Prevalence and incidence of flat foot among Middle East and Asian Population:An Overview

Satheesha Nambiar Periya[1], Jagatheesan Alagesan[2]

1. *Associate Professor, Department of Biomedical Sciences (Human Anatomy), College of Medicine,Gulf Medical University, Ajman. United Arab Emirates.*
2. *Assistant Professor, Department of Physical Therapy, College of Allied Health Sciences, Gulf Medical University, Ajman. United Arab Emirates*

Abstract:

Flat foot is one of the most commonly seen foot deformity, which is also known as pes planus. It is characterised by a very low or an absence of arch, which are the main supportive structure of the foot. It becomes completely flat when the foot placed on the ground.The main supportive structure of the foot isthe arches. Flat foot may be diagnosed if the arch is collapsed flattened or absent. Flat foot may be noted early in life and in this case it is considered to be congenitalFlat foot. This condition may also be acquired due to inheritance of poor foot mechanics, trauma, excessive use, impaired collagen synthesis, rheumatoid arthritis, neurologic disorders and neuromuscular disorders, pregnancy, types of shoes a child or adult wears, or the way they sit or sleepand obesity.Flat foot in an individual may be either flexible or rigid. The majority of the flat foot are of flexible type, and in this type the arch can be re-established either by manual manipulation or by standing on one's toes. Rigid flat feet may be due to a congenital condition, trauma, and late stages of neuroarthropathy.The flat foot could be congenital, where the foot can have an arch but it flattens out when placed on the ground owing to flexibility.

The significance of flat foot has been studied since many years among the clinicians of various specialties. Individuals with flat foot do not experience any functional disadvantage or any symptoms; however, some people with aflat foot prone to foot/ankle/knee/hip/back pain,

foot fatigue/cramping, and other associated deformities such as hammer toes. In flat foot, the bone and joint instability are dependson function of certain muscles and tendons. The degree of standing and walking, level and type of activities believed to have an impact on the symptoms associated with flat foot. The available literature on prevalence flat foot is limited and therefore, this article has been reviewed the prevalence of flatfoot among the Asian and Arab population.

Key Words: Flat foot; pesplanus; foot deformity;prevalence

Introduction:

Pesplanus or the flat foot is one of the frequentorthopaedic issues in paediatricsand adulthealth practice. The prevalence of flatfoot is not much known probably because thereis no comprehensivedefinition, proper classification and distinct radiographic criteriafor defining a flat foot[1]. The development of foot arch is brisk between the age of two and six years. It becomes structurally perfected around the age of twelveto thirteen years. There are several causes of flat foot, it can be congenital, adult flexible, posterior tibialtendon dysfunction, tarsal coalition,peroneal spasticity, post traumatic arthritis, charcotfoot or due to neuromuscular in-coordination[2].

In adultpopulation,pesplanusfoot type exist about 10‑25% and has been related to musculoskeletal symptoms likeback and knee jointpain[3, 4]. Presence of an averted rear foot, loweredmedial longitudinal arch (MLA),abductedanddorsiflexed mid foot are the characteristic feature of the flat foot[5,6]. The cause of pesplanusdepends on the direct effect between external and internal forces atthe articular surfaces, supporting ligaments, joint capsules, extrinsic and intrinsic muscles[7,8].Fatigue, paralysis of the intrinsic muscles of the foot due to anaesthesiacan also results in reducedheight of the MLA[7,9].There are few reports which indicate that, plantar fascia contributes in supporting the MLA along with flexor

digitorumbrevisand abductor hallucis muscles(ABH)[10, 11]. There are reports that the paralysis of ABHlowers medial arch height because it is the active elevator of the MLA[12]. About 80% of the resistance for lowering of MLA is furnished by tension in the plantar fascia in the final stage of the swing[8, 13].Persons with pesplanus tend to develop plantar fasciitis and plantar fascia becomes thicker and rigid due to excessive load[3].In pesplanus, the altered nature of the plantar fascia is not well understood in the mid and forefoot area where it divides into digital slips, however there reports suggesting studies at itscalcaneal attachment[14,15,16]. In the foot,after skeletal maturity if the medial longitudinal arch undergoes a complete or partial collapse then it is referred as flat foot according to foot and ankle specialists[17].The prevalence of flat feet is not well established.Most of the studies on prevalence of flat foot were done on children below 10 year age. Minimal literature is available with studies on flat foot between 18-25 yearsage group and in adults. All children are born with flat feet and more than 30% of them have the deformity referred as calcaneovalgusfeet. Gradually, as the age advances by three to six years age this condition is reduced due to walking and activity of the child. It is reported that occurrence of flat feet is more in boys than girls[18]. Flat foot, weakens the usual ability of the foot with structural defect of the foot with lateral deviation of the toes, which may lead to bone damage and affects the adulthood [18,19,20]. A timely investigation of the prevalence of flat foot in society is necessary, to avoid any complications resulting from it[21,22,23]. The available literature on flat foot is scanty and therefore, this article has been reviewed the prevalence of flatfoot among the Asian and Arab population.

Prevalence of flat foot in Middle East population:

A study on flat foot among 2100 military recruitswith mean age of them was 19.3 years was conducted in Saudi ArabiaAbdel-Fattah MM et al (2006)[24].About 104 recruits was diagnosed with flat foot (5.0%) and 412 of them had normal flat foot which was the control study group. Majority were from rural regions of Saudi Arabia. About 5.8% of cases in comparison with

2.2% among controls had obesity. 75.0% of caseshad bilateral flat foot, with normal heel in all cases(99.0%), 37.5% had moderate 45.2 % had severe degrees of flat foot. All cases of flat foot were asymptomatic with no signs ofmetatarsalalgia or disfigurement. In one-fifth of cases (20.2%) this condition was related to abnormalities in the knee joint and 2 cases (1.9%) had a congenitaldefect.Urban populationand overweight or obese persons was associated higher chance of flat foot compared with normal subjects and was related to family history. It was noted that the quality and model of foot wear used in childhood was an indicator for the occurrence of flat foot. This was by comparing the cases of bare-footed children with those children who wore shoes in their early life. The risk of developing flat foot in later were almost twice. It was found that no history of rheumatic arthritis or accidents with ruptured ligaments or tendons were associated with flat foot.

A study on flat foot in 400 school children (156 boys and 244 girls) with average weight of 61-70 kilograms was conducted in Iran by Abtahian A and Farzan S (2016)[25]. The report indicates, 377 children had rigid foot and 13students had flexible flatfoot and 10 students had rigid flatfoot. Homayouni K et al (2015)26studied the flat foot by using the method of navicular drop test in 290 school girls between 6 to 11 years age. Beighton score was used to study the joint laxity. Among 290 school girls, four of them were excluded from the study due to of rigid flatfoot. Median age of the children was 8.45 years (range was 6-11 years) including: 52 (18.2%) as 6 years age, 46 (16.1%) 7 years age, 44 (15.4%) 8 years age, 52 (18.1%) 9 years age, 47 (16.4%) 10 years age, and 45 (15.7%) were 11 years age. Flexible flatfoot was detected in 100 students with estimated prevalence of 34.9%. Mean age of children with flatfoot was lower than that of children without flatfoot significantly, and the former group had a greater risk of joint laxity.

Halbachi F et al (2013)[27]undertaken a study in Iran on algorithmic approach to pediatric flexible flatfoot and its clinical aspects. They reported that no treatment required for most flexibleflatfeet, because they arephysiologic and asymptomatic and only the symptomatic flexible flatfoot should require treatment. Proper orthoses,shoe, exercises,activity modification, and medications are the prime treatment. If the non-surgical treatment is unsuccessful then the surgical intervention is required.

Pourhoseingholi E and Pourhoseingholi MA (2013)[28] compared the of foot arch index in twenty children with normal footand flatfoot in each category aged between 6-7 years.The difference in arch index measurement between the left and right foot was significant in normal children and between left and right footthe difference was not significantas perthe foot posture index measurement. A significant difference in foot posture index andarch index measurement was found in left and right flatfoot.By using Mann-Whitney test it was found mean value of arch indexofthe right and left foot in normalfoot weresignificantly lessthan the flatfoot. The mean value of foot posture index in healthychildren for leftandrightfoot werelessthan respectivefoot in flatfoot cases.

Prevalence of flatfoot male adolescents in Turkey was studied by Cilli F et al (2009)[29]among 3169 school children in Istanbul. The relationship of weight and height of the samples with flatfoot were evaluated in which 22 students who had flatfoot. Almost 3147 were had normal foot. All flat feet were flexible and not rigid. Prevalence of flatfoot in this study was estimated to be 0.69%. In the normal group average of body weight is 55.4kilograms and the flatfoot group it was 58.6 kilograms. According to Mann Whitney U, the difference observed in twogroups was notsignificant. The body weightalonedid not have any impact on the occurrence of flat foot.The normal and flat foot group had an average body height was 165.5 cm in the normal group and 166.40 cm in the flat foot group. Between the two study groups

there was no much height difference was observed and it did not influence the occurrence of flatfoot.

By means of a radiological method, Pehlivan O et al (2009)[30]distinguished asymptomatic and symptomatic flexible flat feetin 56 adultmalesin Istanbul, Turkey. Statistical evaluation of the results indicates among 56 flat feet, 43% were asymptomatic and 57% were symptomatic. The chi-square testrevealed nostatistically significant difference between two groups; however it was significant according to the non-parametric method. Statistically, the talo-first metatarsal angle is a risk factor as per on thelogistic regression and itsalteration towards higherdegrees increases the symptomaticthreat by 2.41times.Statistically, thecalcaneal pitch angle wasnot a risk factor; itsalteration towards the lower degree increases the symptomatic threat by0.83 times as per the logistic regression.

Angin S et al (2014)[31]comparedthe thickness and cross-sectional area (CSA)of plantar fascia, foot muscles(extrinsic and intrinsic) in49 pes planus feet in Izmir, Turkey. Recording of images of the plantar fascia and muscleswere done using a 5–13 MHz transducer and venue 40 ultrasound system.In comparison to thenormal group,the CSA of abductor hallucis, flexor hallucis brevis, peroneus longus and brevis muscle were significantly lesser inpesplanus foot. Thickness of these muscles was also found to be less. In flat foot group, flexor hallucis longus, flexor digitorum longus and muscle hada significantly larger CSA by 28.3% and 24%and the musclewerethickeras 15.2%and 9.8%. CSA and thickness of the flexor digitorumbrevis muscle and thecalcaneal part of the flexor digitorumprofunduswere found innormal and pes planus groupwere notstatistically significant. In the pes planus group the metatarsal portion andmiddle of the PF were thin by 10.6% and 21.7% respectively.

Prevalence is Asian population:

Sanadheera Vet al (2016)[32]undertaken a descriptive cross sectional study using 722 participants (360 males, 362 females) aged between six to ten year children in the central district of Sri Lanka.The prevalence of flatfoot was found to be about 16.06% (116). Uni-lateral flatfoot were present in forty three cases (5.95%) and seventy three (10.11%) were with bilateral flatfoot. Right and left side unilateral flatfoot were found in 7.76% and 2.35% of the cases. In 6years age group, the mean normalized navicular height(NNH) was 0.196 and NNH less than 0.1565 considered as flatfoot. In 7 and 8 age group mean NNH were 0.203 and 0.1733, respectively and NNH less than 0.1676 and 0.1416 considered as flatfoot. Meanwhile in age 9groups, NNH less than 0.1677 considered as flatfoot and in 10 year age group less than 0.1721 considered as the flatfoot.The maximum prevalence of the flatfoot was seen in the 6 year age group (26.35%), 23 (16.2%) in the 7 year age group, 19 (12.75%) in the 8year age group. In the9year age group flat foot was present in 19 (13.57%) of the cases. The lowest prevalence was seen in the age group 10 (11.19%). A significant association between flatfoot and age was observed and flatfoot prevalence has reduced with increase in age. Sixty one (8.44%) males and 55 (7.61%) females had flatfoot and was not statistically significant.The body mass index and prevalence of flat foot were much related and found to be increased as body mass index value increases.

Lower limb kinematics was performed in Taiwan byShih YF et al (2012)[33] in twentychildren with normal foot and flexible flatfoot. Mean age of 10 children with flat foot was 9.7years and 10normal foot archchildren were9.6 years. The body mass index, quadriceps angle, femoralanteversion, measurement of ankle flexibility,weight,age and heighthad no significant differencein the groups. The measurement ofnavicular height and calcaneal eversionangle were different between the twogroups, indicating thatthe collapse ofarches of footishigher in flexible flatfoot group. An average angular displacements of calcaneus, hip and kneejoint is

seen during gait cycle the in lower extremity kinematics.Similar of movement aroundhip, ankle jointsand knee were seen in cases with or without flexible flat foot.No significant interaction factors likejoint, plane of movement across the stance phase. The group differences were identified by t-tests and the kinematic variables in two groupswere compared. Flexible flat foot caseshad greater knee internal rotation angle and lower hip internal rotation excursion in the stance in comparison to the children with normal arches.

In Korea, Lee JH et al (2016)[34] studied the differences in angulation ofMLA, task of abductor hallucis, tibialis anterior muscle as well as the activity ratio of tibialis anterior/abductor hallucis (TA/ABDH) during short-foot exercises in pesplanus and normal foot.Using an independent *t*-testthe groups were analyzed. Among 28 students (14 in each group) it was found that the ABDH muscle activity waslower significantly and the TA/ABDH muscle activity ratio was significantly greater in pesplanussubjects, whereas the MLA angle and activity of theTA muscle did not have significantdifference in two groups. In the height, weight, BMI and age,between the groupsno significant difference was observed as well asin the MLAangleor the activity of the TA muscle. The ABDH muscle activity was significantlylower in subjects with pesplanus than in thosewith normal foot, and the TA/ ABDH activityratio was significantly greater in the pesplanussubjects.

In Indonesia, Idris FH (2005)[35] studied thefactors influencing the growth of foot arches in 8376 children aged 0-18 years. He reported that, the stable proportions of grade 3 flat foot were foundmost of the age groups. Older agehad smaller proportions grade 2 flat foot and 1 compared to young generation. The normal foot proportions werehigher in old age people. A small percentage of pescavus was found in girls at the age of 9 and boys at the age of 7. At zero to three year age group showed flat footgrade 2, at 4 years flat foot grade 1, and at 18 years age normal foot was found with consistent mean foot arch measurements. Children 0-10

years were consistent median foot arch measurement of with grade 1flat foot, and 11 years old children werewith healthy normal foot.There was a positive influence of age and height on flat foot.It was suggestedthat the best and advantageous period for surgical interference is0-7 years for male0-3years for females.

Rao UBand Joseph B (1992)[36]conducted a survey on 2300 children to find out theconsequence and resultof footwear onthe prevalence of pes planus in India. In this study normal arches in both feet were found in 1551, high arch inone or both feet was found in595 and had unilateral or bilateralflat foot was found in 154 (6.7%). With increasing age the prevalence of flat foot found decreasing. Childrenwho wore shoes had significantly higher prevalence (8.6%) than those who did not wear (2.8%). Four of the flat foot were rigid and had a negative Jack's test. 710 childrenshowed a ligament laxity. Children withligament laxity had 14.4% flat foot compared with 3.3% in thosewho had no ligament laxity.The mean body mass index for children with flat foot and without flat foot was not statistically significant.

Conclusion

Prevalence of flatfoot is high in overweight children in Asian population.Studiesindicated that theprevalence of flatfoot students ages 14 to 18 years andthe prevalence of flatfeet is not depend on gender. Study indicated that younger children with excessive joint laxity are more predisposed to flatfoot compared with older children with normal joint laxity. Most of the research indicate that the prevalence of flat foot wereasymptomatic. The statistical value of betweenasymptomatic and symptomatic flat foot was useful in orthotic management of flexible flatfootor surgical interventions.

Flexible flatfoot showed more calcaneal eversion standing position and did not show any kinematicadaptation during walking which requires more evidence before anyclinical implication. However, there is no significant association observed between flatfoot and gender.Continuation of these exercises probably reduces the severity of effects and

deformation of ankle and other abnormalities. Use of orthotic insoles could be recommended for treatment of flexible flatfoot to prevent further development. The main risk factors for the prevalence of flat foot were family background, types of shoe wearing in childhood, obesity and urban life. However, future research and further study is required to estimate the effects of orthotics onother plantar pressure variables and lower limb kinematics with flexible flatfoot.

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