinguish between fat and lean body mass. In recent study, elderly adults showed that obese individual has more flatter feet than non-obese individual with reduce inversion-eversion range of motion and higher plantar pressure while walking [1].

The Foot Posture Index (FPI) is an experimental, useful, and reliable diagnostic clinical tool to assess or palpate different types of foot posture [12]. The FPI measures foot posture in three types and two anatomical foot position and considered into six criteria assessment [12]. Foot posture is categorized into normal foot, pronated (flatfoot), and supinated (high-arched foot) [12]. Pronated and Supinated foot postures may associate with increased risks of lower extremities musculoskeletal injuries when compared with the normal foot posture [15]. Thus, foot posture alignment deviations, including pronation and supination, may be evaluated using the FPI. Hence, difference in various foot posture may lead to effect the function of lower extremity and therefore involved in predisposition to overuse musculoskeletal injury [16]. Structural foot disorders affect up to 60% of older adults which might leads to mobility limitations and decreased health-related quality of life [5, 17] . A study done by Yousefi Azarfam AA on, the relationship between body mass index and footprint parameters in older people foot concluded that older people present with pronated foot (pes planus) can be due to high BMI or any structural changes and discomfort in the foot [18].

Foot Posture has been recommended that it is related to development of lower extremity musculoskeletal conditions due to its potential influence on the mechanical alignment and dynamic function of lower extremity [10]. The lower limb function is also affected by foot posture; for example, individuals with normal-arched feet, individuals with flat-arched feet use their tibialis anterior muscle during the contact phase but use the tibialis posterior muscle during midstance or propulsion [19]. Several factors such as Foot wear, Excessive body weight, job nature, physical activity, these factors may affect in elderly people as they age [19]. Weight bearing of subtalar pronation is accomplished by the various movements of eversion of calcaneus and plantar-flexion and adduction of the talar head [1]. Hence, increased amount of stress applied on foot due to higher body mass might affect on the overall lower limb kinetic chain [1, 16]. A study done in Riyadh, Saudi Arabia showed that in their biomechanical assessment of FPI, induvial with high BMI tend to have flat feet. Accordingly, a higher amount of result of obesity has been observed in individuals with flat feet which could be due to the previous observation that a more convex talonavicular prominence and forefoot abduction relative to the rear of the foot are present in individuals with flat feet [12]. Muscles functions such as strengthening and endurance of the lower limb might be the primary reason which affects the mobility performance in Geriatric population [19]. A study done on Geriatric population showed that foot problems are associated with decrease in walking speed and reduce physical activity and might impair balance might result due to foot lesion and postural changes due to structural deformities [16, 19]. Individual with supinated feet may present with disturbed foot posture control [19]. Elderly population with foot deformities had been reported multiple falls as compared to the population who do not have foot deformities which might indicate risk of falls or loss of balance in elderly [23,34].

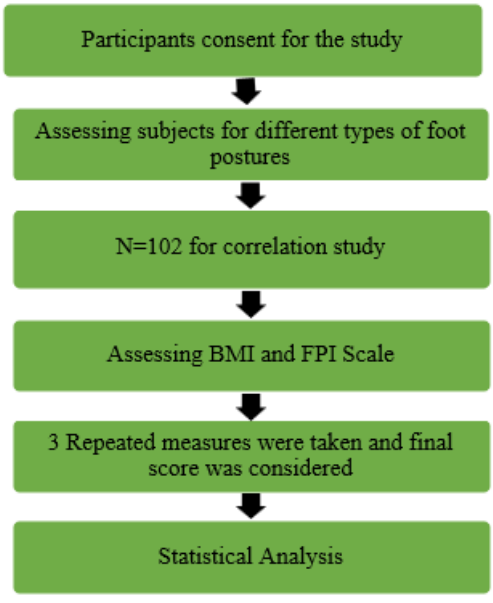
Elderly people undergo Age related loss of natural soft tissue fat cushioning, loss of skin elasticity, bony deformities, foot posture changes such as pronated/low arch (flat) foot or supinated/high arch (hollow) foot [12, 17]. Elderly People with a high rate of body mass index (BMI) due to being overweight or obese may leads to increase in risk factors and musculoskeletal disorders and sedentary lifestyle that affects lower limb structures which limits the body mobility and decreased health-related quality of life.

A Research was conducted in children, young adults, middle age adults. However, there has been less study done in geriatric population. Hence, research on elderly adults will be helpful and useful for prevention and further rehabilitation. Thus, present study aims to find out Correlation of BMI with different foot posture types among geriatric population.

2. Methodology

The Non-Experimental Study design was conducted at urban and suburban region of Mumbai over duration of 6 months. Both elderly Male and Females of above 60 years of age, who were participated in the study and giving their consent were included. People with trauma or injury or surgery or musculoskeletal problems to the lower extremity within past 6 months, individuals suffering from cognitive defects (Stroke, Muscular Dystrophy, Multiple Sclerosis, Parkinson's Disease, Guillain-Bare Syndrome, Vestibular Disorders, Myasthenia Gravis, Cerebral palsy) and who were wheelchair bound were excluded. Following calculation of sample size, 102 individuals were selected by consecutive sampling method. The research topic was approved by Institutional Ethics Committee. Each Participants were assessed by using Demographic details and valid Body Mass Index (BMI) Score and Foot Posture Index (FPI) scale. The assessment was noted in a form of an offline pen and paper format by the investigator and include participants who fit in the inclusion criteria.

3. Study Layout



Body Mass Index (BMI): A BMI [1, 12] was evaluated by the height participants was measured by measuring tape and height were measured in cm/m and weight was measured with a scale (Breuer electronics scale). During the measurement, the subject was barefoot and stand on the scale with double leg stance. The subject was instructed to stand still with

straight head and subject should not swivel, so that there was no error while measuring the height. A BMI was calculated by weight (kg) and height (m^2) of the subject by using a measuring tape and weighing machine. The score was categorised into underweight, normal, overweight, obese type 1, obese type 2, and obese type 3 [21] Asian classification to assess BMI type among middle age adults. Body Mass index is calculated by formula: BMI = Weight(kg) ÷ Height(m^2).

Foot Posture Index (FPI) Scale: A validated Foot Posture Index (FPI) [1, 22] scale was evaluated by making the subjects to stand in relaxed stance position with double limb support. The subject was explained to stand in the relaxed stance position with double limb support. The subject was instructed to stand still with their arms by the side and looking straight ahead. During this process, make sure the patient does not swivel to see what is happening will affect foot posture measurement. The six-criteria assessment clinical tool is used: a. Talar head palpation, b. Supra and infra lateral malleolar curvature, c. Calcaneal frontal position, d. Prominence in the region of the talonavicular joint, e. Congruence of the medial longitudinal arch, f. Abduction / Adduction of the forefoot on the rearfoot. Each criterion will be score by numbers ranging from -2 to +2; thus, the total score ranged from -12 (indicating maximal supination) to +12 (indicating maximal pronation).

Figure 1: Talar Head Palpation

Figure 2: Supra and Infra Lateral Malleolar

Figure 3: Calcaneal Frontal Position

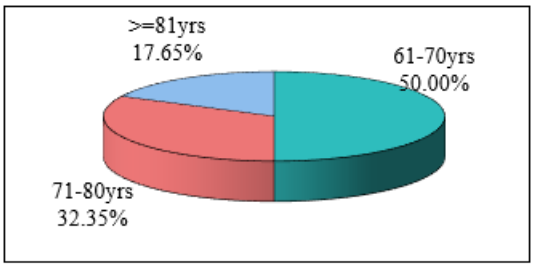
Figure 4: Prominence in the region of TNJ

Figure 5: Congruence of the MLA

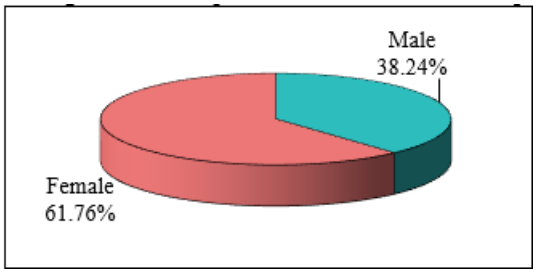
Figure 6: Abd/Add of the Forefoot on Rearfoot

4. Results

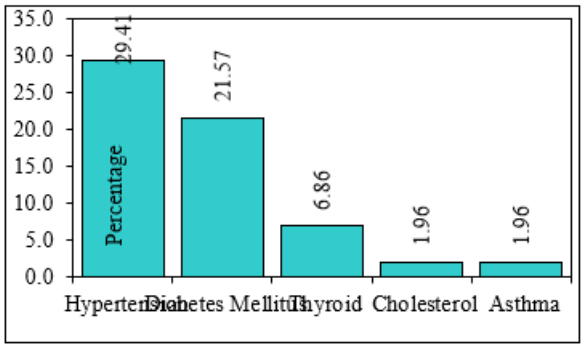
In this study offline forms (Consent form) were used to collect the data from the Geriatric Population both male and female. Microsoft Excel was used to analyse the collected data. Percentages were calculated based on the collected data, graphs.



Graph 1: Age wise distribution of respondents, out of 102 subjects, 50% of geriatric population were in the age group of 61-70 years, 32.35% were in the age group of 71-80 years, 17.65% were in the age group of above 80 years. Maximum were in the age group of 61-70 years of age in Geriatric Population.



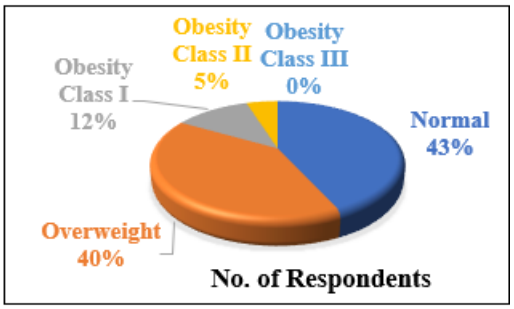
Graph 2: Gender wise distribution of respondents, out of 102 subjects, 39 (38.24%) were Male and 63 (61.76%) were female among Geriatric Population. Hence, Maximum population were female.



Graph 3: Medical history wise distribution of respondents, out of 102 Geriatric Population, 22 (21.57%) were having Medical History of Diabetes Mellitus, 7 (6.86%) were having thyroid disorder, 30 (29.41%) were having Hypertension, 2 (1.96%) were having Cholesterol and Asthma, 39 (38.24%) did not have any medical history.

Table 1: BMI wise distribution of respondents

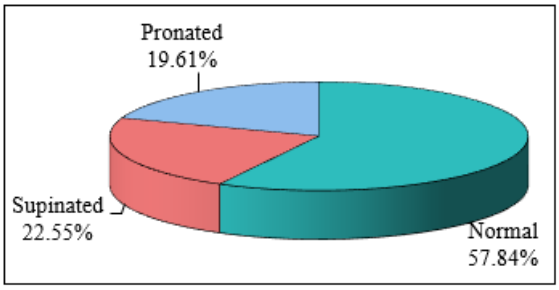
BMI	No. of Respondents	% of Respondents
Normal	44	43.14%
Overweight	41	40.20%
Obesity Class I	12	11.80%
Obesity Class II	5	4.90%
Obesity Class III	0	0%



Graph 4: BMI wise distribution of respondents, out of 102 Geriatric Population, (44) 43% were Normal, 41 (40%) were Overweight, 12(12%) were Obesity class I, 5(5%) were Obesity Class II and there were (0) 0% of population which belongs to Obesity Class III.

Table 2: Status of left FPI wise distribution of respondents

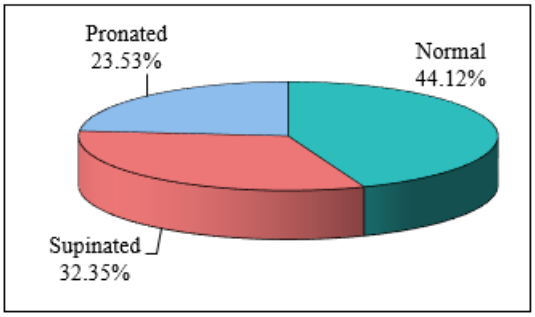
Left FPI	No of respondents	% of respondents
Normal	59	57.84
Supinated	23	22.55
Pronated	20	19.61
Total	102	100.00



Graph 5: Status of left FPI wise distribution of respondents, out of 102 Geriatric Population, the Left Foot Posture Index (FPI) among 23 (22.55%) were present with Supinated FPI, 20 (19.61%) were presented with Pronated FPI and remaining of them 59 (57.84%) were present with Normal FPI Score. Thus, Maximum Population had Normal FPI score.

Table 3: Status of right wise FPI distribution of respondents

Right FPI	No of respondents	% of respondents
Normal	45	44.12
Supinated	33	32.35
Pronated	24	23.53
Total	102	100.00

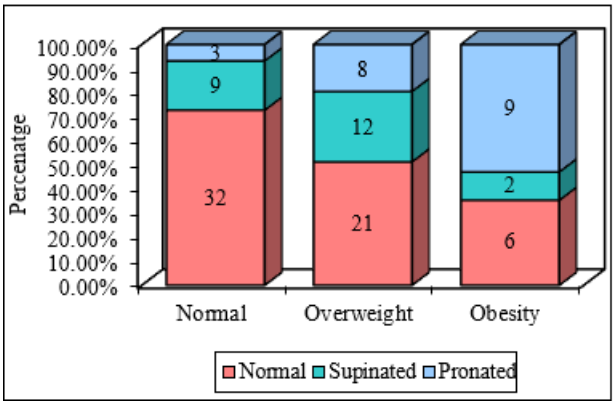


Graph 6: Status of right wise FPI distribution of respondents, out of 102 Geriatric Population, the right foot posture index (FPI) in 45 (44.12%) were presented with Normal FPI, 33 (32.35%) were present with Supinated FPI, 24 (23.53%) were presented with Pronated FPI. Hence, Maximum Population were having Normal FPI score and Minimum Population were having pronated FPI.

Table 4: Association between left FPI with BMI

Left FPI	Normal	%	OW	%	Obesity	%	Total	Chi-square	p-value
Normal	32	54.24	21	35.59	6	10.17	59	18.578	0.0010*
Supinated	9	39.13	12	52.17	2	8.70	23		
Pronated	3	15.00	8	40.00	9	45.00	20		
Total	44	43.14	41	40.20	17	16.67	102		

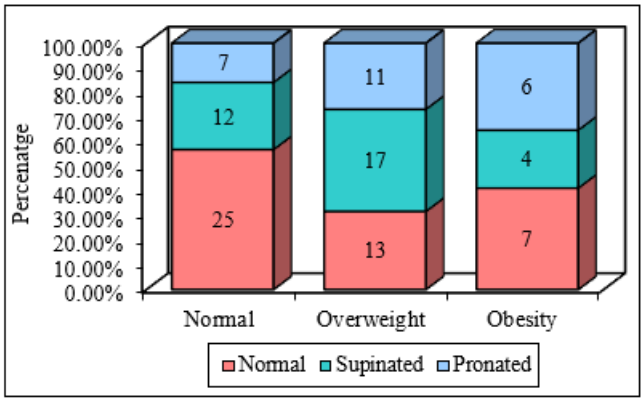
*p<0.05



Graph 7: Association between left FPI with BMI, out of 102 subjects, Geriatric Population of 32 (54.24%) in Normal BMI, 21 (31.59%) in Overweight BMI and 6 (10.17%) in Obesity BMI were associated with Normal Left FPI Score. Hence, there were total 59 Subjects with different categories of BMI were associated with Normal FPI Score. 9 (39.13%) with Normal BMI, 12 (52.17%) with Overweight BMI and 2 (8.70%) with Obesity BMI were associated with Supinated Left Foot Posture. Thus, Maximum number of Overweight categories of BMI were associated with Supinated Left FPI Score. In Older Adults, there were 3 (15%) of population with Normal BMI, 8 (40%) of Overweight BMI and 9 (45%) of Obesity Categories of BMI were present with Pronated Left Foot Posture. Hence, Maximum number of Older Adults with Obesity categories of BMI were present with Pronated Foot Posture.

Table 5: Association between right FPI with BMI

Right FPI	Normal	%	OW	%	Obesity	%	Total	Chi-square	p-value
Normal	25	55.56	13	28.89	7	15.56	45	7.161	0.1280
Supinated	12	36.36	17	51.52	4	12.12	33		
Pronated	7	29.17	11	45.83	6	25.00	24		
Total	44	43.14	41	40.20	17	16.67	102		



Graph 8: Association between right FPI with BMI, out of 102 Subjects, 25 (55.56%) with Normal BMI, 13 (28.89%) with Overweight BMI, 7 (15.56%) with obesity category of BMI were present with Normal Foot posture in Right. 12 (36.36%) with Normal BMI, 17 (52.52%) with Overweight Category of BMI and 4 (12.12%) with Obesity Category of BMI present with Supinated Foot posture in right. In Pronated Right Foot Posture, Population of 7 (29.17%) with Normal BMI, 11 (45.83%) with overweight BMI and 6 (25%) with Obesity categories of BMI associated between Right FPI and BMI.

Table 6: Summery of age and BMI, out of 102, older adults present with Minimum age of 61 years and 16.86 Kg/m^2 of BMI with Maximum age of 85 years and 36.14Kg/m^2 of BMI present in the current Study. Hence, mean standard Deviation between Minimum and Maximum Age and BMI are Mean age with standard deviation (67.03±5.72) and Mean BMI with standard deviation (25.77±4.54) in this Current Study.

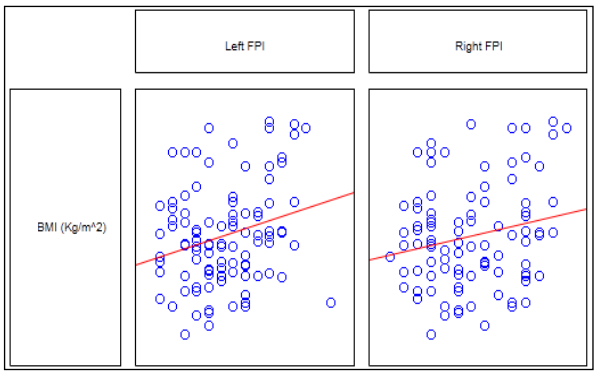
Variables	N	Minimum	Maximum	Mean	Std.Dev.
Age	102	61.00	85.00	67.03	5.72
Weight	102	42.00	90.00	64.43	11.16
Height	102	1.24	1.82	1.59	0.12
BMI	102	16.86	36.14	25.77	4.54

*p<0.05

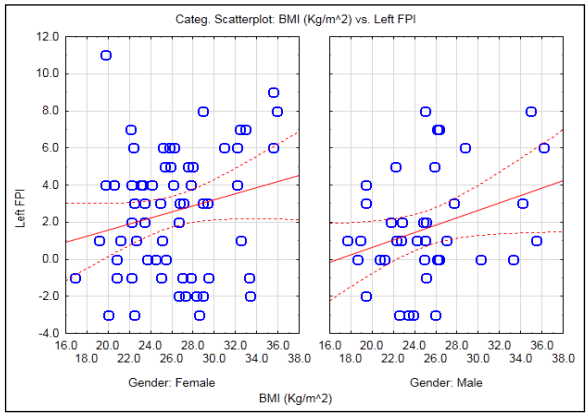
Table 7: Correlation between BMI with left FPI and right FPI scores by Spearman's rank correlation coefficient, Correlation between BMI with Left FPI and Right FPI Scores between both Male and Female Geriatric Population by Spearman's Rank Correlation Coefficient between Spearman R, t-value, and p-value. Out of 39 male Population, subjects with left FPI spearman's R value being 0.2497 and right FPI spearman's R value being 0.1452, t-value for Left FPI being 1.5688 and Right FPI being 0.8925, p-value for Left FPI being 0.1252 and Right FPI being 0.3779. Out of 63 Female Population, Spearman's R value for Left FPI being 0.1636 and Right FPI being 0.1165, t-value for Left FPI value being 1.2948 and Right FPI being 0.9160, p-value for Left FPI being 0.2003 and Right FPI being 0.3633 among Older Adults.

Samples	Variables	Correlation between BMI with			
		N	Spearman R	t-value	p-value
Total	Left FPI	102	0.2124	2.1737	0.0321*
	Right FPI	102	0.1554	1.5731	0.1189
Male	Left FPI	39	0.2497	1.5688	0.1252

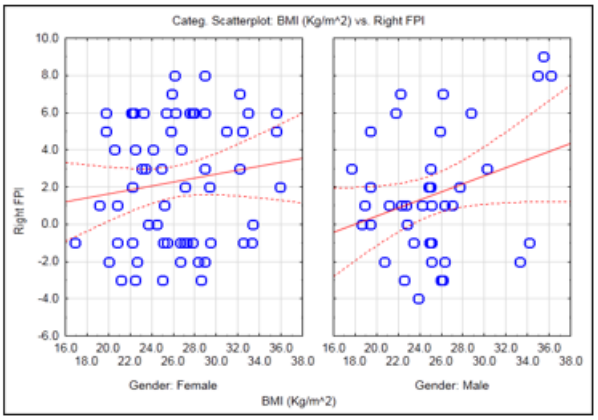
	Right FPI	39	0.1452	0.8925	0.3779
Female	Left FPI	63	0.1636	1.2948	0.2003
	Right FPI	63	0.1165	0.9160	0.3633



Graph 9: Scatter diagram of correlation between BMI with left FPI and right FPI scores in total samples shows positive correlation between left FPI and Right FPI scores in both male and female Geriatric population in the current study.



Graph 10: Scatter diagram of correlation between BMI with left FPI scores in male and female samples shows positive correlation between BMI with Left FPI scores in both male and female samples among geriatric population.



Graph 11: Scatter diagram of correlation between BMI with left FPI and right FPI scores in male and female samples shows positive correlation between BMI with Left FPI and Right FPI cores in both Male and Female samples in geriatric population

2. Discussion

Obesity in older people might be associated with planus (low arched) foot posture, pronated dynamic foot function, and increased plantar pressures when walking [5]. In older population, less muscle mass and a lower metabolism might make it easier to gain weight [9, 10]. Foot Posture has been recommended that it is related to development of lower extremity musculoskeletal conditions due to its potential influence on the mechanical alignment and dynamic function of lower extremity [10]. Several factors such as Foot wear, Excessive body weight, job nature, physical activity, these factors may affect in older adults as they age [19]. Hence, this study was done to find the correlation of BMI with Foot posture type among Geriatric population.

Demographic Details:

Out of 102 subjects, 50% of geriatric population were in the age group of 61-70 years, 32.35% were in the age group of 71-80 years, 17.65% were in the age group of above 80 years. Maximum were in the age group of 61-70 years of age in Geriatric Population. Out of 102 subjects, 39 (38.24%) were Male and 63 (61.76%) were female among Geriatric Population. Hence, Maximum population were female. Out of 102 Geriatric Population, 26 (25.49%) were qualified in Primary Education, 31 (30.39%) were qualified in Secondary Education, 7 (6.86%) were qualified in Higher Secondary Education, 32 (31.37%) were qualified with Degree and others 6 (5.88%) were uneducated in older age group. Out of 102 Geriatric Population, 22 (21.57%) were having Medical History of Diabetes Mellitus, 7 (6.86%) were having thyroid disorder, 30 (29.41%) were having Hypertension, 2 (1.96%) were having Cholesterol and Asthma, 39 (38.24%) did not have any medical history and 2 (1.96%) were had surgical history of Angiography and Appendicectomy, 8 (7.84%) were had Hysterectomy, 11 (10.78%) were had LSCS, 6(5.88%) were had Cataract Surgery, 51(50%) of population did not undergo any surgery and 22 (21.57%) had other surgical history.

BMI for Asian classification:

Out of 102 Geriatric Population, Maximum number of older adults were of (44) 43% Normal category of BMI. The body mass index (BMI) classification by Asian scale, which is calculated by dividing the body weight in kilograms (Kg) by the square of the height in metres (m), as a valuable tool for determining whether a person has an excess of body fat. The different categories of BMI scores are given as follows:

- <16.5 kg/m^2 – Severely Underweight
- <18.5 kg/m^2 – Underweight
- ≥18.5 to 24.9 kg/m^2 – Normal
- ≥25 to 29.9 kg/m^2 – Overweight
- ≥ 30 kg/m^2 – Obesity
- 30 to 34.9 kg/m^2 – Obesity class I
- 35 to 39.9 kg/m^2 – Obesity Class II
- ≥ 40 kg/m^2 – Obesity Class III (also referred to as severe, extreme, or massive obesity)

According to the study collected, out of 102 Geriatric Population, the (44) 43% were present with Normal BMI which is between (≥18.5 to 24.9 kg/m^2). The 41 (40%) of geriatric population were present with Overweight category

of BMI that is between (≥25 to 29.9 kg/m^2). The 12(12%) of geriatric population were present with Obesity class I, 5(5%) which is between (30 to 34.9 kg/m^2) were Obesity Class II and there were (0) 0% of population which belongs to Obesity Class III which is greater than or equal to (≥ 40 kg/m^2) in older adults. Hence, Normal category of BMI was more frequently present in both male and female geriatric population compare to overweight and obese categories of BMI.

Indah Margaretha Masela, Titi Moertolo, Kirana Anggraeni at Faculty of Medicine, University of Trisakt conducted similar study stated that Most of the subject were of female geriatric population aged between 60-74 years. Hence, Maximum number of older adults 48 (46.2%) has Normal BMI [25].

Foot Posture Index (FPI) Score

Out of 102 geriatric population, 59 (57.84%) were present with Normal FPI Score in Left side and 45 (44.12%) were presented with Normal FPI in Right side. The Foot Posture Index (FPI) scale include six-criteria assessment clinical tool is used:

a) Talar head palpation,
b) Supra and infra lateral malleolar curvature,
c) Calcaneal frontal position,
d) Prominence in the region of the talonavicular joint,
e) Congruence of the medial longitudinal arch, f. Abduction / Adduction of the forefoot on the rearfoot.

The Reference value for FPI score are as follows:

- 0 to +5 = Normal
- =6 to +9 = Pronated
- 10+ = Highly Pronated
- -1 to -4 = Supinated
- -5 to -12 = Highly Supinated

According to the study Collected, out of 102 Geriatric Population, the Left Foot Posture Index (FPI) among 23 (22.55%) were present with Supinated FPI score, 20 (19.61%) were presented with Pronated FPI score and remaining of them 59 (57.84%) were present with Normal FPI Score. Thus, Maximum Population had Normal FPI score. Out of 102 Geriatric Population, the right foot posture index (FPI) in 45 (44.12%) were presented with Normal FPI, 33 (32.35%) were present with Supinated FPI, 24 (23.53%) were presented with Pronated FPI. Hence, Maximum Population were having Normal FPI score and Minimum Population were having pronated FPI.

A recent study done on "The Increasing of Body Mass Index and The Pes Cavus have a higher prevalence of the Plantar Fasciitis in the Elderly" by I.M. Masela, T. Moertolo and K. Anggraeni from University of Trisakti, West Jakarta, Indonesia stated that Fifty-eight percent of the subjects had normal foot posture compare to (supinated)Pes Planus and (Pronated)Ples Cavus in Geriatric Population [25].

Correlation between BMI with Left FPI and Right FPI:

This study shows that out of 102 subjects, Geriatric Population of 32 (54.24%) in Normal BMI, 21 (31.59%) in Overweight BMI and 6 (10.17%) in Obesity BMI were associated with Normal Left FPI Score. Hence, there were total 59 Subjects with different categories of BMI were associated with Normal FPI Score. Geriatric Population of 9 (39.13%) with Normal BMI, 12 (52.17%) with Overweight BMI and 2 (8.70%) with Obesity BMI were associated with Supinated Left Foot Posture. Thus, Maximum number of Overweight categories of BMI were associated with Supinated Left FPI Score. In Older Adults, there were 3 (15%) of population with Normal BMI, 8 (40%) of Overweight BMI and 9 (45%) of Obesity Categories of BMI were present with Pronated Left Foot Posture. Hence, Maximum number of Older Adults with Obesity categories of BMI were present with Pronated Foot Posture.

Our study also demonstrates that out of 102 Subjects, Geriatric Population of 25 (55.56%) with Normal BMI, 13 (28.89%) with Overweight BMI, 7 (15.56%) with obesity category of BMI were present with Normal Foot posture in Right. 12 (36.36%) with Normal BMI, 17 (52.52%) with Overweight Category of BMI and 4 (12.12%) with Obesity Category of BMI present with Supinated Foot posture in right. In Pronated Right Foot Posture, Population of 7 (29.17%) with Normal BMI, 11 (45.83%) with overweight BMI and 6 (25%) with Obesity categories of BMI associated between Right FPI and BMI.

This study shows similar result to the study done by Nisha Dhasal, Zeba Barodawala on correlation of body mass index with foot posture and core stability in the young adult population which showing percentages of left feet in the normal, pronated and highly pronated category were 61% normal, 39% pronated and 0% in highly pronated category and percentages of right feet in the normal, pronated and highly pronated category were 69% normal, 27% pronated and4% in highly pronated category [1].

According to spearman's rank correlation coefficient, out of 39 male Population, subjects with left FPI spearman's R value being 0.2497 and right FPI spearman's R value being (0.1452), t-value for Left FPI being (1.5688) and Right FPI being (0.8925), p-value for Left FPI being (0.1252) and Right FPI being (0.3779). Out of 63 Female Population, Spearman's R value for Left FPI being (0.1636) and Right FPI being (0.1165), t-value for Left FPI value being (1.2948) and Right FPI being (0.9160), p-value for Left FPI being 0.2003 and Right FPI being (0.3633) among Older Adults.

The result of this study is in conjunction with previous study done by Data analysis revealed a correlation between BMI and FPI (left) with the coefficient of correlation being 0.4239 and p-value 0.0064 as seen in the correlation of body mass index with FPI (left) where values of BMI are plotted on the x axis and values of FPI plotted on y-axis. Similarly, Coefficient correlation of BMI and FPI (right) was 0.3436, p value being 0.0299. Their findings suggest that there is decrease in the foot arch due to increased body mass causing increased elevated loading of the foot. There is increasing number of stresses applied to the foot directly via increased body weight and indirectly via alterations to the foot [1]. This influences the overall lower limb kinetic chain.

Thus, this study correlated BMI with Foot Posture types among both male and female Geriatric Population.

3. Limitations

a) The study limitations include less samples size.
b) Assessment of core stability should be included in the study.
c) Other variables of body composition like waist circumference, waist hip ratio, skin girth measurement, Anthropometric, Bioelelctrical Impedance should be considered and correlated with foot posture and core stability.
d) The research included was both male and female Geriatric Population so findings may be affected to the study and other Population.
e) Data Collection was limited to only Mumbai and sub-urban Mumbai Geriatric Population.

4. Conclusion

According to the study, correlation of body mass index with foot posture types in Geriatric Population analysis was done. It revealed that there found to be no significant correlation of BMI with Foot Posture. In this study, the Foot postures index between (left foot) and (right Foot) among geriatric population found out that compare to female population, male presented with higher Foot Posture Index (FPI) Score in left foot as compared to right foot.

5. Future Scope of Study

a) A survey in identifying the prevalence/awareness of BMI with FPI with large sample size across multiple regions along with clinical evaluation of Core stability can be future scope of the study.
b) A Research study can be conducted on prevention and management of Obesity and Poor Foot Posture.
c) A study can be conducted on Correlation of BMI with FPI Among different age adults either in Male or Female Population.

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