



# Investigating the effects of wrestling gear in flatfoot deformity of wrestlers

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## Abstract

**Purpose:** In this study, our aim was to determine the effects of wrestling shoes, wrestling mats and wrestling styles on postural deformation of the foot and to elaborate its possible causes.

**Material:** Study group comprised of 158 athletes (109 males, 59 females) from 26 different countries who participated in the 12th World University Wrestling Championship. Of the athletes, 102 (59 females, 43 males) performed in freestyle and 56 performed in Greco-Roman style. The age range of the athletes was 19 to 31 years and they have done wrestling for 3 to 18 years. Were evaluated to determine the relationship between flatfoot deformity and gender, age, wrestling style and years in the sport. Footprint parameters were used to determine and evaluate the overall structure of the foot. The Staheli and the Chippaux-Smirak indexes were used in the study. Statistical analyses were performed using the SPSS v.21.0 software, with the significance level set at  $\alpha=0.05$ .

**Results:** No significant relationship was found either between the gender of the wrestlers or their age and their pes planus state. A significant relationship was detected between the wrestling style performed and the wrestlers' pes planus state, and between the years in the sport and their pes planus state.

**Conclusions:** The fact that wrestlers wear the wrestling shoes for a long time can be a cause of pes planus. The center of mass of freestyle wrestlers shifts during continuous feet movement, and the surface of their soles extends the contact surface on the mat to maintain balance. This situation can also lead to a higher prevalence of pes planus in wrestlers. In addition, the wrestling shoes wrap around the Achilles tendon and thus the stretching of this tendon is restricted. Such restriction strengthens the opinion that freestyle wrestlers experience pes planus more.

**Keywords:** flatfoot, pes planus, postural distortion, wrestling.

## Introduction

Physical structures formed due to the movements in different sport subdivisions differ from each other in terms of both posture features and anthropometric features [1]. Studies report that sport subdivisions demonstrate differences in postural forms [2]. Wrestling is a performance sport and it requires one to be physically healthy and balanced in addition to features such as physiological, psychological, technical, tactical, strength, and agility. Among these features, balance has a different aspect in wrestling. Foot posture plays an important role in maintaining balance. Pes planus, which distorts foot posture, is a foot deformation that is characterized by the inner longitudinal arch's disappearance and the heel's outer movement. Medically, pes planus, expressed as flat feet, is the flattening or disappearance of one of the longitudinal or transverse arches. This condition rules out the springiness of the foot and obstructs normal movements during walking or running. In another expression, pes planus is defined as when the "foot's medial longitudinal arch's heights decrease or the deformation caused by its total collapse" [3]. Pes planus disorder is characterized by the foot arch's flatness in the medial part and the contact of the whole foot with the ground. The reason for this disease, which usually does not cause pain, may be the nonformation of foot arches in

childhood. The rate of pes planus in 3-year-old children is 44%, whereas it decreases to 24% in 6-year-old children [4]. Daneshmandi, Rahnema, and Mehdizadeh reported a meaningful relationship between obesity and pes planus [5].

In recent years, heavy training techniques have been employed by athletes at an early age. Such training practices may bring about significant changes in the body as the musculoskeletal system is not mature enough [6]. Hawkins et al. reported that when an athlete, a tennis player for example, is exposed to a unilateral overload, he may display an apparent inconsistency, such as increased external rotation and decreased internal rotation of one foot compared to the other [7]. It is known that sport-specific training and repeated practices may have an effect on the arch index of the sole of the athletes [6]. Gymnasts who begin training at early ages, weightlifters who lift enormous weights during training periods and wrestlers who require complex and heavy training sessions are included in this category. The arch of the foot develops and strengthens in early childhood as a part of normal growth of bones, ligaments, muscles and tendons. When misalignment or deformation of the bones, or weakening of the tendon or ligament occur, a postural defect of the foot, such as pes planus, can pose serious problems [8].

Pes planus has two clinical forms; flexible and rigid. Using insoles is a basic application suggested for

individuals with pes planus. Depending on the severity and the type of the deformity; whether pediatric or adult, congenital or acquired or flexible or rigid, several types of orthoses may be used in the treatment of pes planus [9, 10]. It is important to determine the factors involved in forming and maintaining the arches of the foot, and to evaluate the foot posture correctly in order to identify flatfoot deformity and differentiate cases that need treatment from those that need only reassurance [8]. Doctors often suggest using insoles made of steel arches and leather surfaces with shock-absorbing material, such as silicon or semi-rubber [11]. Aak [12] and Yurt [13] reported that the use of insoles in pes planus reduced the pain and the subjects got tired later than usual. Nevertheless, it should be noted that these insoles do not provide the original setting for a standard arch's height, but are rather used only for pain-relief purposes.

Wrestling was first performed barefoot on a dirt surface in the 1<sup>st</sup> Modern Olympics in Athens in 1896, whereas it was practiced on thick and soft mats and with leather shoes, which covered ankles tightly, in London in 1908 [12]. These high neck wrestling shoes used in the London Olympics made it to our day with almost the same features. The shoes do not have any elevation in the heel or any orthopedic insole. It is still debatable whether the foot arch morphology or the use of flat shoes causes pes planus in athletes. The literature holds no study on postural distortion of the foot in wrestlers. The lack of elevation in the heel or an orthopedic support causes postural distortions on the soles of wrestlers, which constitutes the topic of our study. Thus, the aim of this study was to determine the effects of wrestling shoes, wrestling mats and wrestling styles on postural deformation of the foot and to elaborate possible causes. We hypothesized that the foot structure would be affected by wearing the wrong wrestling shoes, thus showing an increased eversion at the mid-stance phase.

### Material and Methods

*Participants:* The study was designed based on the quantitative screening model to evaluate the flatfoot deformity of wrestlers. Our study group comprised of 158 athletes (109 males, 59 females) from 26 different countries who participated in the 12<sup>th</sup> World University Wrestling Championship. Of the athletes, 102 (59 females, 43 males) performed in freestyle and 56

performed in Greco-Roman style. The age range of the athletes was 19 to 31 years and they have done wrestling for 3 to 18 years. The participants were categorized under four different age groups: those 19 years old and under, 20 to 23 years old, 24 to 27 years old and 28 years old and above. The athletes were also categorized according to the time they performed the sport: 5 years or less, 6 to 10 years and 11 years or more.

*Procedure:* Footprint parameters were used to determine and evaluate the overall structure of the foot. An evaluation form was created after receiving the approval of the officials of the championship, and measurements were made based on this form. The Staheli and the Chippaux-Smirak indexes were used in the study [14].

*Statistical analysis:* Statistical analyses of the data were performed using the SPSS v.21.0 software. The significance level in comparisons was set at  $\alpha=0.05$ . The chi-square test was used in the evaluation of the qualitative data and the significance of the difference between the observed and expected frequencies.

### Results

The prevalence of flatfoot was 18.4% in female wrestlers and 19.3% in males. The chi-square test revealed no significant relationship between the gender of the wrestlers and their pes planus state ( $n=158$ ;  $X^2=0.018$ ,  $df=1$ ,  $p>0.05$ ) (Table 1).

The prevalence of flatfoot was 10.5% in the wrestlers that are 19 years old or younger, 15.7% in those who are 20 to 23 years old, 26.2% in the 24 to 27 years old wrestlers and 28.6% in the 28 years old and above. The chi-square test revealed no significant relationship between the age of the wrestlers and their pes planus state ( $n=158$ ;  $X^2=3.733$ ,  $df=3$ ,  $p>0.05$ ) (Table 2).

The prevalence of flatfoot was 22.5% in the freestyle wrestlers and 12.5% in the Greco-Roman style wrestlers. The chi-square test revealed a significant relationship between the style performed and the wrestlers' pes planus state ( $n=158$ ;  $X^2=18.234$ ,  $df=1$ ,  $p<0.05$ ) (Table 3).

Regardless of the gender and style of the sport performed, the prevalence of flatfoot was 9.1% in wrestlers who wrestled for 5 years or less, 13.6% in wrestlers who wrestled for 6 to 10 years and 28.8% in wrestlers who wrestled for 11 years or more. The chi-square test revealed a significant relationship between the years in the sport and the wrestlers' pes planus state ( $n=158$ ;  $X^2=6.042$ ,  $df=2$ ,  $p<0.05$ ) (Table 4).

**Table 1.** Prevalence of flatfoot based on gender

Participants	Pes planus state			
	Not present		Present	
	n	%	n	%
Woman	40	81.6	9	18.4
Male	88	80.7	21	19.3
Total	128	81.0	30	19.0

$X^2=0.018$ ,  $df=1$ ,  $p=0.894$

**Table 2.** Prevalence of flatfoot based on age groups

Age group	Pes planus state			
	Not present		Present	
	n	%	n	%
19 years old and under	17	89.5	2	10.5
20 to 23 years old	70	84.3	13	15.7
24 to 27 years old	31	73.8	11	26.2
28 years old and above	10	71.4	4	28.6
Total	128	81.0	30	19.0

$\chi^2=3.733$ ,  $df=3$ ,  $p=0.064$

**Table 3.** Prevalence of flatfoot based on style

Style	Pes planus state			
	Not present		Present	
	n	%	n	%
Freestyle	79	77.5	23	22.5
Greco-Roman style	49	87.5	7	12.5
Total	128	81.0	30	19.0

$\chi^2=18.234$ ,  $df=1$ ,  $p=0.44$

**Table 4.** Prevalence of flatfoot based on years in the sport

Years in the sport	Pes planus state			
	Not present		Present	
	n	%	n	%
5 years or less	10	90.9	1	9.1
6 to 10 years	76	86.4	12	13.6
11 years or more	42	71.2	17	28.8
Total	128	81.0	30	19.0

$\chi^2=6.042$ ,  $df=2$ ,  $p=0.049$

### Discussion

The results of our study, which exhibit a significant relationship between the wrestling style and pes planus state of freestyle and Greco-Roman wrestlers (Table 3), are in concordance with those of Taşkıran et al. [15] Their leaning forward further, standing on their feet spread sideways for balance and pulling and pushing the opponent forward, backward, and sideways may be an important factor of higher prevalence of flatfoot deformity in freestyle wrestlers in comparison to the Greco-Roman style performers. The surface of the sole extends the contact surface with the mat, or the contact surface may be wider than desired due to the shock-absorbency characteristics of the foam core. This might lead us to think that such incident may be a predisposing factor for higher incidence of flatfoot deformity among freestyle wrestlers. Moreover, by wrapping around it, the wrestling shoes avoid the movement of the Achilles tendon. The failure of the Achilles tendon to stretch supports the opinion of its predisposing effect in the higher incidence of flatfoot deformity among freestyle wrestlers.

Based on the age variable of the participants in our study, the prevalence of flatfoot was 10.5% in the 19 years old and younger wrestlers, 15.7% in the 20 to 23 years old wrestlers, 26.2% in the 24 to 27 years old wrestlers and 28.6% in the 28 years old and older wrestlers; showing a steady increase in the prevalence as the age went up (Table 2). However, no significant relationship was detected between the age of the wrestlers and their pes planus state. The prevalence of the deformity was higher in the male athletes, yet, the difference with their female counterparts was statistically insignificant (Table 1).

A significant relationship was detected between the years in the sport and the wrestlers' pes planus state (Table 4). The athletes were more prone to having flatfoot deformity as their years in the sport increased. Our results were accordant with the results from the study of Taşkıran et al., [15] in which postural deformities of the feet were examined. In another supporting study, Wojtyś et al. suggested that frequent training sessions in early ages have an impact on the posture [16]. In their study on the height of the arch of athletes playing different sports, Aydog et al. observed that the prevalence of flatfoot among

gymnasts was significantly lower than that of wrestlers [6]. Considering that the gymnasts from Aydog et al.'s study had started sports four years before the participating wrestlers, our results exhibiting the relationship with the time spent in the sport and flatfoot deformity support the view that suggests that the prevalence of the deformity in wrestlers is higher.

As flatfoot patients lack a normal arch, the impact on the sole is dispersed without absorption. Forces exerted on the soles and upper parts of the body will cause a chain reaction in especially in the spine and lumbar spine [17]. Flatfoot deformity has been shown to cause pain while standing [18], walking and running [10]. The deformity has also shown a positive correlation with waist pain in the studies of Violante et al. [19] and Oskay et al. [20]. Kaufman et al. [21] showed that flatfoot triggered feeling of pain and stiffness in the foot, imbalance in foot muscles and tension in ligaments, fatigue when walking and most importantly the stress fractures. Taking such complications into account, it is not hard to predict that wrestlers are prone to facing serious problems.

The increase in the time spent in the sport in turn means more training and matches, and thus, wearing the wrestling shoes more. This might suggest that the wrestling shoes lead to unfavorable results in the long term. The characteristics of the sole of the wrestling shoes depict similarity to those of the boots worn in the folk dance, *horon*. In their study, Aydos et al. [22] revealed that significant deviations occur in the soles of *horon* dancers, due to the characteristic figures of the dances performed over a long period of time and the incapability of the shoes in supporting and protecting the feet. It is natural to expect that similar characteristics will lead to similar results.

Continuous and balanced feet movements are necessary to perform the practiced figures, to disrupt

the opponent's balance and to intimidate him. While disrupting the opponent's balance, a wrestler will have a significant advantage in technical performance and preserving energy as long as he maintains his balance. In addition, an accessory navicular in flatfoot individuals will stretch the posterior tibial tendon and impair its elasticity to a great extent. This in turn will significantly restrict the performance of moves like salto, arm throw and takedown, where rising on tiptoes, springing and throwing the opponent over your own body are performed.

Under the light of the outcomes of our study, we can recommend the following; the need for redesigning the wrestling shoes, raising the heels of the wrestling shoes like those in sneakers and daily shoes, placing orthopedic insoles in the wrestling shoes, and that the wrestlers wear normal sneakers when performing exercises other than wrestling, such as warm up runs and moves, and educational and sportive activities.

### Conclusion

The pes planus seen in wrestlers was found to be in direct proportion to the style, wrestling year and age of the wrestlers. It was noted that the factors such as; freestyle wrestlers tying their shoes very tightly, transferring their center of gravity to the front, the wrestling shoes not supporting the foot arch area, the wrestling cushion being soft and athletes running whilst the wrestling shoes on might have contributed to pes planus. It was concluded that wrestling shoes, which were produced more than 100 years ago and have not changed much, should be produced or researched in accordance with the health of athletes.

### Conflict of Interests

The authors declare that they have no conflict of interests.

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