

Anthropological Study of the Foot and It's Relationship between Different Parameters and Stature in an Adult Population of Different Areas of Gujarat.

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Abstracts: Background And Objectives: The study has been done to find out correlation between different parameters of foot. The aim and objective are to develop a model to reconstruct a stature from foot breadth. The study is carried out in 285 asymptomatic healthy adults 149 Males and 136 Females between 18-23 years of age, belongs to different region of Gujarat. Materials And Methods: Foot breadth and foot length were measured with sliding calliper and stature was measured by a standard anthropometer rod in erect anatomical position. Observation And Results: Obtained data was statistically analysed, and a significant correlation of stature was observed with foot breadth and foot length with foot breadth on both Rt. And Lt. side in males and females. Linear regression equations were derived to calculate foot length and stature from foot breadth. Interpretation And Conclusion: A highly significant correlation coefficient (p-value 0.0000) has been found between different parameters of foot on both Rt. and Lt. side in males and females. So stature can be more accurately calculated by foot breadth than long bones. The findings are useful to anatomists, criminologists, human biologist and forensic medicine experts. [Patel S. M. et al. NJIRM 2011; 2(3) : 67-70]

Key Words: Anthropometry, Correlation, Foot breadth, Foot length, stature.

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Introduction: Anthropometry is a series of systematized measuring techniques that express quantitatively the dimension of the human body and skeleton. It is highly objective and reliable in the hands of trained anthropometrics. Anthropometry, the typical and the traditional tool of physical anthropology, provide the scientific methods and techniques for estimating the various measurements and the observations on the living as well as skeleton of man.

It is a fact especially familiar to Anatomists those trunks and limbs exhibit consistent ratios among themselves. This relationship is very useful anthropologically to find racial differences and medico legally, when only parts of the deceased body are available. In many circumstances as a medico legal expert, the stature of a deceased individual has to be calculated by using the regression equation from the available skeleton material in the form of incomplete skeleton or isolated long bones or from reconstructed lengths of long bone from its available fragments for establishing the individual identity of the deceased. Many workers have measured different parameters in cadavers but certain

factors like chronic diseases give faulty results. So the present study is done on living adult persons. As the foot gets ossified earlier than other long bones, here the attempt has been made to find out the correlation between various parameters of foot.

Material and Methods: Measurements of the foot breadth, foot length, and stature of total 285 adults of different areas of Gujarat were taken. Out of them 149 males and 136 females. There ages ranged between 18 to 23 years. Foot breadth and foot length were measured in centimetre with a sliding calliper (Hrdlicka type)¹. The length of the foot was measured as direct distance from the most prominent of the back of the heel to the tip of the hallux, or to the tip of the second toe, when the second toe was larger than the hallux. The breadth of the foot was measured as the direct distance between the medial metatarsal point. (most prominent part of the head of the 1st metatarsal bone) and the lateral metatarsal point (the most prominent point of the head of the 5th metatarsal bone). The stature was measured in centimetre with a standard anthropometer rod in

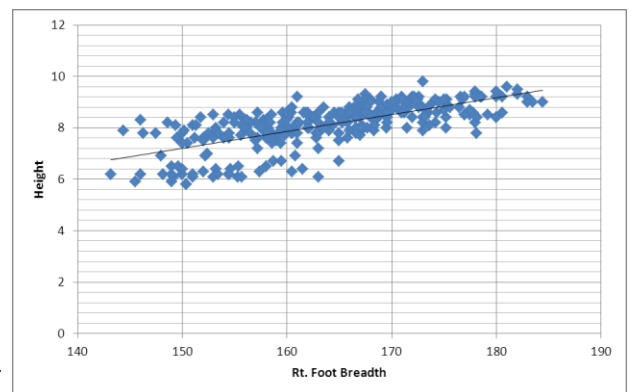
the erect vertical position with the subject standing barefooted.

Result: All the data was statistically analysed and results were calculated in Table:1.

Table:1 Study variables (Rt. & Lt. Foot Breadth and Rt. & Lt. Foot Length) in different age groups

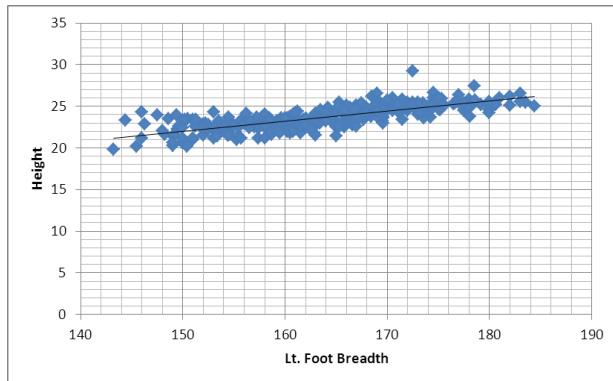
Variables	Age	No. Of Samples	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		F-value	p-value
						Lower Bound	Upper Bound		
RT.FOOT LENGTH	18	53	22.981	1.0554	0.1450	22.690	23.272	12.494	0.000
	19	73	23.310	1.5384	0.1801	22.951	23.669		
	20	16	23.469	2.1614	0.5403	22.317	24.620		
	21	36	23.203	1.2612	0.2102	22.776	23.629		
	22	19	23.568	0.8314	0.1907	23.168	23.969		
	23	88	24.493	1.0226	0.1090	24.277	24.710		
	Total	285	23.627	1.4041	0.0832	23.463	23.790		
RT.FOOT BREADTH	18	53	7.84	0.728	0.100	7.64	8.04	10.845	0.000
	19	73	7.96	0.998	0.117	7.73	8.19		
	20	16	8.02	1.355	0.339	7.30	8.74		
	21	36	7.74	0.800	0.133	7.47	8.01		
	22	19	8.06	0.379	0.087	7.88	8.24		
	23	88	8.63	0.520	0.055	8.52	8.74		
	Total	285	8.13	0.859	0.051	8.03	8.23		
LT.FOOT LENGTH	18	53	23.028	0.9828	0.1350	22.757	23.299	11.668	0.000
	19	73	23.393	1.6490	0.1930	23.008	23.778		
	20	16	23.675	2.3202	0.5801	22.439	24.911		
	21	36	23.267	1.2631	0.2105	22.839	23.694		
	22	19	23.500	0.7902	0.1813	23.119	23.881		
	23	88	24.547	1.0217	0.1089	24.330	24.763		
LT.FOOT BREADTH	18	53	7.855	0.7355	0.1010	7.652	8.057	10.076	0.000
	19	73	7.992	1.0113	0.1184	7.756	8.228		
	20	16	8.069	1.3812	0.3453	7.333	8.805		
	21	36	7.833	0.8622	0.1437	7.542	8.125		
	22	19	8.116	0.3731	0.0856	7.936	8.296		
	23	88	8.659	0.5192	0.0553	8.549	8.769		

Correlation coefficient between Height and Rt. foot breadth, between Height and Lt. foot breadth, between Rt. Foot length and Rt. Foot breadth and between Lt. foot length and Lt. foot breadth in combined males and females respondents, for males respondents and for female respondents separately has been calculated. The results are highly significant (p-value 0.000).

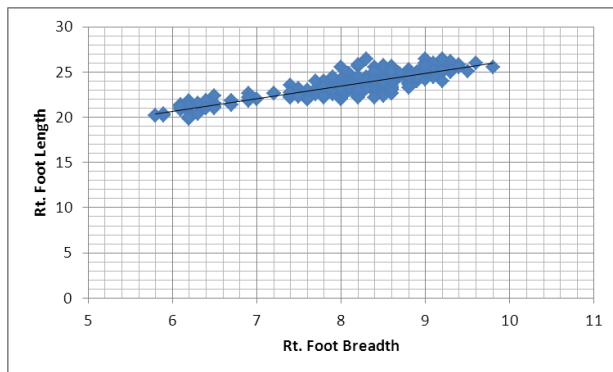


Graph- 1: Regression lines showing relation of Rt. Foot breadth with height

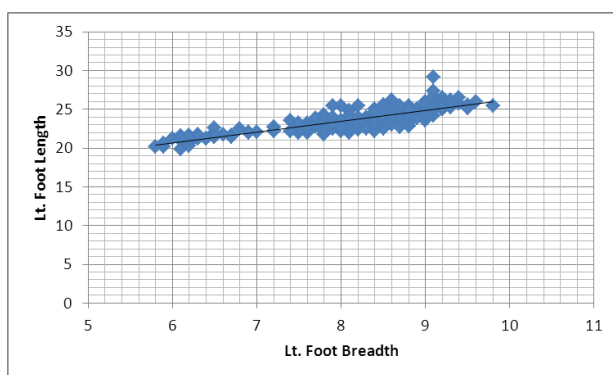
Graph-2: Regression lines showing relation of Lt. Foot breadth with height



Graph-3: Regression lines showing relation of Rt. Foot breadth with Rt. Foot length



Graph-4: Regression lines showing relation of Lt. Foot breadth with Lt. Foot length



Discussion: The measurements of different parameters of various long bones have been done by many workers and their use in measurement of stature has been attempted. However foot dimensions have not frequently been used for this. Difficulty to obtain accurate measurements of long bones has been pointed out by several workers. Nat² showed that accurate measurements of

length of Femur were not possible because of variable position of angle of neck with shaft of Femur. Prolonged exposure of cadavers to the environment often results in resorption of bone ends and thus viciating the accuracy of their measurements. A significant inter-observer error in long bone measurements has been shown by Trotter and Gleser^{3,4}. The difficulties of availability of adequate quantity of bones, in the choice of bones, their measurements and need of trained personnel lead Rutishauser⁵ to consider various parameters of foot to be more reliable to reconstruct height. Ossification and maturation in foot occurs earlier than long bones and therefore, during adolescent age, height could be more accurately predicted from foot measurements as compared to that from long bones.

Musgrave and Herneja⁶, worked on metacarpals among British adults and found significant degree of association with stature in both sexes (Male: $r=0.58$ to 0.67 and Female: $r=0.49$ to 0.71). Jit and Singh⁷, observed significant correlation between clavicle and height. However estimation of stature from cadaver clavicle was poor (36 percent). Regarding measurements of various parameters of foot, no much data is available except V.M.Charnalia⁸, who studied foot and find out correlation between different parameters in different castes and tribes of Pondicherry state.

In the present study significant correlation of height with foot breadth on Rt. side, in males 0.641 and females 0.552 and on Lt. Side in males 0.630 and in females 0.555 has been observed. Even good significant correlation of foot length with foot breadth on Rt. side, in males 0.794 and in females 0.857 and on Lt. Side in males 0.769 and in females 0.852 has been found. These findings are consistent with Rutishauser's observations in children. The linear regression lines has been plotted in graph (I-IV) showing relation between Rt. & Lt. foot breadth and height, Rt. & Lt. foot breadth and foot length. The Monograms have been successfully formed to determine the foot length and stature from foot breadth in young adults from different regions of Gujarat.

Conclusion: The correlation coefficient between height and foot breadth on both Rt. And Lt. side in

males and females is very significant (p value 0.000). The correlation coefficient between foot length and foot breadth on both Rt. and Lt. side in males and females is highly significant (p value 0.000). It means there is strong bond between foot length and foot breadth as well as stature and foot breadth. So stature could be more accurately predicted from foot breadth as compared to that from long bones. This information will be highly important for Anatomists, Criminologist, Forensic scientists, human biologist and physical anthropologist in four ways:

1. Medico legal purpose, when only foot of the deceased body is available.
2. It is useful in identifying war casualties
3. Studies, such as respiratory efficiency test and others in kyphoscoliotic subjects where uncoiled heights make the proper evaluation possible.
4. It also helpful for criminologist to trace out criminals from the chance foot prints.

In addition to this it can also be used in deriving anthropological indices.

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