

A Study on the parameters of the feet of adolescent boy

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Abstract

The study was carried out in province of Izmir in order to determine foot measurements of boys within 7-14 age group according to TS 5553. The results were different from values of Paris system which was accepted by Turkish Standards Institution. It was observed that feet of Turkish people were shorter and wider comparing to standards of Paris system. Gathering the data, measurement standardization table for boys within 7-14 age group was prepared.

Introduction

Anthropologic characteristics of feet, which have carried the body weight of mankind through his whole life, show differences between ethnics and genders.^{1,2,3,4} An important determinant for a functional and comfortable foot support is how well it fits with the plantar foot shape.^{5,6} So, many developed countries determined their nationals' foot measurements scientifically years ago, and they standardized right fit system of their shoes.^{7,8} However, in Turkey shoe sizing system, which was accepted by Turkish Standards Institution (TSI) in 1988, is a French standard as known Paris System.⁹

Shoe made according to "Paris System" causes many problems such as blistering, chafing, black toes, bunions, pain and tired feet because of poor fitting shoes.⁴ This study

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meant to determine right fit measurement of boys who have soft bone tissue. So, the problems related to shoe fit can minimize future foot problems and deformity of them.

Materials and Methods

Materials

Footprints of right and left foot shapes of each subject were drawn separately on A4 sheets; lengths and breadth of the feet together with the breadths of heels were determined by using a ruler.^{10,11} Other encircling foot measurements of subjects were taken with a wide tape.^{10,11}

Methods

Parameters

According to TS 5553, 5 different foot parameters from each subject were taken Figure 1.⁹ The parameters were taken from right and left feet of subjects who had normal and healthy feet as it was required by TS ISO 9407.¹²

All parameters taken from feet of subject boys studying at elementary schools are defined below;^{10, 13, 14, 15, 16, 7}

1. *Foot length*: The distance between the tip of the great toe and the rear end of heel of a foot in standing position,
2. *Foot breadth*: The distance in width between outer ends of projected outline of a foot on the surface in measurement position, at the joint line of first and fifth foot bones and first and fifth toe bones,
3. *Heel width*: The distance in width at the widest point of heel on the projected outline of a foot in standing position,
4. *Ball girth*: The circumferential length measured around the ball width line,

5. *Long heel girth*: Circumference of a foot between the highest point on top and concave section of the sole.

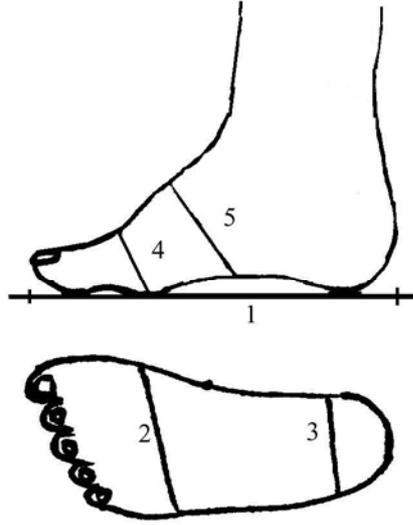


Figure 1. Parameters taken on the foot

Number of subjects

At the beginning of this study standard deviation value (σ) was worked out by taking foot measurements of left and right feet of 90 subject boys within 7-14 age groups. Tolerance (L) was accepted as 0.3 cm. After that, number of subjects (N) was calculated by layer samplings according to 95% trust coefficient by the formula $N = (1.96)^2 \times \sigma^2 / L^2$.^{17, 18}

Number of samples

Population densities of boys within 7-14 age groups in Izmir were obtained from Turkish Statistical Institute (TURKSTAT).¹⁹ Some districts of Izmir, from which samplings were to be made, were so close to each other and in some of them density of adolescent boys was low. Therefore, samplings were made in 16 districts. 920 total number of samples was

multiplied by population density to find the number of samples according to age groups and districts, thus number of samples to be taken from each age group in districts were calculated.

Results and discussion

Determination of foot measurement

Averages of 10 measurements taken within the study from left and right feet of boys' aged 7-14 are given in Table 2. As it's observed from the table, average of each measurement has an increase parallel to the increase in age groups. When findings were compared with Paris system, it was observed that feet of Turkish boys were shorter and wider. In this study obtained the results have proved similar to the ones achieved by Hasde et al, in their studies on adult males.⁴

Preparation of standardization table

In preparing standardization table, Paris system was taken as the basis and size numbers matching feet lengths were determined and average difference between size numbers was accepted as 6.66 mm. Median values of left and right feet obtained from results of statistical analysis of left and right foot lengths, which is known the most important factor in determining foot size numbers, were used in preparing standardization table.

Table 1. Measurements of right and left feet

Age Groups*	Foot length (mm)		Foot width (mm)		Heel width (mm)		Ball girth (mm)		Long heel girth (mm)	
	Mean±SD		Mean±SD		Mean±SD		Mean±SD		Mean±SD	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
6-7	191.95±10.96	191.77±9.93	74.73±4.37	74.77±4.63	48.16±3.71	48.07±4.20	183.92±8.68	183.92±8.9	202.32±12.03	202.25±12.33
7-8	202.13±11.26	200.55±11.81	77.14±4.98	77.87±4.91	48.63±3.92	48.67±3.96	189.74±11.40	189.80±11.73	208.90±12.82	209.17±12.90
8-9	212.53±11.45	211.75±11.0	80.71±5.08	80.29±4.96	50.23±3.68	49.40±3.90	194.57±13.45	194.50±13.54	219.40±11.38	219.34±11.69
9-10	221.77±9.62	222.05±9.44	84.15±5.10	83.57±4.57	52.02±3.60	51.01±3.55	201.75±12.89	201.82±12.90	223.46±12.87	223.41±12.80
10-11	231.31±13.00	230.47±13.48	87.46±5.90	87.35±5.95	54.03±4.87	53.71±5.00	209.08±15.47	208.73±15.43	230.29±13.06	230.20±12.99
11-12	239.73±13.30	239.78±13.59	90.38±5.57	90.11±6.31	55.52±4.34	55.52±4.67	214.06±16.19	213.99±16.22	236.18±15.33	235.99±15.44
12-13	250.59±14.42	250.29±13.71	94.13±5.81	93.84±6.16	58.44±4.90	58.35±5.20	221.52±14.92	221.33±15.03	243.05±16.93	243.03±16.98
13-14	256.20±13.70	255.67±13.73	97.29±6.17	96.71±5.82	59.95±5.10	59.75±5.22	226.86±16.45	226.75±16.63	251.48±13.42	251.54±13.35

* Measurements were taken from 115 subjects for each age group.

Table 2. Standardization table

Shoe Number	Foot length (mm)	Foot width (mm)	Heel width (mm)	Ball girth (mm)	Long heel girth (mm)
28	182	73.5	46	182	193
29	186	74	47	183.5	202
30	193	75	48	184	205
31	200	78.5	48	185	209.5
32	206	79	50	191	215
33	213	81	50	198	221.5
34	221	83	51	204	226
35	226	86	54	209	228
36	233	88	54	210.5	231
37	240	90	56	213	233
38	247	93	57	221.5	243
39	253	94	58	225	253.5
40	260	97	59	230	256
41	267	99	60	235	256
42	272.5	100	62	241	258

Conclusions

This study demonstrates that values of Paris system, which was accepted by TSI, did not equal the foot measurements of Turkish people, and the lengths of right and left feet of Turkish people were not equal. Therefore, it has to carry out similar studies for all age groups with greater number of subjects in order to determine shoe sizing standards for Turkish people. Thus foot discomforts and deformations can be prevented. Besides, many useless stocks of some sizes will be prevented; proper percentages of sizes will be produced and most importantly considerable contributions will be made to national economy.

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