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Body Mass Indexand Waist to Hip Ratio as Potential Factors for Development of Halluxmisalignementinfemale University Students

Kristína Tománková — Department of Natural Sciences in kinanthropology, Faculty of Physical Culture, Palacký University Olomouc,TřídaMíru

Miroslava Přidalová — Department of Natural Sciences in kinanthropology, Faculty of Physical Culture, Palacký University Olomouc,TřídaMíru 111, 771 11 Olomouc, Czech Republic

Barbora Matejovičová — Department of Zoology and Anthropology, Faculty of Natural Sciences, Constantinethe Philosopher University in Nitra,Nábrežie mládeže 91, 949 74 Nitra, Slovak Republic

ABSTRACT

Background: Overweight and obesity are major risk factors for number diseases. Objective: The aim of study was to evaluate the relationship between hallux angle and BMI, and also WHR. Methods: The sample included 217 females aged 18.3–27.2 years. For each person were calculated BMI and WHR. It was measured hallux angle of the both feet from handmade footprints. Results: Lower hallux angle values was inversely associated with higher BMI ($r = –0.15$; $p<0.05$; dex. and $r = –0.19$; $p<0.01$; sin.) and higher WHR ($r = –0.13$; $p<0.05$; dex. and $r = -0.13$; $p<0.05$; sin.). The highest frequency of valgus position of hallux was in women with normal weight. Conclusion: Weak relationship between BMI and WHR and hallux angle suggest that key role in hallux valgus pathogenesisplay except obesity, other important factors as an age, gender and shoe-wearing.

KEYWORDS foot morphology, forefoot, obesity

Introduction

The number of overweight and obese individuals increased from 857 million in 1980, to 2.1 billion in 2013 (Ng et al., 2014). Research exploring the nature and strength of the associations between obesity and musculoskeletal conditions is accumulating, providing a better understanding of underlying mechanisms. Weight reduction is important in ameliorating some of the manifestations of musculoskeletal disease and improving function (Anandacoomarasamy, Caterson, Sambrook, Fransen, & March, 2008).Hallux valgus is one of the most common deformities in podiatric and orthopedic practice(Deschamps, Birch, Desloovere, & Matricali, 2010). It is characterized by a lateral deviation of the hallux with a corresponding medial deviation of the first metatarsal(Glasoe, Nuckley, & Ludewig, 2010). Clinically, hallux valgus occurs more frequently in women (Roddy, Zhang, & Doherty, 2008) and is associated with increased BMI (Frey & Zamora, 2007; Cho, Kim, Kwon, & Kim, 2009). Current research suggests the potential role of shoe types in the development of hallux valgus (Menz & Morris, 2005). Therefore, the strength of the association between BMI and foot structure is unclear (Butterworth, Landorf, Gilleard, Urquhart, & Menz, 2014), in submitted study we aimed on the examination of hallux misalignment in relationship to BMI, in addition WHR.

Sample and methods

The submitted cross-sectional study include 217 female university students aged 18.3–27.2 years from Constantinethe-Philosopher University in Nitra(SlovakRepublic) (Table 1). Age was calculated by the special decimal method(Weiner & Lourie, 1969). To the study sample were included women with values of the hallux angle (HA) in range from +15° to –15° (Table 2). All of the 217 participants recruited were informed about the purpose of this study and provided informed written consent before participation in the research. This study was approved by the Ethics Committee of the Constantineth-ePhilosopher University. The authorsare not aware ofany conflict of interest.Women underwent the basic anthropometric measurements of body weight (kg), body height (cm), abdomen and hip circumference (cm). BMI was calculated and evaluated by classification scale which was used as follows: underweight (< 18.5 kg/m2), normal weight (< 24.9 kg/m2), overweight (< 29.9 kg/m2) and obese 1st degree (< 34.9 kg/m2) (WHO, 2012). Waist to hip ratio was calculated and evaluated by classification scale which was used as follows: normal value (<0.85) and risk value (>0.85) (Abolfotouh, Soliman, Mansour, Farghaly, & El-Dawaiaty, 2008).

Table 1: Statistical analysis of basic characteristics of study sample

n = 217	M	SD	Mdn	Min.	Max.
Age (years)	20.6	1.4	20	18.3	27.2
BMI (kg/m2)	21.51	3.10	20.93	15.10	34.8
Body height (cm)	166.8	6.4	166,4	152	183.5
Body weight (kg)	59.8	9.3	58	37	97
WHR	0.79	0.05	0.79	0.67	0.99
Hip circumference (cm)	96.1	9.1	96	11,5	125
Abdomen circumference (cm)	77.3	8.9	77	58	106
Hallux angle dex.	4.2	2.15	5	-15	14
Hallux angle sin.	4.8	5.3	5,5	-13	15

Table 2: Statistical and frequency analysis of hallux angle in female university students

	Normal position (0°)		Valgus position (HVA (>0°))		Varus position (<0°)	
	dex.	sin.	dex.	sin.	dex.	sin.

n	12	12	172	173	33	32
%	5.5	5.5	79.3	79.7	15.2	14.7
M	0	0	6.2	6.8	–5.1	–4.5
SD	0	0	3.2	3.5	3.3	2.9
Mdn	0	0	6	7	–4	–4.8
Min.	0	0	0.5	0.5	–15	–13
Max.	0	0	14	15	-1	–0.5

In orderto obtain morphological and structural characteristicsstatic footprints of the both feet were made whichwere taken by podographwith a specialrubber membrane. Footprints were used to manual metric evaluation by Kabelka´spodometric method(Firbas, Kabelka, Heinrich, & Krejs, 2000), where HAwas assessed (Figure 1). Normally, the hallux valgus angle (HVA) is no more than 15°, and when increased, it typifies a hallux valgus deformity (Xu et al., 2015).We applied descriptive statistical methods for the baseanalysis of the investigated parameters. Relationships between somatic and foot parameters were examined by the Pearson correlation coefficient test (r)and confirmed by the coefficient of determination(r^2), which showed on the impact of researched variable (r^2× 100 = %). All analyzeswasperformed by STATISTICA software (Version 12; StatSoft, Tulsa, OK, USA) on the two levels of statistical significance ($p < 0.05$ and $p < 0.01$).

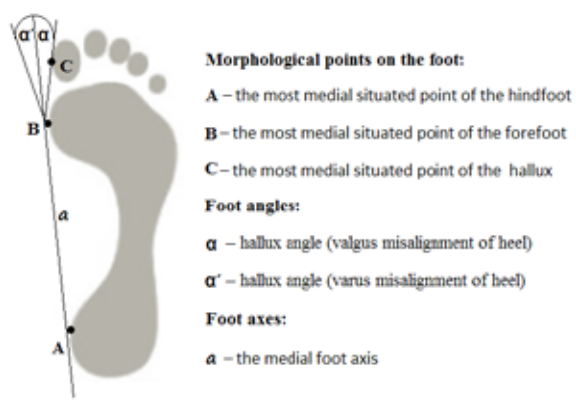

Figure 1: Morphological foot points, axes and angles (Kabelka, 2000 In: Firbas, Kabelka, Heinrich, & Krejs, 2000).

Results and discussion

As shown in Table 3 it exist small inversely linear statistically significant relationship between BMI and HA. It means that with increasing BMI, average values of HVA and HA decreased on the both feet (Table 4). It explains only 2.2% (dex.) and 3.5% (sin.) of BMI impact on development of misalignment. On the right foot is effect of obesity lower ($p < 0.05$) compared to left foot ($p < 0.01$). The highest frequency of the valgus positions on the both feet is in women with normal weight (Table 4). Very similar inversely linear trend was showed in evaluation relationship between WHR and HA on the both feet, while correlations scored lower values ($p < 0.05$) and explain only 1.7% of variation (Table 3). It means that with increasing WHR, average values of HVA and HA decreased on the both feet (Table 5).Again, the higher frequency of the valgus positions of the both feet was obtained in female group with normal WHR (Table 5).Differences in normal and varus positions by BMI and WHR groups are slight.The association between BMI and hallux valgus, found in a sample of 563 people Cho et al. (2009) in contrary to our findings, they found a higher BMI in those with hallux valgus.In agreement to our findings are next two studies. Analysis of 1,411 patients showed that patients with a normal BMI were more likely to have hallux valgus than those who were overweight or obese (Frey & Zamora, 2007). Finally, a population-based study of 600 patients reported a significant positive association between increased BMI and hallux valgus in men, but in women obesity appeared to be protective against hallux valgus (Nguyen et al., 2010).

Table 3: Relationships between hallux angle and BMI and WHR in female university students

n = 222 r		BMI		WHR	
		d (%)	r	d (%)	
Hallux angle	dex.	–0.15*	2.2	–0.13*	1.7
	sin.	–0.19**	3.5	–0.13*	1.7

Notes: r – Pearson´s coefficient of correlation r > 0.1 < 0.3 – small relationship; d – coefficient of determination (%; r2 × 100); p – statistical significance *p< 0.05, ** p < 0.01.

Table 4: Statistical and frequency analysis of hallux angle in female university students according BMI

n = 217		<18.5		<24.9		<29.9		>29.9	
		n	M	*n*	M	*n*	M	*n*	M
dex.	>0°	*29*	6.6	*159*	4.2	*14*	4.6	*2*	4.3
	0	*1*	0	*1*	0	*2*	0	*0*	0
	<0°	*2*	-5	*1*	-6	*5*	-4.4	*1*	-2,5
	∑	***32***	**5.7**	***161***	**4.1**	***21***	**2.4**	***3***	**2**
sin.	>0°	*26*	7,0	*132*	6,8	*13*	6.7	*2*	4,8
	0	*2*	0	*7*	0	*3*	0	*0*	0

Table 5: Statistical and frequency analysis of hallux angle in female university students according WHR

n = 217 n		<0.85		>0.85	
		M	n	M	
dex	>0°	143	6.3	29	5.8
	0	12	0	0	0
	<0°	25	-5.0	8	-5.2
	∑	180	4.3	37	3.4
sin	>0°	146	6.9	27	6.2
	0	11	0	1	0
	<0°	23	-4,6	9	-4,3
	∑	180	5.0	37	3,5

Conclusions

In agreement with other authors, higher average values of the HA and HVA andhigher frequency of the valgus positions of hallux were associated with lower BMI and lower WHR. The strength of the our results suggest that other notable factors as a type of shoe wearing, gender and agemay inputs to the pathogenesis of hallux valgus.

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