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Normative Value of Arch Index in Elderly- A Cross Sectional Study

Miss. Vaishali. R. Pornak[*1], Dr. Nitin. S. Nikhade[2]

[1]BPTh Intern

[2]Associate Professor, DVVPF's College of Physiotherapy, Ahmednagar

Abstract:

Background: *The Medial longitudinal arch (MLA) is a very important structure of the foot. As age advances it undergoes some anatomical and biomehanical changes. Body mass index may have its effect on the MLA. Till date Normal values of arch Index have not yet been established in elderly Indian population and Body Mass Index (BMI) may influence the Arch Index.*

Aims and objectives: *To find the normative values of Arch Index and to find its correlaion with BMI.*

Method: *A cross sectional study was conducted among the community dwelling elderly of Ahmednagar district. 100 elderly (50 Males & 50 Females) in the age group of 60-85 years were included in the study. The demographic data was collected and measurements of Arch Index were taken to find out normative values.*

Results: *The normative values of Arch Index were 0.352(0.21, 0.44) on right foot and 0.354(0.19, 0.48) on left foot in both the genders. There was no correlation of BMI with Arch Index on both sides.*

Conclusion: *The normative value of arch index in elderly is 0.35 in both males and females and Arch index has no correlation with BMI.*

Keywords: ***Arch Index, Medial Longitudinal Arch, BMI, Elderly.***

INTRODUCTION

Almost all human anthropometric characteristics differ from each other at different ages. Similarly foot posture also varies among children, adults and elderly. Foot problems are reported by approximately 30% of community-dwelling older people[1–4],and are associated with reduced walking speed and difficulty performing activities of daily living [1,4,5] and may impair balance in older people.

The structure of the foot influences the biomechanics of the foot, chiefly the medial longitudinal arch. The medial longitudinal arch acts a vital role in shock absorbance and energy shift during walking[6,7]. Elements like gender, age, weight of the body, footwear, anatomical configuration of foot influence the medial longitudinal arch. The feet are susceptible to disproportionate pronation and supination due to the undue forces applied to the medial longitudinal arch during every day activities. Exessesive amount of pronation owing to soft tissue laxity and recurring stresses may perhaps diminish the medial longitudinal arch[8]. The high arched cavus foot has been associated with low back facet syndrome and knee pain, while the low arched planus foot has been linked with pathologied including Moron's neuroma, plantar fascitis, hallux abducto valgus, chrondomalcia patella and shin splints[9,10.11].

In 1987, Cavanagh and Rogers[12] developed the Arch Index (AI), which represents the ratio of the area of the middle third of a footprint relative to the total area excluding the toes, with a higher ratio indicating a flatter foot. The flat arch is caused by the collapse of the MLA and/or the lack of support and strength to the arch. The AI has since been found to have excellent reliability [13,14].

Foot pain is reported commonly in overweight and obese individuals [15] and increased BMI [16]. Excessive fat deposition leads to increased loading of pressure over the arches causing flat foot [17, 18].Obesity, illness, faulty biomechanics and prolonged stress to the feet can develop flat foot [19]. In obese individuals there are changes in foot due to excessive mechanical loading during walking [20]. Thus the objective of this study was to determine the normative values of arch index and to examine if Body Mass Index and foot arch have any association between each other in older people.

*Corresponding Author - Miss. Vaishali. R. Pornak

MATERIALS AND METHODOLOGY

The Ethical clearance was obtained from the Ethical Committee of DVVPF's College Of Physiotherapy, Ahmednagar. A Cross sectional study was conducted in Dr. Vikhe Patil Hospital's Physiotherapy OPD and Matoshree old age home, Ahmednagar. A convenient sampling of 100 subjects between the age group of 60-85 years (50 male and 50 females) were included in the study. The Materials required were a measuring scale, pencil, ink, plane paper. Subjects who can stand and walk independently were included in the study. Subjects using an assistive device and with any neurological or musculoskeletal disorders leading to loss of balance were excluded from the study.

Procedure:

BMI	No. of subjects (N=100)	%
Upto 18	10	10%
18.1-24.9	61	61%
25-29.9	23	23%
≥30	6	6%
Mean±SD	22.71±4.08	

Written consent was obtained from all the subjects fitting into the inclusion and exclusion criteria. Demographic data was collected. Then the following outcome measures were assessed.

1. Arch Index
2. BMI

Measurement of arch index

The arch index was measured by applying ink on the plantar surface of foot and a foot print was obtained on a paper. On the footprint, a line is drawn from the centre of the heel and the tip of the second toe (FJ). Then a line is drawn perpendicular to the ball of the foot (DE).Then this line was divided into 3 parts –the ball of the foot (A), the MLA (B), heel (C) respectively. The length of each part was measured and was put into the following formula for Arch Index. Arch Index = B ÷ [A+B+C][12] (Fig 1). Flat feet (pronated) shows high values of arch index and high arch feet (supinated) shows lower values of arch index.

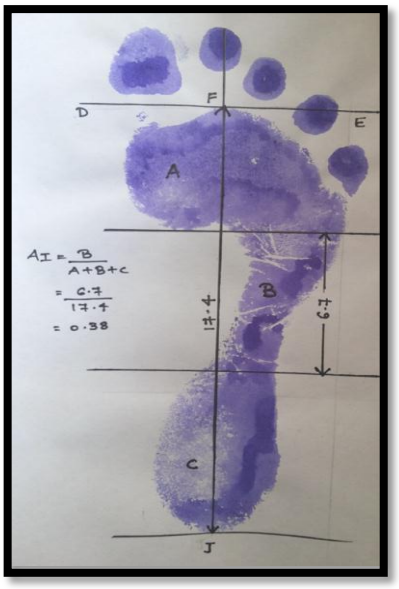


Fig 1: Arch index

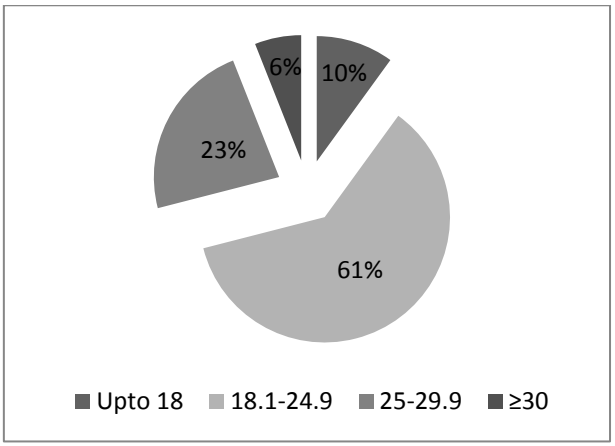
Measurement of BMI

BMI was calculated by dividing the subjects body weight by the square height. It computes a unit of Kg/m^2. BMI is classified as underweight (<18.5 Kg/m^2), normal (18.5–24.9 Kg/m^2), overweight (25–29.9 Kg/m^2) and obese (>30 Kg/m^2)[21]

RESULT

GRAPHICAL REPRESENTATION

Table 1: Distribution of subjects according to BMI



Graph 1: Distribution of subjects according to BMI

Table 2: Normative values of Arch Index on right and left foot

Arch index	RIGHT	LEFT	P value
Mean	0.352 (0.21,0.44)	0.354 (0.19,0.48)	0.056#

#-NOT SIGNIFICANT

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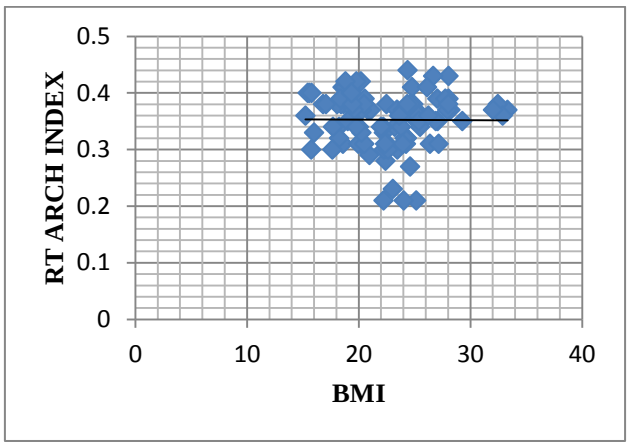
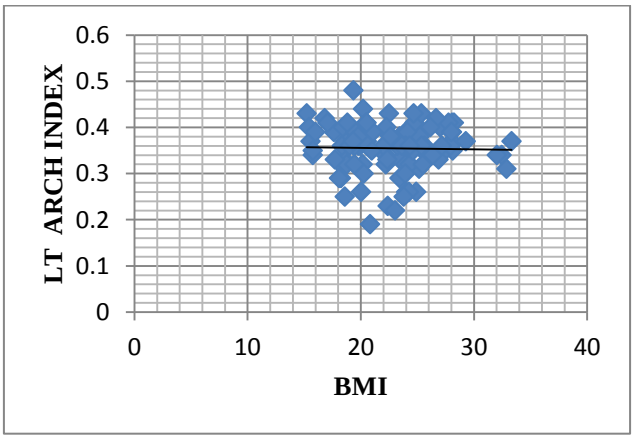
CORRELATION OF ARCH INDEX WITH BMI



Graph 2: Correlation of Arch Index with BMI of Right foot



Graph 3: Correlation of Arch Index with BMI of Left foot

All the data except the height, BMI and foot length was non parametric. Therefore Spearman's rank correlation test was used in the analysis of correlation of BMI using Instat Graph pad 3rd version.

Table 1 & graph 1 shows distribution of subjects according to BMI. Out of 100 subjects 10 were underweight, 61 were normal BMI range, 23 belonged to pre-obese category and 6 belonged to obese category. The mean BMI was 22.71 ± 4.08.

Table 2 shows mean values of Arch Index with upper and lower limits, 0.352 (0.21, 0.44) on right foot and 0.354 (0.19, 0.48) on left foot respectively in both the genders.

Graph 2 and 3 shows no correlation of BMI with Arch Index on both feet, in both the genders.

DISCUSSION

The present study investigated normative values of Arch Index in elderly and its correlation with BMI. The study incorporated 100 participants of which 50 were male and 50 were female.

The normative values of Arch Index were 0.352 (0.21, 0.44) and 0.354 (0.19, 0.48) on right and left sides respectively. Cavanagh et.al considered Arch Index between 0.21-0.26 as normal, < 0.21 as high arch (pes cavus) whereas > 0.26 as low arch (pes planus)[12]. Our study also shows that older people have a relatively low arch with mean value of arch index 0.35.

The mean BMI was 22.71 ± 4.08.Yousefi et al conducted a study on The relationship between BMI and foot print parameters in older people and he found a weak correlation of BMI with Arch Index which is supported by the results of our study.

Limitations of the study was small sample size, our results may have varied with a large study sample size. Ranges of BMI were not distributed equally even though we tried to include subjects with different BMI. Since arch index values are variable in elderly, it needs future studies with a large sample size.

CONCLUSION

The normative value of arch index in elderly is 0.35 in both males and females and BMI has no association with arch index.

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