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Foot Anthropometric Profile in High School Students in Bandung in 2014

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Abstract: - Background: *In the process of walking, the foot plays a role in supporting the body weight. Due to continuously withstand the weight; a person will experience foot pain aggravated by the use of improper shoe size. Foot anthropometric data acts as reference in the manufacture of orthotics and shoes with appropriate size while Indonesia still does not have a foot anthropometric data. The purpose of this study is to describe foot anthropometric in high school students in Bandung in order to get the fitted shoes.*
Methods: *The study was performed using observational descriptive method in eighty one students with range age 16–18 years in regionally different three senior high school in Bandung in November 2014.*
Results: *The mean of foot and ankle anthropometry student senior high school in bandung in 2014 are 25.75 cm for Foot Length, 18.82 cm for Ball of Foot Length, 21.57 cm for Outside Ball of Foot Length, 9.70 cm for Foot Breadth Diagonal, 5.43 for Heel Breadth, 6.00 cm Navicular Height, 6.62 cm for Instep Height and 5.06 for Heel to Lateral Malleolus.*
Conclusion: *This anthropometric data helps footwear industry to determine the design and size for the shoe in Indonesia.*

Keywords: *Ankle anthropometry, foot anthropometry*

Introduction:

Foot is the first structure of the musculoskeletal system that begin to grow at puberty.[1] The human foot is composed of 26 bones and more than 30 synovial articulation.[2] During walking, the foot supports the body to hold the weight of the body so it can cause someone feel pain on his feet due to that mechanism and exacerbated by using ill–fitting shoes.[3] The use of narrow shoes associated with the occurrence of corn on the finger–toe, bunion, and leg pain, while the use of shoes which is shorter than leg associated with deformities of toes.[4]

Comfortable shoes require the dimensions of the foot of the shoe by measuring the length, width and height of the leg.[3] For example, Japan has its own standards to determine the size of the shoe by measuring leg length, girth, and width of the foot joint.[5] However, Indonesia still have not yet had a foot anthropometric data to be used as reference in the development of footwear products. Moreover, the proper fit of shoes is important for diabetes patient to prevent complication.[6]

In its role in product development, each region should have the anthropometric data based on its population because the anthropometric data of each area is different. Therefore, anthropometric data for a population is very important in designing the shoes to prevent incompatibility with the user.[7] In addition, different anthropometric dimension of each population is influenced by age, race, region, and work that should be a reference in the provision of anthropometric data.[8]

Methods:

This study was conducted using observational descriptive method. Data were collected in November 2014 in three senior high schools in Bandung. Anthropometric data collection performed in this study was approved by the Health Research Ethic Committee, Faculty of Medicine, Universitas Padjadjaran. Samples were male senior high school students spread over three regions that had been randomly selected from six regions of development in the city of Bandung. The number of samples that must be met was 81 people. It was obtained by quantitative descriptive study formula with a precision value was 0.3 cm. Samples included in the study are students who met the inclusion criteria, aged 16–18 years and do not have a foot deformity.

Anthropometric measurements performed in a separate place from the classroom and several students gathered in that place. After fill the consent form, the students are instructed to sit with legs parallel to the floor then conducted anthropometric measurements foot and ankle. The measurement method used in this study was similar with previous studies.[3, 9]

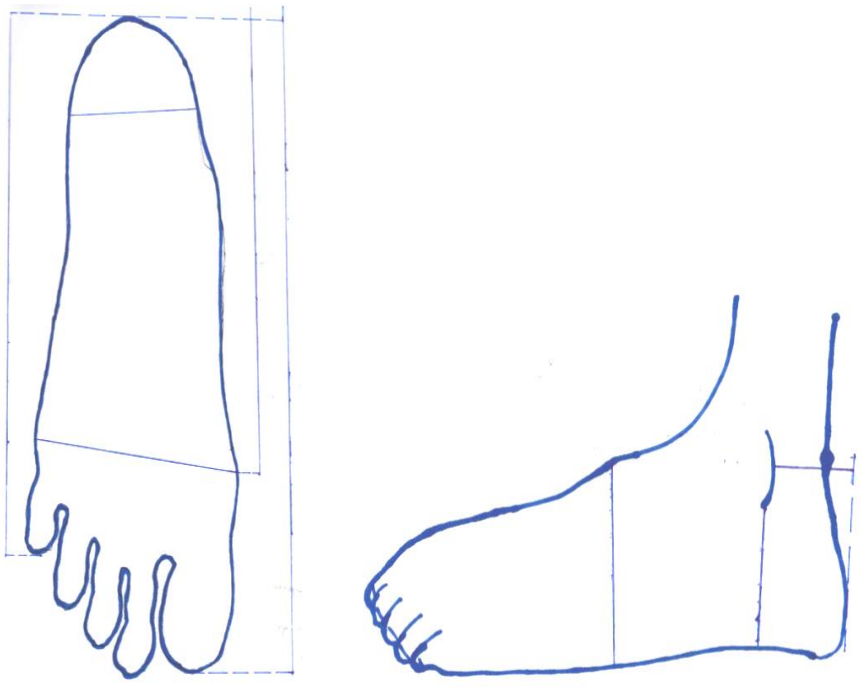

Figure 1: Eight dimensions of foot and ankle

Eight dimensions of foot and ankle were measured consists of Foot Length, Ball of Foot Length, Outside Ball of Foot Length, Foot Breadth Diagonal, Heel Breadth, Navicular Height, Instep Heightand and Heel to Lateral Malleolus. Those were processed with statistical software to find mean, standard deviation, minimum and maximum values, the 5^{th} percentile, 50^{th} and 95^{th}.

Results:

The age distribution of the sample includes subject from 16–18 years old male students (Table 1).

Table 1: Age Distribution of Subjects (n = 81)

Age group (years)	Percentage	Total
16	13.6	11
17	72.8	59
18	13.6	11
Total	100	81

Table 2: Foot Length Distribution by Age

Age	Foot length group (cm)							Total
	23–24	24–25	25–26	26–27	27–28	28–29	29–30	
16	1	1	0	4	3	1	1	11
17	9	14	17	6	11	2	0	59
18	0	2	5	4	0	0	0	11
Total	10	17	22	14	14	3	1	81

In this study, there was a 16–years–old student included the longest foot lengths group (Table 2). While based on the region, one male student in B senior high school were included to the longest foot lengths group (Table 3).

Table 3: Foot Length Distribution by School

Senior High School	Foot length group (cm)							Total
	23–24	24–25	25–26	26–27	27–28	28–29	29–30	
A	1	4	7	7	2	2	0	11
B	3	4	7	2	10	1	1	59
C	6	9	8	5	2	0	0	11
Total	10	17	22	14	14	3	1	81

Anthropometric dimensions of the foot and ankle were presented (Table 4 and Table 5).

Table 4: Mean (M), Standard Deviation (SD), Minimum (Min) and Maximum (Max) for Anthropometric Dimensions of the Foot and Ankle (n = 81), values in cm

Foot Dimensions	M	SD	Min	Max
Foot Length	25.75	1.42	23.1	29.3
Ball of Foot Length	18.82	1.14	17	22.7
Outside Ball of Foot Length	21.57	1.13	19	23.7
Foot Breadth Diagonal	9.70	0.58	8.4	10.9
Heel Breadth	5.43	0.55	4.5	8.1
Navicular Height	6.00	0.58	4.8	7.7
Instep Height	6.62	0.51	5.4	8.5
Heel to Lateral Malleolus	5.06	0.65	3.5	6.7

Table 5: Percentile for Anthropometric Dimensions of the Foot and Ankle (n = 81), values in cm

Foot Dimensions	5^{th} percentile	50^{th} percentile	95^{th} percentile
Foot Length	23.60	25.70	28.25
Ball of Foot Length	17.20	18.80	20.40
Outside Ball of Foot Length	19.42	21.70	23.29
Foot Breadth Diagonal	8.70	9.60	10.50
Heel Breadth	4.61	5.40	6.29
Navicular Height	5.21	5.90	7.18
Instep Height	5.81	6.60	7.78
Heel to Lateral Malleolus	4.21	5.00	6.30

Discussion:

Based on anthropometric measurements of foot and ankle in 81 senior high school students included in inclusion criteria selected from several development areas in the city, the results are displayed in the resultss.

There is a 16–years–old student who has a longest foot length (Table 2). And also, There is one student in SMAN B are belonging to the longest foot lengths group (Table 3). It could be due to differences in physical activity or nutritional factors such as the anthropometric studies done in India which is shows that anthropometric differences could be due to different regional.[10]

The foot length has an average value±SD 25.75±1.42 with minimum and maximum values 23.1 and 29.3 (Table 4). In a study of 160 male students in Iran with the age from 18–25 years, mean±SD values for the foot length are 26.5±1.31 with a maximum value 30.5 and a minimum value of 23.1.[3] There is difference in the value of foot length between Iran and Indonesia, 26.5 and 25.75. This difference occurs due to the number of subjects with different ages and different methods in which research conducted Kanaani besides using a ruler also coupled with a digital camera.

For mean±SD values of the width of the foot is 9.70±0.58 and minimum and maximum values of 8.4 and 10.9 (Table 4). In a study of 26 men with an age from 19–24 years in Hong Kong, the foot width value for mean±SD is 9.67±0.55 and minimum and maximum values is 8.7 and 10.6.[11] The value obtained by the study was not too much different, 9.70 to 9.67.

Anthropometric values are useful in many ways, such as product development fitting shoes. But,

basically these anthropometric measurements was

limited to foot measuring that the development of products that fit the shoes must also consider several factors, such as the design of the shoe. The results of this study hopefully encourage other researchers to conduct this kind of research because Indonesia does not have a national standardization. Daily activities, age, and gender also needs to be considered in next studies because of those factor influence variation in the dimensions of the foot based on research that has been done in other countries.

Limitation in this study is the use of simple instrument, a ruler. Another instrument that can be used in the measurement of foot can be a digital caliper, digital gauges and first metatarsophalangeal joint indicators.[12] For next study, it is recommended to pay attention to several factors, such as age, gender, and physical activity.

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