PREVALENCE AND EFFECT OF FLATFOOT AMONG ARMY PRIVATES

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Background: Specific populations require strenuous activities such as soldiers, and flatfoot deformity can cause significant problems during training or operations. Prevalence of this deformity among Thai Army privates is limited and underestimated due to improper screening techniques. We would like to report the prevalence of flatfoot deformity using a new standardized device and compare performances of army privates between normal foot and flatfoot deformity.

Study design: The study employed a cross-sectional design.

Materials and Methods: A prospective study of 490 army privates in the King's Guard, 2nd Cavalry Division, between June 2015 and November 2015 was conducted. Footprints were collected from all participants using a Harris Mat imprinter and the shape of their feet was recorded based on arch height. The Stahili index >0.77 (NY index) and arch height less than 6 mm were used as cut-off point values to diagnose flatfoot deformity. Additionally, military training performance (running 2 km) was evaluated using validated functional outcome (VAS-FA) and compared between normal arch and flatfoot deformity groups.

Results: The prevalence of flatfoot deformity determined using footprints was 52.5% (233 participants: 111 of 233 participants were unilateral (47.6%) and 146 of 233 participants (52.3%) were bilateral flatfeet). The physical training revealed significant differences when compared between bilateral flatfeet and normal arch groups (p = 0.038) and bilateral flatfeet and unilateral flatfoot groups (p = 0.009). BMI, VAS score and flatfoot deformity significantly affected the performances of their training (p =0.03, 0.02, and 0.03 for BMI, VAS score and flatfoot deformity, respectively.)

Conclusion: The prevalence of flatfeet deformity among army privates from this study was higher than related studies. Bilateral flatfeet deformity had a significant effect on physical training. Although many factors affect training performance, BMI, VAS score and flatfoot deformity significantly affected the military training program.

Keywords : Flatfoot deformity, Army Private, Plantar Foot Pressure, Functional Outcome

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Introduction

Flatfoot deformity is one of the most common foot deformities affecting both children and adults.[1] This deformity typically consists of a combination of arch collapse, midfoot abduction, heel valgus and forefoot varus.[2] These deformities result from structural overloading on the medial side of the foot and ankle and impinge on the lateral column and hindfoot causing muscle fatigue and cramps because of overuse.[1] Once flatfoot deformities progress, pain and disability increase and can affect daily activities, sports, and work leading to significant problems and economic burden. The prevalence of flatfoot varies among different age groups and the highest incidence is among young children aged two to three years (57%) and declines at age five to six years (27%).

However, related literature reports that the incidence is approximately 5% in both child and adult populations.[3] Additionally, the incidence also differs in specific populations such as a military population that requires strenuous physical activities for training or operations and this incidence varies between 5 to 21% from related studies.[4, 5] In Thailand, limited studies have reported the prevalence of flatfoot deformity among army privates including the effects of flatfoot in army private training. Moreover, one related study did not use a standardized device to diagnose flatfoot deformity in an army private population.[6]

The purpose of this study was to report the prevalence of flatfoot deformity in an army private population determining plantar foot pressure using a Harris Matt imprinter. In addition, functional outcomes of army privates receiving military training program were compared between army privates who had flatfoot and those with normal foot using VAS - FA.

Materials and Methods

After approval from the Institutional Review Board (IRB), 450 army privates, stationed in the King's Guard, 2nd Cavalry Division, were enrolled in this study.

Inclusion criteria included army privates older than 18 years and participating in a fully trained military program. All participants were able to complete questionnaires at pretraining and six weeks posttraining.

Exclusion criteria included previous foot and ankle fractures within three months, previous surgery in the foot and ankle region within three months, underlying inflammatory joint arthritis such as gout and other inflammatory joint diseases, metabolic disorders such as diabetes, rickets and lower limb deformities such as hip, knee and ankle deformities.

Measurement

Demographic data including age, visual analogue score and body mass index (BMI) was recorded for all participants. All participants who met the inclusion criteria had their footprints taken using a Harris Matt imprinter in the King's Guard, 2nd Cavalry Division. In addition, arch appearance was measured using a ruler from the floor to the lowest part of the medial cuneiform of both feet. When this distance was less than 6 mm, it indicated flatfoot deformity.

All participants filled out pretraining questionnaires using a VAS-FA (Visual analog score foot and ankle) in Thai to analyze their foot and ankle functions.[7] Data of training performance (Running 2 km) by individual army private was collected from their unit after finishing their training at 6th week.

Outcomes measurement

Plantar foot pressure of all army privates was recorded using Harris a Matt imprinter. The cut-off point for flatfoot deformity was a Stahili index >0.77.[8,9] All participants were categorized in three groups based on the Stahili index, i.e., normal arch (Stahili index <0.77), unilateral flatfoot (Stahili >0.77, either right or left side) and bilateral flatfeet (Stahili index > 0.77, both feet).

The results of a physical performance test of running 2 km among all participants were recorded at pretraining and at 6th week posttraining and compared among normal arch, unilateral flatfoot and bilateral flatfeet groups.

Statistical analysis

STATA/MP, version 12, was used to analyze data. We used descriptive statistical analysis for demographic data. The Chi-square test was used for categorical data and one-way ANOVA was used for continuous data. A measured ANOVA test was used to compare the different physical performances (Running 2 KM) among the three groups. Multiple comparison testing was used to define the relations among the three groups. A significant difference was considered for p -value less than 0.05.

Results

A total of 490 army privates met the inclusion criteria and were able to complete physical training as well as the questionnaires. The prevalence of flatfoot deformity determined by footprint was 52.5% (233 participants). Among the 233 flatfoot participants, 111 participants presented unilateral (47.6%) and 146 participants (52.3%) exhibited bilateral flatfoot). The details of the prevalence of flatfoot deformity are shown in **Fig. 3**.

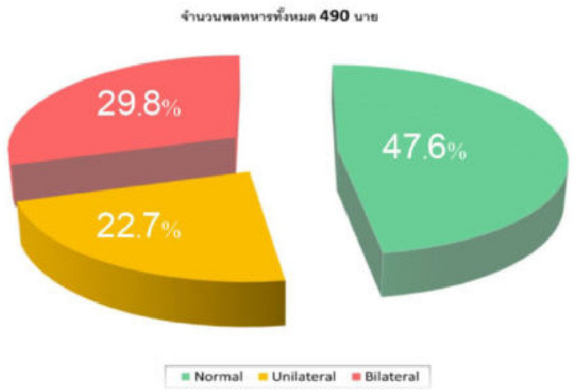

Fig. 3 Prevalence of flatfoot deformity.

The details of demographic data are shown in **Table 1.** BMI significant differed among the three groups (p<0.01); however, age and visual analog score (VAS) did not significantly differ between the three groups (p>0.05).

Table 1. Demographic data in this study

Parameters	Normal arch (n=233)	Unilateral flatfoot (n=111)	Bilateral flatfeet (n=146)	Total (n=490)	*p*-value
Age	21.2±1.7	21.3±1.0	21.5±1.3	21.3±1.4	0.306
VAS	7.6±1.6	7.6±1.5	7.9±1.7	7.7±1.6	0.278
BMI	22.4±9.0	22.7±3.4	24.5±4.0	23.1±6.8	0.010*

The 2 km run performance results were not significant when compare between normal arch and unilateral flatfoot groups (p>0.05). However, statistically significant differences were found between bilateral flatfeet and normal arch groups (p=0.038) and bilateral flatfeet and unilateral flatfoot groups (p= 0.009). The details of physical training performance are presented in **Table 2**. Finally, factors affecting running performance in this study included BMI, pretraining VAS score and bilateral flatfeet.

Table 2. Comparison outcomes between normal arch, unilateral flatfoot, and bilateral flatfeet using one-way ANOVA.

Comparison between groups		Mean Difference	95% CI
Normal arch	**Unilateral flatfoot**	0.226	0.344
Normal arch	**Bilateral flatfeet**	-.459*	0.038*
Unilateral flatfoot	**Bilateral flatfeet**	-.685*	0.009*

Discussion

Flatfoot deformity is a commonly encountered condition in Thai army private populations. The incidence of flatfoot deformity in this study was 55% and bilateral flatfeet deformity was more commonly seen than unilateral flatfoot deformity. One possible reason that we found a high incidence of flatfoot deformity among army privates is that we used an effective device with a new cut-off point value based on the Stahili index to diagnose flatfoot deformity.[8,9] The incidence of flatfoot deformity among Saudi army privates using a Harris Matt foot imprinter was reportedly 5%.7 This incidence was much lower than ours due to using a different cut-off point value to diagnose flatfoot deformity. Our study used the Stahili index which is more accurate and differs from footprint appearance as described by Denis.[10] In addition, flatfoot deformity is a systemic problem affecting bilaterally more than unilaterally. Patients with flatfoot deformity require a complete examination on the other foot. Footprintint is a worldwide method and commonly used as a screening tool for flatfoot deformity.[11] Clinical appearance of the foot is unreliable because of greater subjectivity and difficulty to interpret. We used a Harris Matt foot imprinter in this study because as a more reliable technique than diagnosing flatfoot deformity based on foot appearance. This improved the quality of the results in this study and provided a more accurate measure of the incidence of flatfoot deformity in a Thai army private population. Additionally, we could use this method to study the incidence of flatfoot deformity among Thais. Bilateral flatfoot deformity directly affects the physical training performance of army privates. This finding emphasizes the findings of related studies that flatfoot deformity can cause significant pain leading to functional deficit and disability.[12]

Patients with unilateral flatfoot deformity presented better bilateral feet possibly due to compensation on the normal foot. Because a higher incidence of this deformity among army privates causes a significant reduction in physical training, army personnel should consider regarding flatfoot deformity as a significant problem and prepare a suitable training program or even establish this condition as exclusion criteria for army service.

The limitations in this study included the short period of follow-up after physical training (6 weeks) and no radiography used as a gold standard to diagnose flatfoot deformity leading to a higher incidence of flatfoot deformity. In addition, although VAS-SF is a validated outcome score, it could not be used to properly evaluate sport or contact activities. Future prospective studies should be conducted using valid outcome scores that could be used to effectively evaluate sport and contact activities in an army population.

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