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Correlation of Stature with Footprint of Bangladeshi Male Medical Students

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Abstract

Context: *Foot dimension has great use in anatomy, physiology, ergonomics, forensic science, plastic surgery, radiology, podiatry, archaeology, anthropology, nutrition science and diagnostic knowledge between patient and normal population. The data of foot dimensions of Bangladeshi male is essential for the anatomist for normative reference. Stature can be correlated with foot dimensions using different foot segments from footprints. This cross sectional analytic study was planned to determine the different dimensions of the footprint of the Bangladeshi males and to find out the correlation of stature with foot dimensions from footprint of male Bangladeshi medical students.*

Materials & Methods: *Two hundred (200) male medical college students of 18-25 years of age were selected from different medical colleges of Dhaka city and their age was determined by their national ID cards. Stature was measured using a stadiometer. Both feet of the same individual were painted with ink with the help of the brush. After ensuring that toes and sole were inked properly, footprints were taken at the same time for both feet while the ink was still wet. Length of the different toes(t) were then measured in centimetre from the footprints using a Vernier digital caliper.*

Results: *In the present study, significant differences were observed between T1, T2, T3, T4 and T5 lengths of right and left foot (P<0.001). Each of the T1, T2, T3, T4 and T5 lengths of the left foot were greater than the right foot. There was a strong correlation between the stature and foot length among Bangladeshi males (P<0.001).*

Conclusion: *All the foot lengths of left footprint were significantly higher than the right footprint among Bangladeshi male medical students. Further studies with larger sample size are recommended to get more precise picture in order to produce a more comprehensive data that will help to determine the correlation of stature with dimensions of footprint of Bangladeshi medical students.*

Key Words: *Stature, foot length*

Introduction:

Every part of human body is unique in itself as every part of the body is different in its own way from a similar part in another body. There is also a relationship between each part of the body and the whole body. Footprint is the impression of the sole of the foot on an even flat ground or surface which provides the size dimensions of the plantar surface of the foot actually touching the floor or a hard surface.

Footprints are of immense value in establishing personal identity of the criminals in forensic examinations. The partial or complete footprints can be found on rain covered areas, newly waxed floors, freshly cemented surfaces, moistened surfaces, in dust, mud, sand, oil, paint and can be left in blood at the crime scenes[1]. The foot dimensions derived from footprint can provide definitive information on many physical characteristics of the individual as morphology of human foot shows variations due to the combined effects of heredity, lifestyle and climatic factors[2].

Assessing the height of an individual from measurements of different dimensions of the foot has always been of immense interest to

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anatomists, anthropologists, podiatrists and industrialists involved in designing foot wears. It has been shown that the reliability of prediction of stature from foot dimensions is as high as that from long bones. Foot or shoe prints, if present at the scene of crime, may provide clue regarding the stature of the person which may help in establishing partial identity of the suspect. Moreover, in an aircraft accident it is the feet, which are recovered more intact than other parts of the body, as they are often shoe clad[3]. As ossification of the bones of the foot occurs earlier than the long bones of the lower extremity, therefore even during adolescence, stature can be predicted more accurately from foot measurements than that from the long bones of the lower limb[4]. This would enable forensic scientists to solve crimes in the absence of complete evidence[5]and the anthropologist and archeologist to analyze events that occurred in remote past. Reliable anthropometric data for a target population are necessary when designing foot wears for that population, otherwise the product may not be suitable for the user[6].

The stature estimated from skeleton by anatomical method was introduced by Dwight in 1894.The vertical height of a person needs an equally firm base to support it, which is provided by feet [7,8,9]. This provides information that increase in height is associated with an increase in foot dimensions Estimation of stature from toe lengths in a footprint are of utmost importance as they are strongly correlated with stature and thus gives a better prediction of stature than correlated with other measurements[10]. The foot has been used to estimate stature in several studies in different tribal groups, where normograms have been derived to reconstruct stature from foot dimensions.These types of studies in different communities become essential, as several factors which include genetic and environmental, are known to affect stature and foot morphology as well as dimensions[11].

The present study includes foot length from each toe of footprint rather than taking length and breadth only as have been done in most of the previous studies. So, the study will be applicable not only to complete footprint measurement but also to partial footprint in estimation of stature. With the above perspective, the present study was carried out to give the overview of foot dimensions of Bangladeshi males and to correlate the foot anthropometric data with stature of the same age group of Bangladeshi males.

Materials and Methods:

This cross sectional analytic study was carried out in the Department of Anatomy of Dhaka Medical College, Dhaka from July 2012 to June 2013. The study was performed on 200 male Bangladeshi medical students of age ranging from 18-25 years. individuals with congenital anomaly of feet, any deformity of feet from any disease, endocrine diseases like acromegaly, gigantism, those who have encountered any road traffic accident or burn injury affecting feet and tribal population were excluded from the study.

Stature was measured in centimetre according to standard procedures using a stadiometer. The feet of the individual were then washed with liquid soap before inking. Feet were washed to remove oily or greasy substance and dirt from the foot. The feet were then wiped with a towel. Two legal size white papers were fixed on a clip board with double clips to take print of right and left foot which was placed on an even floor as footprints of both feet were collected at the same time. A small amount of ink was poured into a clean and dry flat box with a wide base. The individual was asked to sit on a chair and rest his legs on a low stool with extended knee so that his feet were placed beyond the stool for proper painting of the soles. A wide paint brush was moved in the ink over flat surface of the wide based box until the ink spread thinly and homogenously in the brush.

The right and left foot were painted with ink with the help of the brush. After ensuring that toes and sole were inked properly, footprints were taken at the same time for both foot while the ink was still

wet. The feet were carefully removed from the stool and the soles were placed slowly on the paper from proximal to distal endwhile the individual still remained seated. The individual was then asked to stand from sitting position with his feet placed on the papers on the clipboard without moving the feet. After ensuring that the feet were placed properly the individual was asked to stand erect withoutany support while putting equal pressure on both foot without moving their position on the papers. The individual was then asked to sit. The feet were then lifted from the paper at the same time so that there was no overlapping of the already imprinted footprint.A sharp 2B lead pencil was used to mark the mid-rear heel point or pternion (pte. fp) and the most distal point of each toes. Straight lines were drawn from ptrenion to distal points of each toe marked earlier.

Pternion is the most posteriorly projecting point on the heel when the subject stands erect. These measurements were taken from pternion (pte.fp) to the most anterior part of each toe, i.e. d1.t, d2.t, d3.t, d4.t and d5.t for 1st to 5th toes respectively and thus T1,T2,T3,T4,T5 lengths were measured for each toes. The vernier digital spreading caliper was placed horizontally on the landmarks and all the measurements were taken in centimeter (Fig.1).

For statistical analysis, SPSS version 16 was used. The relationship between the right and left footprint measurements were determined by paired t- test (Table 1). Stature was correlated with the footprint by Pearson's correlation coefficient test (Table 2).

Ethical Clearance:

The study was approved by Ethical Review Committee of Dhaka Medical College, Dhaka

Results:

Table-I

T1, T2, T3, T4 and T5 length of right and left footprints of Bangladeshi male medical students

Length (cm)	Right foot (n=200) Mean±SD	Left foot (n=200) Mean±SD	*P value*
T1 (d1.t pte.fp)	23.90±1.21	24.00±1.28	0.004**
(20.72 27.08)	(20.72 27.58)		
T2 (d2.t pte.fp)	23.68±1.29	23.82±1.31	0.0001***
(20.22 27.08)	(20.57 27.94)		
T3 (d3.t pte.fp)	22.83±1.26	22.98±1.25	0.0001***
(19.43 26.43)	(19.89 27.09)		
T4 (d4.t pte.fp)	21.69±1.23	21.81±1.24	0.0001***
(18.28 25.28)	(18.59 25.80)		
T5 (d5.t pte.fp)	20.09±1.12	20.21±1.14	0.0001***
(16.93 23.47)	(17.31 23.91)		

Figures in parentheses indicate range. Comparison between right and left foot done by paired Student's 't' test, ** = significant at P<0.01, *** = significant at P<0.001

T means distance from pternion (mid rear heel point) to the most anterior point of the toes; T1, T2, T3, T4 and T5 means distance from pternion to the most anterior point of respective toes

Table-II

Relationship between stature and T1, T2, T3, T4 and T5 length of right and left footprint of Bangladeshi male medical students

Foot length (cm)	Right foot (n=200)		Left foot (n=200)	
	r value	P value	r value	P value
T1 (d1.t pte.fp)	+0.702	0.0001***	+0.705	0.0001***
T2 (d2.t pte.fp)	+0.721	0.0001***	+0.720	0.0001***
T3 (d3.t pte.fp)	+0.714	0.0001***	+0.728	0.0001***
T4 (d4.t pte.fp)	+0.678	0.0001***	+0.691	0.0001***
T5 (d5.t pte.fp)	+0.699	0.0001***	+0.698	0.0001***

Pearson's correlation coefficient (r) test was performed to compare relationship between parameters, *** = significant at P<0.001

T means distance from pternion (mid rear heel point) to the most anterior point of the toes; T1, T2, T3, T4 and T5 means distance from pternion to the most anterior point of respective toes

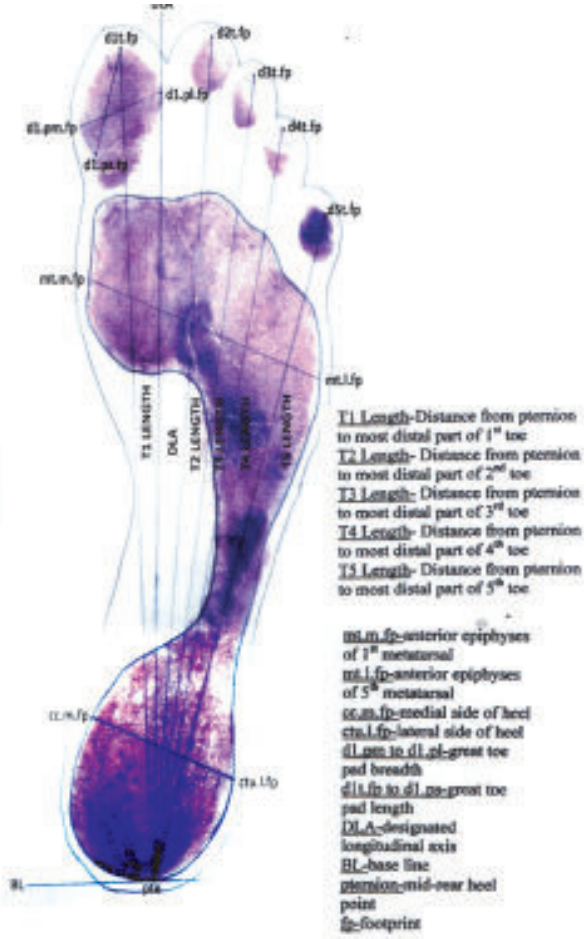

Fig 1: *Showing footprint landmarks and measurements*

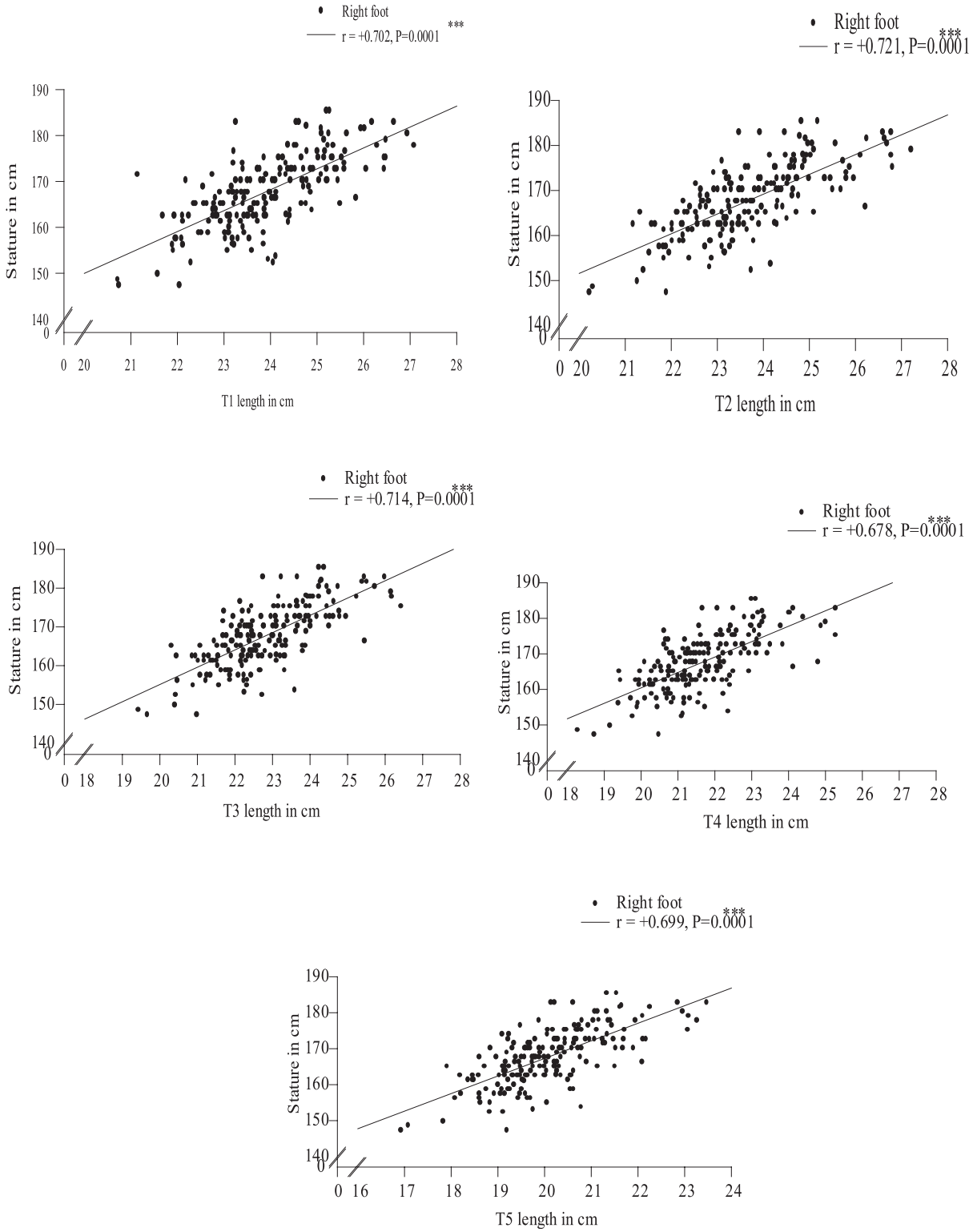

Fig 2 : *Relationship between stature and T1,T2,T3,T4,T5 length of right footprint of Bangladeshi male medical students*

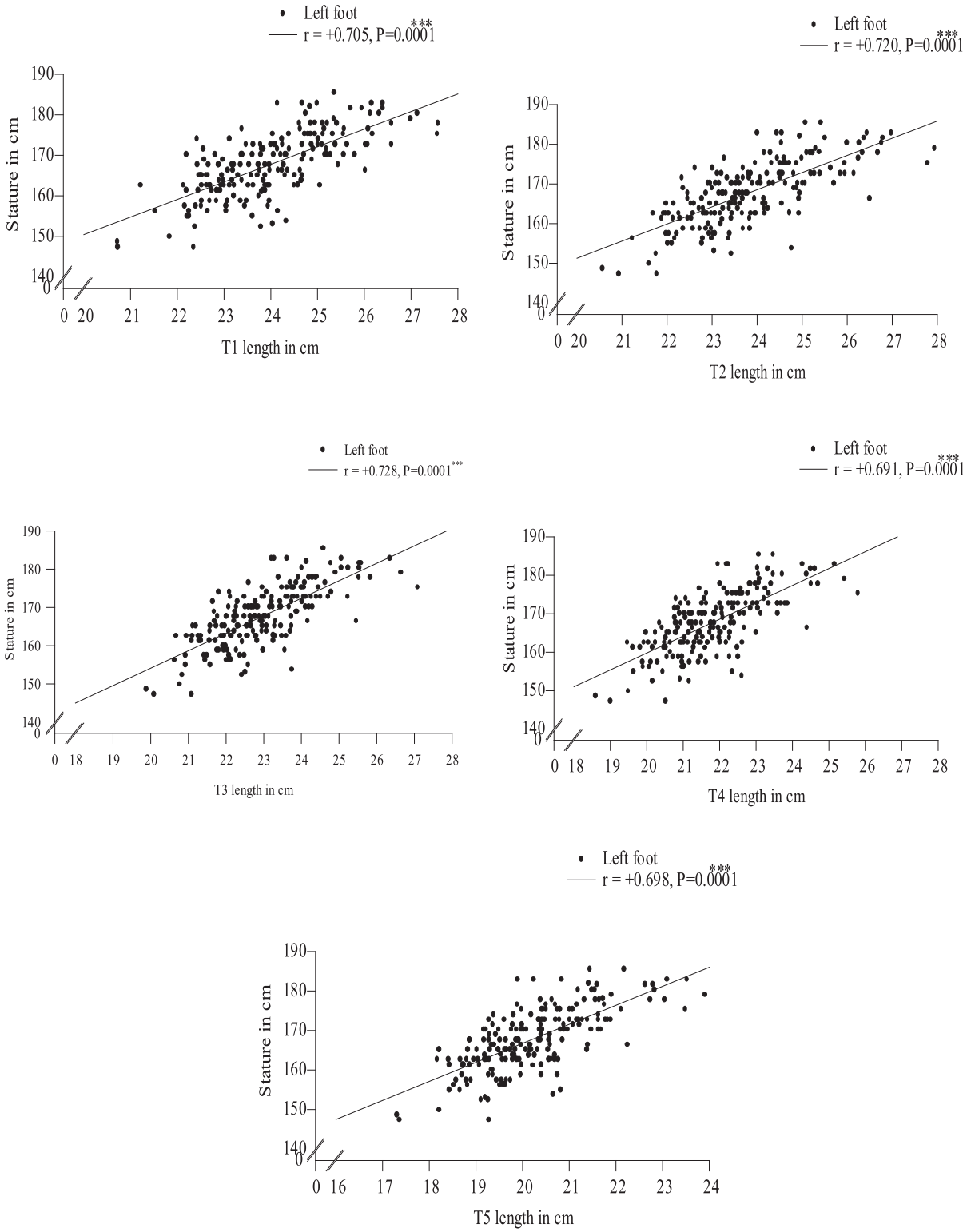

Fig.-3 : *Relationship between stature and T1,T2,T3,T4,T5 length of left footprint of Bangladeshi male medical students*

Discussion:

The present work was undertaken to study foot length from footprint of 200(two hundred) medical college students of Dhaka city and describes a statistically based analysis that illustrates the usefulness of the footprint as an indicator of correlation of stature of an individual.

In the present study, significant differences were observed between T1, T2, T3, T4 and T5 lengths of right and left foot (P<0.001). Each of the T1, T2, T3, T4 and T5 lengths of the left foot were greater than the right foot. Kewal Krishan[2] reported greater T1, T2, T3, T4 and T5 lengths of the left foot than the respective lengths of the right foot. T1, T2, T3 and T4 length of the right foot except T5 length reported by Kewal Krishan[2] showed highly significant difference with the present study (P < 0.001). T5 length of the right foot was not significant with the present study (P>0.05). In the left foot T2, T3, T5 length were significantly higher than the present study (P<0.001) except T1, T4 length which again showed no significant difference with the present study (P>0.05). The reason of dissimilarities might be due to racial variation as the researcher mentioned used sample from tribal population. Reason of dissimilarity is also supported by Rao and Kotian, cited by Kewal Krishan[2] as they suggested that the difference between left and right footprints in the same individual is not a coincidence but may be explained on the basis of the “dominant foot”. Most of the individuals have dominant foot, usually the left one, which always support the body to a greater extent while in standing or in walking. The shoe of this foot wears off at a faster rate than the shoe on the other foot. The bones in the dominant foot are regularly subjected to stronger stress forces like weight bearing pressures, than the bones of the other foot. This in turn enlarges the bones of the dominant foot and therefore produces a footprint of larger dimension.

Study by Robbins[1] showed each of the T1, T2, T3, T4 and T5 lengths of left foot was greater than the right foot. All T1, T2, T3, T4, T5 lengths of the both feet in her study were significantly lower than the findings of the present study (P<0.001).

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