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Prevalence of Flatfoot in Collegiate Students, Thailand

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ABSTRACT

Background: The primary shock absorbing and force distributing structure of the foot is the medial longitudinal arch. the arch of foot consists of several articulations, ligaments and muscles but the major supportive structures in static position are ligament and in dynamic activities are muscles. Flexible flatfoot is one of the most common conditions seen. **Objective:** The purpose of the study was to investigate the prevalence of flatfoot in collegiate students. One hundred and twenty seven subjects were examined. AHI measurements were collected in seat and standing position. **Results:** the average AHI with 10% weight bearing of subjects was in normative range (Lt. foot = 0.369, Rt. foot = 0.367), with 50% weight bearing in normative range (Lt. foot = 0.34, Rt. foot = 0.339) and with 100% weight bearing was in flat foot range (Lt. foot = 0.31, Lt. foot = 0.329). **Conclusion:** The incidence of flatfoot among adolescent was 78% when full weight bearing. No correlation between BMI and AHI was found.

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INTRODUCTION

The foot is the complex structure which external impact is applied to the body. The foot plays a major role in maintaining and providing a base during activities and moving from one to another location such as walking, running and jumping. The primary shock absorbing and force distributing structure of the foot is the medial longitudinal arch (MLA) (Huang et al., 1993). However, the arch of foot consists of several articulations, ligaments and muscles but the major supportive structures in static position are ligament and in dynamic activities are muscles (Jahss, 1982; Ker et al., 1987; Dowling & Steele, 2001). Foot problems are reported by approximately 70% to 80% of adults and 30% of children (Pauk et al., 2012). The absence of foot arch, especially medial longitudinal arch known as flatfoot is a common condition in normal infants and toddlers (Lin et al., 2001). There are two kinds of flatfoot; rigid and flexible flatfoot. Rigid flatfoot is characterized by permanently stiff and flattened arch all the time of weight or non-weight bearing.

Flexible flatfoot is one of the most common conditions seen in pediatrics. The flexible flatfoot is characterized by a normal arch during non-weight bearing and collapsing of the foot arch on stance (Menz, 2008; Vittore et al., 2009). It is associated with ligament laxity, age, lateral dominance and obesity (Sachithanandam and Benjamin, 1995; Zifchock et al., 2006). The prevalence of flexible flatfoot is 21-57% in children at preschool age (El et al., 2006; Pfeiffer et al., 2006). Generally, the foot of infant is flexible flatfoot (El et al., 2006). It takes time to develop the strength of ligaments and bones in the foot. The arches of foot have started to develop rapidly when the children bear weight on their feet and continuously develop during the first 2-6 years of age (Pfeiffer et al., 2006). Toddlers' walking pattern is the natural mechanism for increasing stability, no weight transfers from heel to toe as adulthood. At the age of 6, children's foot becomes less flexible, the fat pads under their feet disappear as the arch of foot is formed. It develops maturely at the age of 14 in girl and 15 in boy (Volpon, 1994; Vittore et al., 2009). However, about 20 percent of children, the arch does not develop and continue to adulthood (Abass, 2007). Shoe-wearing in early childhood is detrimental to the development of a normal longitudinal arch (Rao and Joseph, 1992). Several studies stated that the children with flatfoot would influence the physical performance, especially gait, and cause pain and disorders in the future. In addition, it might lead to the deficit of gross motor development in activity daily living in the long term such as calf pain, osteoarthritis (D'Amico, 1984; Cappello, 1998; Lin et al., 2001). One of several factors which limit the development of arches of foot is to wear footwear regularly, especially fully supporting footwear. Several studies investigated the children who regularly wear shoes more than eight hours per day and children who wear

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minimalist – style or other footwear like moccasins, slippers. They found that the children who regularly wear tended to be flatfoot (Rao and Joseph, 1992; Sachithanandam and Joseph, 1995)

The height of the medial longitudinal arch (MLA) has become a common measurement used to classify the foot type (Williams and McClay, 2000; Zifchock, 2006; Cobb et al., 2009 McPoil, 2008). Although the radiographic measurement is the gold standard for determining the foot structures but it is not easy to access (Menz, 1998; Thomas et al., 2006). Several indicies have been developed to quantify the height of foot arch such as ink-footprint, foot posture-related indicies, staheli's plantar arch index (SI)(Staheli et al., 1987), arch index (AI) (Cavanagh and Rodgers, 1987), arch height index (AHI) and navicular height (Saltzman et al., 1995; Scott et al., 2007). The arch height index measurement system is one of the most reliable for measuring the arch height index. It was developed by Williams and McClay (2000). The mechanical device has demonstrated good reliability and validity when compared with radiographic measurements (Williams and McClay, 2000). The purposes of the study was to investigate the prevalence of flatfoot in collegiate students.

MATERIAL AND METHODS

One hundred and twenty seven subjects (ninety males with mean age ……. years, mean weight 64.40±10.52 kg and mean height 171.82±6.32 cm), and thirty seven females with mean age ……. years, mean weight 53.16±8.94 kg and mean height 161.43±6.42 cm), recruited from Burapha University, were examined in the study. All subjects were healthy and free from injury of lower extremities at the period of measurement. They were informed about the purposes, procedures and advantage of the study. Ethical approval for this study was obtained from the Mahidol University Human Ethics Committee. Informed consent was obtained from all subjects.

General characteristics such as bodyweight, height and leg length were collected. The custom-built AHI device consists of heel cup and series of sliding calipers. The device was placed on the two separate blocks with the weight measuring device in the center. Subjects were asked to seat with their hip, knee and ankle joints at 90^{O}. The heel was placed against the heel cup and sliding horizontal calipers were used to measure the foot length (FL) and truncated foot length (TL). The vertical sliding caliper was at the half of foot length, and used to measure the height of the dorsal of the foot (DH). The AHI was calculated as the ratio of DH:TL (Williams and McClay, 2000). Then, the subjects were asked to stand and bare weight equally on both feet and bare weight 90% of their bodyweight. The measurement was repeated respectively. Arch height index (AHI), indirect method of estimating the height of the medial longitudinal arch of the foot, is defined as the ratio of dorsum height (DH) to truncated foot length (TL) expressed as a percent in both seat and standing postures.

Results:

General characteristics:

The subjects were one hundred and twenty seven collegiate students, divided into ninety males (70.9%) and thirty seven females (29.1%). The average values of weight were 64.40 kg for male and 53.16 kg for female. The average values of height were 171.72 cm for male and 161.43 for female. The average mean values of body mass index (BMI) were 21.81±3.44 for male and 20.33±2.65 for female. 50.4 percent of subjects regularly ran more than one year, frequency of running was 3 times per week and the average distance was 3.65±1.28 km (Table 1).

Foot characteristics:

The results of the study showed that all subjects were divided into three types of foot arch. At the 10% of weight bearing, the percentage of subjects with normal arch was 52.8 and 59.1, high arch was 34.6 and 27.6, and flatfoot was 12.6 and 13.4 for Lt. and Rt. foot respectively. The arch height index showed that the average AHI with 10% weight bearing of subjects was in normative range (Lt. foot = 0.369, Rt. foot = 0.367). At the 50% of weight bearing, the percentage of subjects with normal arch was 42.5 and 49.6, high arch was 17.3 and 9.4, and flatfoot was 40.2 and 42.5 for Lt. and Rt. foot respectively. The arch height index showed that the average AHI with 50% weight bearing of subjects was in normative range (Lt. foot = 0.34, Rt. foot = 0.339). At the 100% of weight bearing, the percentage of subjects with normal arch was 12.6 and 38.6, high arch was 8.7 and 7.9, and flatfoot was 78.7 and 53.5 for Lt. and Rt. foot respectively. The average AHI with 100% weight bearing of subjects was in flat foot range (Lt. foot = 0.31, Lt. foot = 0.329).

Table 1 General characteristics of subjects (n=127)

Parameters	Male	Female
Body weight (kg)	65.10±8.56	53.16±8.94
Height (cm)	171.82±6.32	161.43±6.42
Body mass index (BMI)	21.81± 3.32	20.33± 2.65
Running per week (day)	3.76±1.26	3.40±1.28
Average distance (km)	3.14±1.61	2.45±1.67

Rt. leg length (cm)	89.21±4.74	84.42±4.29
Lt. leg length (cm)	89.02±4.60	84.42±4.23

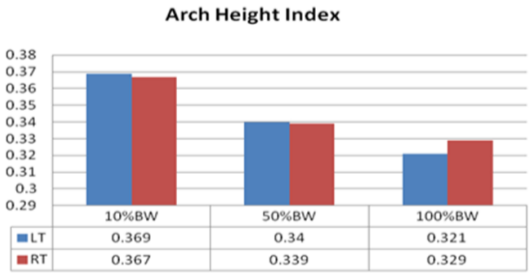

Fig. 1: Arch height index at 10%, 50% and 100% weight bearing of Lt. and Rt. Foot.

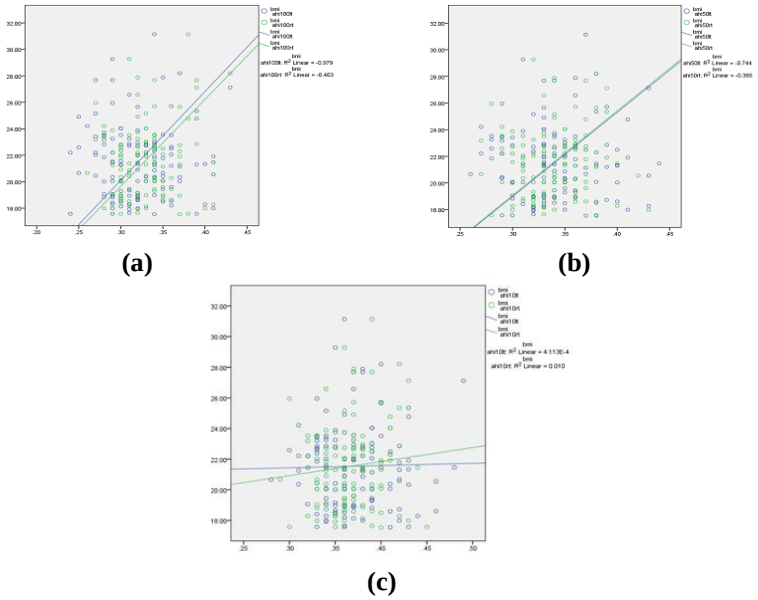

Fig. 2: Scatter plot showing regression amongst foot arch index and body mass index in either foot: a) 100% , b) 50% and c) 10% bodyweight.

Figure 2 presented the results of linear regression as applied to arch height index. There was no association between the BMI and AHI in both feet.

Discussion:

The results indicated that all subjects were divided into three groups of arch types; normal, high arch and flatfoot. Most of the subjects were flexible flatfoot since 100% of weight bearing the medial longitudinal arch (MLA) flattened when compared to the 10% of weight bearing. Several research claimed that bodyweight is one of the important factors which influenced the appearance of flatfoot (Aurichio et al., 2011; Barati et al., 2013; Azarfam et al., 2014) but the correlation between BMI and AHI in our study was not associated. Therefore, BMI or body weight was not the major effect on flattening arch of foot in adolescent. It would come from the activities in childhood and long time wearing close-toe shoes or inappropriate footwear (over eight hours per day). These shoes are usually rigid and narrow toe-box which limit the development of the foot (Rao and Joseph, 1992; Abass, 2007). In addition, it was found that the arch of foot of dominant leg (mostly Rt. leg) flattened less than of the non-dominant leg. Most of the people usually use dominant leg for bearing weight and start activities or movement. Therefore, the strength of muscles and dense connective tissues in the dominant should be higher and provide more support and stability than non-dominant foot (Kachoosangy et al., 2013).

Conclusion:

The flatfoot is one of the foot problems which high prevalence. The incidence of flatfoot among adolescent was 78% when full weight bearing. No correlation between BMI and AHI was found.

REFERENCES

Abass, W., 2007. Paediatric flat feet. Am J Family Physician, 32:102-105.

Aurichio, T.R., J.R. Rebelatto and A.P. Castro, 2011. The relationship between the body mass index (BMI) and foot posture in elderly people. Arch Gerontol Geriatr, 52: e89-e92.

Azarfam, A.A.Y., O. Ozdemir, O. Altuntas, A. Cetin and Y.G. Kutsal, 2014. The relationship between body mass index and footprint parameters in older people. The Foot, DOI: 10.1016/j.foot.2014.08.009

Barati, A.H., A. Bagheri, R. Azimi, M.A. Darchini and H.N. Nik, 2013. Comparison balance and footprint parameters in normal and overweight children. Int J Prev Med, 4(Suppl 1): S92-97.

Cappello, T.S.K., 1998. Determining treatment of flatfeet in children. Curr Opin Pediatr, 10: 77–81.

Cavanagh, P.R. and M.M. Rodgers, 1987. The arch index: a useful measure from footprints. J Biomech, 20: 547-551.

Cobb, S.C., L.L. Tis, J.T. Johnson, Y. Wang, M.D., Geil and F.A., McCarty, 2009. The effect of low-mobile foot posture on multi-segment medial foot model gait kinematics**.** Gait Posture, 30: 334-339.

D'Amico, J.C., 1984. Developmental flatfoot. Clin Podiatry, 1 :535–546.

Dowling, A.M. and J.R., Steele, 2001. Does obesity influence foot structure and plantar pressure patterns in prepubescent children? Int J Obes, 25: 845-852.

El, O., O. Akcali, C. Kosay, B. Kaner, Y. Arslan, E. Sagol, S. Soylev, D. Iyidogan, N. Cinar and O. Peker, 2006. Flexible flatfoot and related factors in primary school children: a report of a screening study. Rheumatol Int, 26(11): 1050-1053.

Huang, C.K., H.B. Kitaoka, K.N. and E.Y. Chao, 1993. Biomechanical evaluation of longitudinal arch stability. Foot Ankle, 14: 353-357.

Jahss, M.H., 1982. Disorders of the foot. PA: WB Saunders Company.

Kachoosangy, R.A., F. Aliabadi and M. Ghorbani, 2013. Prevalence of flat foot: comparison between male and female primary school students. Iran Rehabil J, 11(18): 22-24.

Ker, R.F., M.B., Bennett, S.R. Bibby, R.C. Kester and R.M.C.N. Alexander, 1987.The spring in the arch of the human foot. Nature, 325; 147-149.

Lin, C.J., K.A. Lai, T.S. Kuan and Y.L. Chou, 2001. Correlating factors and clinical significance of flexible flatfoot in preschool children. J Pediatr Orthop, 21: 378-382.

McPoil, T.G., M.W. Cornwall, L. Medoff, B. Vincenzino, K. Forsberg and D. Hilz, 2008. Arch height change during sit-to-stand: an alternative for the navicular drop test**.** J Foot Ankle Res, 1: 3.

Menz, H.B., 1998. Alternative techniques for the clinical assessment of foot pronation. J Am Podiatr Med Assoc, 88: 119-129.

Menz, H.B., 2008. Foot Problems in Older People: Assessment and Management. P.A.: Churchill Livingstone.

Pauk, J., V. Ezerskiy, J.V. Raso and M. Rogalski, 2012. Epidemiologic factors affecting plantar arch development in children with flat feet. J Am Podiatr Med Assoc, 102(2): 114-121.

Pfeiffer, M., R. Kotz, T. Ledl, G. Hauser, M. Sluga, 2006. Prevalence of flat foot in preschool-aged children. Pediatrics, 118(2): 634-9.

Rao, U.B. and B. Joseph, 1992. The influence of footwear on the prevalence of flat foot: a survey of 2300 children. J Bone Joint Surg, 74(4): 525-527.

Sachithanandam, V. and J. Benjamin, 1995. The influence of footwear on the prevalence of flat foot: a survey of 1846 skeletally mature persons. J Bone Joint Surg, 77: 254-257.

Saltzman, C.L., D.A. Nawoczenski and K.D. Talbot, 1995. Measurement of the medial longitudinal arch. Arch Phys Med Rehabil, 76: 45-49.

Scott, G., H. Menz and L. Newcombe, 2007. Age-related differences in foot structure and function. Gait Posture, 26: 68-75.

Staheli, L.T., D.E. Chew and M. Corbett, 1987. The longitudinal arch: a survey of eight hundred and eighty two feet in normal children and adults. J Bone Joint Surg Am, 69A: 426-428.

Thomas, J.L., M.W. Kunkel, R. Lopez and D. Sparks, 2006. Radiographic values of the adult foot in a standardized population. J Foot Ankle Surg, 45: 3-12.

Vittore, D., V. Patella, M. Petrera, G. Caizzi, M. Ranieri, P. Putignano and A. Spinarelli, 2009. Extensor deficiency: first cause of childhood flexible flat foot. Orthopedics, 32(1): 28.

Volpon, J.B., 1994. Footprint analysis during the growth period. J Pediatr Orthop, 14(1): 83-85.

Williams, D.S. and I.S. McClay, 2000. Measurements used to characterize the foot and the medial longitudinal arch: Reliability and validity**.** Phys Ther, 80: 864-871.

Zifchock, R.A., I. Davis, H. Hillstrom and J.S. Song, 2006. The effect of gender, age, and lateral dominance on arch height and arch stiffness**.** Foot Ankle Int, 27: 367-372.