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IMPACT OF FLAT FOOT ON ABILITIES AND BALANCE IN PEOPLE ADJUSTED TO THE 20-TO 40-YEAR-OLD AGE GROUP

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Abstract— In addition to impairing foot function, the alignment of the ankle, knee, and hip may be negatively impacted by flat foot, a prevalent foot condition. Because it changes the distribution of pressure and the position sensation of the foot joints, walking with flat feet is different from walking normally. Instability and impaired motility are symptoms of flat foot, which is caused by imperfect loading. One definition of functional mobility is the capacity to go about one's daily life unassisted. The purpose of this research is to examine the impact of flat feet on functional mobility and balance in people aged 20–40. Sixty people participated in the test. There were thirty people divided into two groups, A and B. Group A consisted of people with normal arches of the foot. In contrast, those in Group B who suffer from flat feet Both groups are subjected to three tests: the Single Leg Standing test, the Functional Reach test, and the Time Up and Go test. A single observational study was conducted. The outcomes may be seen by comparing the three tests' results. There was a significant decline in adults' functional mobility, dynamic balance, and static balance. The results of the Functional Reach Test (P=0.01018), Time Up & Go (P=4.87414E-06), and Single Leg Standing (P=3.33601E-11) were all statistically significant.

KEYWORDS- Single Leg Standing, Functional Reach test, Time Up & Go test, Flat foot, Normal Arch

INTRODUCTION:

The human foot is composed of 26 bones, 10 main tendons and muscles that are external to the foot, several intrinsic units of musculotendinous tissue, and over 30 joints. A mobile, sensate, and adaptable foundation is provided by these musculoskeletal components in conjunction with neurovascular elements, fat pads, and skin. During standing, they also provide a mechanism of movement and balance. [1] One of the most prevalent foot illnesses, flat foot impacts not only the foot's function but also the alignment of the ankle, knee, and hip joints. A foot's medial and lateral arches run longitudinally [2]. They develop at the junction of the tarsal and proximal metatarsal bones. Support provided by the following muscles: intrinsic foot muscles, flexor hallucis, flexor digitorum longus, femur longus, and anterior and posterior tibialis. Ankle ligaments (plantar and medial) provide structural support. Arch

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and plantar aponeurosis bone shapes provide structural support. [3]

Fig: 1.1 Normal Arched And Reduced Arch Foot

PATHOPHYSIOLOGY:

A flatfoot is characterized by a medial and distal displacement of the talus bone's top from the navicular bone. The consequence is a stretched tendon of the Tibialis Posterior muscle and the Plantar Calcaneo-Navicular ligament, which causes the Medial Longitudinal Arch (MLA) to stop working properly in a person with flat feet. Because to the collapse of the Medial Longitudinal Arch, those who suffer from flatfoot often experience an inward shift of their center of mass. Medial talar prominence and heel valgus deformity are seen. [4]

Fig 1.2: Types Of Foot Arches

The feedback mechanisms of the postural control system and balance rely on the extensive information provided by plantar mechanoreceptors about contact pressure. [6] those with flat arches walk differently than those with regular arches. Inability to adapt to terrain is a symptom of flat feet, which modify the pattern of pressure distribution and alter the position sense of the foot joints [2]. [7] Flat Foot in Adults Babies are born with flat feet, and the abnormality usually goes away on its own by the time they're 10 years old. The talus exhibits valgus angulation in adults, namely those in the middle age bracket. Degeneration of the tibialis posterior tendon, which leads to aberrant loads and increased friction, is the root cause of acquired flat feet. The symptoms include valgus, abducted forefoot, and collapsed metatarsalgae (MLA).

In the case of congenital asymptomatic flexible flatfoot, those who do not experience any symptoms should be reassured that treatment is not necessary. They should also be informed that there is no evidence to suggest that therapy may prevent future difficulties.Patients with symptomatic flexible flatfoot abnormalities often report that standing for lengthy periods of time causes them discomfort and wears their feet out quickly. It is important to meticulously record the range of motion (ROM) of the ankle, hindfoot, midfoot, and forefoot while the foot is in the dependent position, as well as any uncomfortable regions. Evaluating the degree of TA's tightness requires extra care.

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The frequency of flat feet At specific age brackets, the occurrence of flatfoot ranges from less than 1% to 28%. It is more common among youngsters to have Pes Planus. In maturity, the likelihood of a female developing this ailment is higher than that of a man. People with a higher body mass index and those who are older are more likely to have flat feet. Pes Planus affects between twenty percent and thirty percent of youngsters.

Infants often have flat feet, although children often do as well and adults seldom do.[10] Obese children are more likely to have flat feet than normal or overweight children, according to earlier research. [28]

FEET AND THEIR BIOMECHANICS

Pronated feet are characterized by a flat sole. In a "pronated" gait, the foot is in a dorsiflexed (upward) position, abducted (away from the body), and everted (heel-rolled outward) posture all at once.[10] Initial weight bearing begins with heel-strike in the usual gait cycle. A gradual measured pronation of the foot may reduce the force of weight bearing thanks to the talonavicular and calcaneocuboid joints' unlocking, the calcaneus' eversion, and the internal rotation of the tibia.

At foot-flat, the weight-bearing axis goes through the ASIS, patella, and the midfoot, where the second metatarsal meets the first. In preparation for push-off, the foot undergoes an outward rotation of the tibia and an active inversion of the calcaneus, which locks the transverse tarsal joints by means of the posterior tibial tendon pull. This process locks the foot in supination, solidifies the longitudinal arch, and serves as a rigid lever for locomotion.[11]

The extent to which a flatfoot deformity increases the excursion of these movements puts more strain on the ligamentous and muscular 8 systems that support the foot. While in stance, your body's center of gravity moves medially, which might throw off your lower limb's kinetic chain.[12]

Because of this misalignment, you run the risk of developing internal femoral rotation, an internal Q angle, and elevated lateral patellar pressure. An evertor force may be exerted by the anterior tibial and TA when the deformity of the abducted everted foot is severe enough. When the wearer's pronation is severe, the first metatarsal tube (MT) rotates longitudinally, which alters the joint's position with respect to the floor. Hallux valgus may occur as a result of this.in [13]

Unstable Flatfoot Typically, people in their 30s and 40s start to notice symptoms of stiff flatfoot. Ankle DF is limited by a tight TA, which increases gait-related stress on the transverse tarsal joints. The midfoot may break down and cause a rocker-bottom deformity as a consequence of increasing weight and activity level as skeletal development progresses.[13].

In addition to decreased ankle DF, the patient exhibits painful Pes Planus and reduced range of motion in the midfoot and hindfoot joints. Nav-and flatfoot accessories: Between four percent and fourteen percent of the population has

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accessory tarsal naviculars. Most of the time, they don't cause any symptoms and are generally B/L. Radiographic appearance is used to categorize the three most frequent forms.

On the inside of the midfoot, there is an additional mass that is thought to be an accessory navicular. Most shoe lasts won't work for them, and the resulting local friction will be painful. A bursa will develop in more severe instances, and its removal may be necessary. Foot and ankle injuries are common triggers for symptoms in type 2 accessory naviculars. Looking at the foot from an external oblique angle reveals the auxiliary navicular.[16]

Harmony Postural stability is the capacity to maintain one's body in a vertical plane relative to one's base of support with little to no swaying. Reasons for the significance of sway include internal disturbances (such as breathing or changing your weight from one foot to the other or your forefoot to your rearfoot) and external triggers (such as visual distortions or floor translations). Because it is a sign of diminished sensorimotor control, an increase in sway does not always indicate disordered balance. Any irregularity in the integrity of the typical foot arches—the medial longitudinal, lateral longitudinal, and transverse arches—can impact stability and balance since they serve as shock absorbers and aid in regulating stability. When people have flat feet, it leads to improper loading, which in turn impacts the hips, knees, and lumbar region—regions that regulate the body's stability and mobility.[17] [18] in Functional assessments include the following: the Performed Oriented Mobility Assessment (POMA) scale, the Romberg test, the Balance Efficacy Scale, the Star excursion test, the Balance Evaluation Systems test, the mini-BESS, the Functional Reach tests, and the Performed Oriented Mobility Assessment (POMA).[17]

REVIEW OF LITERATURE

One research that looked at the effects of idiopathic flatfoot deformity on knee adduction moments during walking was done by S. Kimberly Byrnes et.al. (2021). Participating in the study were 103 youngsters who had flatfoot deformity and had previously undergone 3D gait analysis using the Oxford Foot Model.

Children with flat feet have a lower peak knee adduction moment, which is explained by the lateralization of the site of force application, which in turn is caused by lateral calcaneal displacement. The most prevalent cause of adult-acquired flatfoot deformity, according to research by Jensen K. Henry et al. (2019), is insufficiency of the posterior tibial tendon. A variety of ligament and tendon failures may cause severe deformity and dysfunction in adults, a condition known as adult-acquired flatfoot deformity (AAFD).

There are a number of socioeconomic variables, medical conditions, and genetic processes that have been tied to posterior tibial tendon deficit (PTTD), which is often seen with this condition. There are four phases to AAFD classification. Always try nonoperative therapy

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techniques first; they usually work in phases I and II to resolve the problem. Surgical treatments including a mix of soft tissue surgeries and osteotomies are usually used to address stage II abnormalities, which may be very diverse in terms of flexibility.

In Stage III, a stiff flatfoot is present, and triple arthrodesis is usually necessary. Ankle arthroplasty or arthrodesis, with or without deltoid ligament restoration, and operations to realign the foot are used to treat flatfoot deformity in its fourth stage, when it affects the ankle joint. Research into surgical indications and procedures is ongoing since there is a lack of information about the best approach. "Assessment of static & dynamic balance in overweight & obese children with and without flat foot:

A cross-sectional study" was the title of the 2017 research by Pallavi Sharma and Deepa Metgud. Of the 1,165 students surveyed from 11 different schools, 87 were determined to be overweight. We used the Bird Balance Stand Test 19 (SBST) and the Four Square Step Test (FSST) to measure static balance, and the Modified Bass Test of Dynamic Balance (MBTDB) to measure dynamic balance. Seven percent of the 1,165 youngsters evaluated for obesity were determined to be overweight in this research.

As compared to Children who are overweight and have flat feet tend to have worse static balance on the BSES and moderate dynamic balance on the Modified Bass Test and the Foot and Stance Test (FSST). Studying "The effects of foot deformities on Gait, Balance and functional mobility in Older women," Tasvuran Horata et al. (2017) did research on the topic. Eligible participants were 80 healthy women residing in nursing homes and their ages ranged from 65 and above. Every participant's gait, balance, functional mobility, and energy consumption were assessed using spatiotemporal methods. Overall, 45 people had mild deformities, 35 had moderate deformities, and 0 had severe deformities, according to the results. Different groups of people with deformities were tested using the following instruments: functional reach test, timed up-and-go test, four square step test, and observatory gait analysis. The energy expenditure of the intermediate deformity group was greater than that of the mild group, and pes planus was the most prevalent deformity.

"The effects of short foot exercises and arch support insoles on improvement in the medial longitudinal arch and dynamic balance on flexible flatfoot patients," was studied by Eun-Kyung Kim and Jin Seop Kim (2016). A total of fourteen college students, all of whom had flexible flat feet, participated in the research. Seven students from the brief exercise group and seven from the arch support insoles group were randomly allocated to each group. A total of five weeks of 30-minute sessions, three times weekly, were devoted to the experiment.

The navicular drop test is used to examine the medial longitudinal arch, whereas the Y balance test is used to assess balance. Results showed that when comparing the

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effects of using arch support insoles with brief foot exercises for medial longitudinal arch improvement and dynamic balancing ability, the latter was significantly more successful. 20 6. The research "Effect of flexible flatfoot on static and dynamic balance in school-going children" was carried out by Tarannum Siddiqui et.al (2016).

One hundred students with flat feet, identified by a survey, and one hundred students with normal arches were tested for static and dynamic balance in this experimental investigation. For static balance, we employed the one-leg standing test, and for dynamic balance, we used the functional reach test. While children's stability does improve with age, this research found no difference between children with normal arch feet and those with flat feet when it came to the Functional Reach Test and the One Leg Standing Test.

The research "Effect of flat foot deformity on physical fitness components in school going children" was carried out by Qureshi Haroon Rasheed and Dr. Sachin B. Pagare (2015). Subjects in this research vary in age from 9 to 14 and come from a variety of educational backgrounds. Of them, 10 had flat feet and 10 had normal feet. Students often suffer from knock knee deformity. Children who attend school often have bow leg malformation. (8) Razieh Tahmasebi, BSc, et.al. (2014).

"Evaluation of Standing Stability in Individuals with Flatfoot" is the product of said research. People with flat feet and those with normal arches were the subjects of this investigation. A Kistler force plate was used to gauge the center of pressure (COP), which is well acknowledged as a reliable indicator of the sway of the center of gravity (COG) on a horizontal plane. Measurements of stability were taken in the mediolateral and anteroposterior directions, as well as the length of the journey and the velocity. Researchers found that when standing quietly, those with flat feet were more likely to wobble than those with regular feet. The insoles of the feet appear to realign the foot's tissues and lessen the strain on the ligament.

Therefore, enhancing the stability of standing. Hence, it may be crucial to evaluate stability in flatfoot patients, and insoles are a helpful method for this population to enhance stability. 8. Mahsid Saghazadeh, Kenji Tsunoda, and Tomohiro Okura (2014). Based on the effects of arch height and arch rigidity index on balance, mobility, and posture sway, this study in "Foot 21 arch height and rigidity index associated with balance and postural sway in elderly women using a 3D foot scanner" implies that these two variables have and play a very important role in these three areas. One hundred forty-four elderly ladies residing in a Japanese city were the subjects of this research. One-Leg Stance and the Time-Up-and-Go (TUG) test were used to evaluate both static and dynamic balance. Using a force plate, we assessed the postural sway variables, total path length (TPL), and area. Using a 3D scanner from DreamGP Incorporated, we measured the arch height index (AHI) and arch rigidity index (ARI). An individual's ankle

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hyperostosis index (AHI) was determined by dividing the linear distance (in millimeters) measured by the foot scanning machine to the supporting surface when sitting and standing with equal weight on each foot by the reduced length of the foot. One way to measure the arch rigidity index was to divide the stand-to-sit ratio by the sit-to-arch ratio. They found that in older women, the Arch Rigidity Index was connected with area, and the Sitting Arch Height Index with postural sway and balance. Publication:

The Foot and Ankle Online Journal, volume 7, issue 4, page 1. 10. The work of Babak Nakhostin and colleagues (2013). "The effect of flexible flatfootedness on selected fitness factors in female students aged 14 to 17 years" was the title of the research project. Fifty students, evenly split between those with flat feet and those with regular feet, participated in the research. Physical fitness parameters were chosen based on results from the following tests: one-leg balance, modified-bass balance, 45-meter dash, and agility. The results of the agility test and the static balancing test were quite different. The researchers came to the conclusion that the foot is the last link in a tight kinematic chain, has a significant role in both dynamic and static posture, and influences physical variables. Though there was no correlation between foot flatness and motor ability, the research did discover that there were statistically significant variations in two of the four measures of physical fitness among the 14–17 year olds who participated. 11.

"Differences in static and dynamic balance task performance after 4 weeks of intrinsic foot muscle training: The short foot exercise versus the towel curl exercise" was the title of a research by Scott K Lynn et.al (2012). Volunteers (n=24) ranging in age from 18 to 24 years old and free of significant lower limb pathology or balance impairment were divided into three groups of 8 people each. Two groups were given different exercises to do for four weeks: one group did short-foot exercises (SFE) and the other did towel-curl exercises (TCE). Every day, the participants would do 100 reps of the workout. For both static and dynamic balancing tests, the arch height was measured by subtracting the navicular height while bearing weight, as well as the complete range of motion of the center of pressure in the medial direction. The findings showed that SFE was more efficient than the towel curl exercise in training the intrinsic foot muscles, although the outcomes varied between the dominant and nondominant legs. Andrezza Aparecida Alexio et al. (2012) as stated in 12. The author has researched the effects of obesity on students' posture, general mobility, and stability in the classroom. Using baby body mass index as a criterion, this research examined 34 school-aged children, 27 of whom were girls and 7 of whom were boys, who were all classified as overweight or obese.

The Fonseca psychomotor battery was used for praxis and global balance evaluation, whereas the "evaluation form by Kendall" was used for posture assessment. Obese individuals exhibited

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dyspraxia, while overweight people with a normal psychomotor profile had dissociation of the upper and lower limbs. Dyspraxia was found in both groups throughout the eye-foot coordination examination. Children who are overweight or obese may have problems with their posture, balance, and motor skills, according to the results. 13. In 2011, researchers Mohamed Salah Eldien Mohamed and Mohamed Ibrahim Ali examined "Dynamic Postural Balance In Subjects With & Without Flatfoot." 11.

Researchers used the Biodex Stability System (Biodex Medical Systems, Shirley, NY, USA) to measure the foot stability of ten male patients with flexible flatfoot (mean age: 20.25 years, mean weight: 84.08 kg, and height: 172.58 cm) and ten healthy subjects (mean age: 20.30 years, mean weight: 84.8 kg, and height: 174 cm). For the athletes' single leg test, we used anteroposterior (AP), mediolateral (ML), and overall (OA) stability at performance stability level 4.

For the fall risk test, we used an overall stability index ranging from 6 to 1, and performance stability level 4 for that. All testing required subjects to maintain an eye-opening posture. The research found that among people aged 20–40, those with flexible flat feet had worse dynamic balance compared to the other groups. as a result, physical treatment programs should include balance training activities. 14. A research titled "Relationship between foot sensation and standing balance in patients with multiple sclerosis" was carried out by Seyit Citaker et.al (2011).

A total of 27 MS patients and 10 healthy individuals participated in this research. The effects of light touch were assessed by measuring the length of one-leg standing balance, vibration, two-point discriminating sensation of the foot sole, and pressure. Multiple sclerosis individuals have impaired standing balance.

The most reliable indicators of static standing balance in multiple sclerosis patients are twopoint discrimination sensation of the heel and vibration sensation of the first metatarsal head area. 15. "Ground Reaction Force and Support moment in typical and flat-footed children" was the subject of research by J. Pauk and J. Griskevicius (2011). From a pool of 250 elementary school students, 60 with symptoms of flexible flat feet and 25 typically developing feet served as a control group. The participants' ages ranged from 6 to 16. The researchers in this study discovered that children with flat feet had a different GRF than age-matched control patients. This investigation, which examined 16. "Effects of foot orthoses on gait patterns of flat feet patients" was the subject of research by Yu-Chi Chen et.al. 2010. Eleven people with flat foot 24 abnormalities participated in this research.

Kinematic and kinetic data were recorded for each participant under three different conditions: barefoot walking, shoe walking, and shoe walking with insoles. An analysis system for motion, two Kistler force plates, and EVaRT software were used to record and analyze the participants' gait pattern during each test. Patients

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suffering from flat feet may find relief for their ankle joints by using the insoles and shoes created for this research. Paik-Ling Harrison and Chris Littlewood (2010) as number seventeen. "Relationship between Pes Planus foot type and Postural Stability" was the subject of the scientist's research. The eight participants in this research all have pes planus foot types and are in good health. A pes planus was determined using the Navicular Drop test, which indicated a drop more than 10 mm. The static postural stability was measured using the hospital Balance Performance Monitor (BPM).

The sway numbers in the lateral and anterio-posterior orientations were averaged, with larger sway numbers indicating more instability. Results showed that static postural stability declined with increasing pes planus deformity severity. 18. Dr. Douglas H. Richie Jr., FACFAS, is a family physician who practiced in 2009. "Biomechanics and Clinical Analysis of Adult Acquired Flatfoot" was produced by this individual. Participants in this research all experienced foot pathology in addition to triceps contracture. According to their findings, a gastrocnemius contracture was indicated by ankle dorsiflexion less than 10 degrees with the knee extended, while an Achilles contracture was indicated by dorsiflexion less than 5 degrees with the knee flexed. Deterioration of the arch's dynamic and static supporting structures leads to AAF. Both the spring ligament and the superficial deltoid ligament are at risk of rupture when the posterior tibial tendon's dynamic support is eliminated. Deformities in AAF most often manifest at the talonavicular joint. Finding out how much ligamentous disruption and loss of stability there is in the MT joint while it is in a static posture should be the primary goals of any AAF clinical assessment approach.

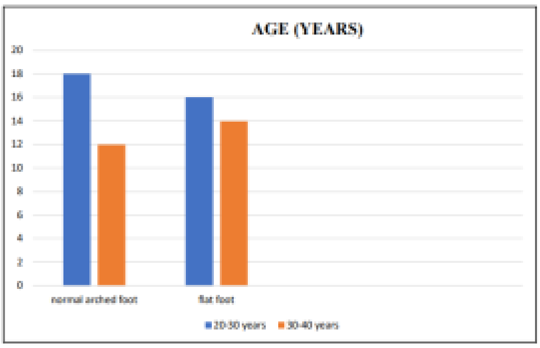
RESULTS

DEMOGRAPHIC DATA

Sixty participants were divided into two groups, A and B, using a random selection process. In terms of functional mobility, dynamic balance, and static balance, 14 men and 16 females made up Group A, whereas 8 men and 22 females made up Group B. Group A has an average age of 28 years, whereas Group B has an average age of 29 years, with a range of 20–40 years.

Age Comparison of Groups A and B

Age (yrs.)	Normal Arched Individuals	Flat Foot Individuals
20-30	18	16
30-40	12	14



GRAPH 3: COMAPRISON OF AGE BETWEEN GROUP A AND GROUP B

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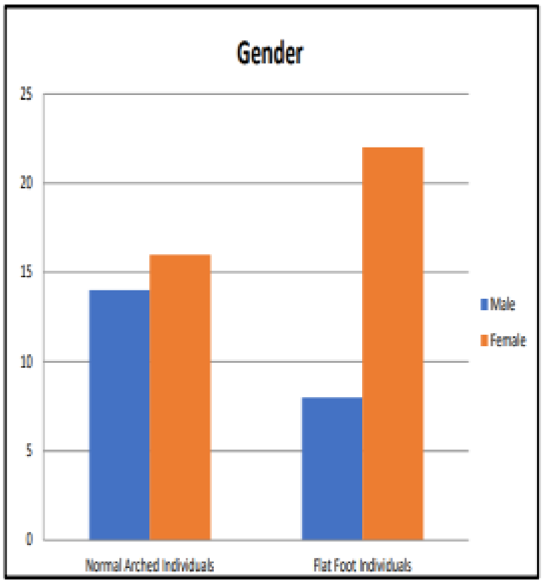
When comparing those with normal arches to those with flat feet, a disproportionately large percentage of responses fall into the 20- to 30-year-old age bracket. Similarly, compared to those with normal arches, those with flat feet tend to be younger, with a higher proportion of patients in the 30–40 age range. Beyond this, compared to those with normal arches, the majority of patients with flat feet are between the ages of 40 and 50.

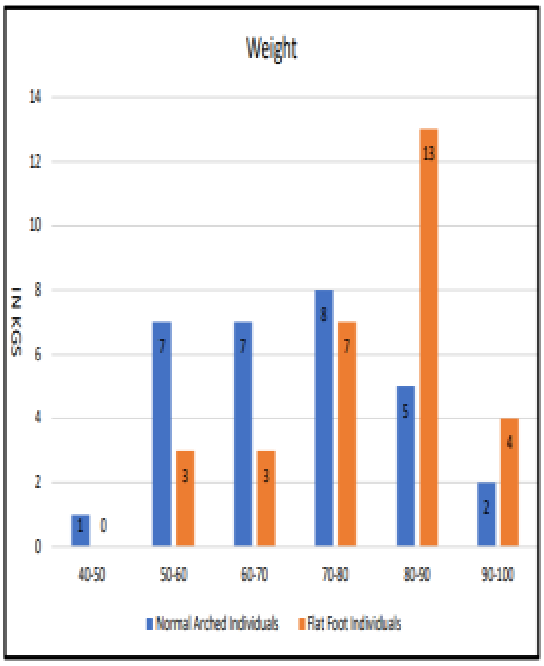
GENDER	NORMAL ARCHED INDIVIDUALS	FLAT FOOT INDIVIDUALS
MALE	14	8
FEMALE	16	22



GRAPH 5.2: COMPARISON OF GENDER VARIATION ON GROUP A &GROUP B

The data also shows that compared to those with regular arches, those with flat feet tend to have more girls. Similarly, compared to those with normal arches, there are much fewer men in the group of people who have flat feet.

Weight (kgs)	Normal Arched Individuals	Flat Foot Individuals
40-50	1	0
50-60	7	3
60-70	7	3
70-80	8	7
80-90	5	13
90-100	2	4



GRAPH WEIGHT DISTRIBUTION IN GROUP A AND GROUP B

There are no patients that fall under 40-50 kg weight in flat foot individuals. There

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are a greater number of patients under the weight of 50-60 kg in normal arched individuals in comparison to flat foot individuals. Apart from this, there are increased number of patients that has a weight in the category of 60-70 kg in normal arched individuals in comparison to flat foot individuals. There are a greater number of patients in the weight group of 70-80 kg in normal arched individuals as compared to flat foot individuals. Along with this, there are a greater number of patients in 80-90 kg in flat foot individuals in comparison to normal arched individuals. In a similar manner, there are a greater number of patients in 90-100 kg in flat foot individuals in comparison to normal arched individuals.

T-Test: Two-Sample Assuming Equal Variances (Functional Reach Test)	Normal Arched Individuals	Flat Foot Individuals
Mean	32.555	28.74166667
Variance	36.22318448	25.60731092
Observations	30	30
Df	58	
t Stat	2.656219949	
P(T<=t) one-tail	0.005094151	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0.010188302	
t Critical two-tail	2.001717484	

It is identified that the mean value of functional reach test (dynamic balance) in normal arched individuals and flat foot individuals are 32.555 and 28.742 respectively which is significantly different. In a similar manner, the variance in both the groups i.e., normal arched individuals and flat foot individuals are significantly different i.e., 36.22 and 25.61. In addition to this, the P(T<=t) two tail i.e., 0.010188302 is less than the standard significance level value 0.05 which indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis.

CONCLUSION

From the above study we concluded that there was significant effect of flat foot on balance and functional mobility in adults There was commendable effect on the static balance, dynamic balance and functional mobility as depicted by the results obtained through statistical analysis done on the observations received by applying tests: SLS, FRT and TUG. Comparing the two groups (normal arched and flat foot individuals) it was seen that there was an effect on balance and functional mobility.

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