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Correlation between the Forearm Plus Little Finger Length and the Actual Femoral Length

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ABSTRACT

Background: Analyzing the relationship among forearm along with little finger length plus femoral length may reveal hidden connections in skeletal proportions, shedding light on human anatomy and biomechanics. **Objective:** To check the association among the combined measurements of the forearm and little finger and the actual measurement of the femur. **Study Design:** Cross sectional study. **Settings:** Department of Orthopedic Sheikh Khalifa Bin Zaid/CMH, Muzaffarabad AJK August 2021 to January 2022. **Methods:** Patients aged 18 to 65 years with absence of musculoskeletal abnormalities or previous surgeries affecting limb length was recruited for this study. Anthropometric measurements were obtained using standardized techniques. Measurements were taken by trained personnel using calibrated instruments to ensure accuracy and consistency. We used the Pearson correlation coefficient for data analysis Collected data was analyzed in SPSS version 22. **Results:** The study comprised 55 individuals, with 47 being males (85.5%) and 8 being females (14.5%). The mean age of the individuals who participated was 40.4 ± 9.06 years. The mean length of the forearm and little finger combined was 40.66 cm, with a standard variation of 1.70. The observed lengths ranged from 38 cm to 44 cm. The mean femoral length was 40.85 cm, with a standard variation of 2.23 cm. The range of femoral lengths observed ranged from 38 cm to 45 cm. An important and strong positive relationship was revealed (correlation coefficient $r = 0.899$, $p < 0.001$). **Conclusion:** Our study establishes a significant positive correlation of forearm and little finger length in relation to femoral length, highlighting the interplay between upper and lower limb dimensions.

Keywords: *Anthropometry, Correlation analysis, Femoral length, Forearm length, Little finger length, Musculoskeletal.*

INTRODUCTION

The Forearm, which contains the bones of radius and ulna, as well as the carpal and metacarpal bones, plays a significant role as the component that connects the hand to the rest of the upper extremity.[1,2] At the other end of the body, the femur, the longest bone in the human skeletal system, forms the longitudinal structural member of the lower extremity, providing support for the body weight and facilitating movement in bipedalism.[3] The femur's head of the hip joint plays a critical role in the motion, stability, and the biomechanics of the body. Both its size and shape are regulated by genetic factors, mechanical forces acting on the bone, developmental processes, and it is an interesting and complex structure to examine in the context of human skeletal morphology.[4,5]

In the case of humans, an understanding of the relationship between upper limb and lower limb proportions could help work out how our ancestors evolved and what adaptations allowed them to become bipedal.[6] The analysis of the correlation between different dimensions of the skeleton, for example, the combined length of the forearm and the little finger and the femur, may help to improve the understanding of the musculoskeletal system as well as health and disease in this area.[7,8]

This research will help to expand the knowledge in human anatomy, biomechanics, and evolution of adaptations through determining the skeleton proportions.

METHODS

This cross-sectional study was approved by the Institutional Review Board (ERC/DME/1090). This study was done in Department of Orthopedic Sheikh Khalifa Bin Zaid/CMH, Muzaffarabad AJK during the period of August 2021 to January 2022. The 55 patients in the age range of 26 to 55 years with no history of musculoskeletal abnormalities or any prior surgery that might have an influence on the limb length, and a written informed consent was taken prior to data collection.

The anthropometric measurements of the forearm and little finger length in relation to the femoral length were done using standardized methods. The length of the forearm was measured from the olecranon to the distal end of the middle finger and the index finger length from the proximal transverse crease of the palm to the tip of the little finger. From the superior larger trochanter to the posterior femoral condyles, femoral length was measured. Measurements were taken by trained personnel using calibrated instruments to ensure accuracy and consistency. Additionally, demographic information such as age and sex was recorded for each participant. SPSS version 25 was employed for statistical analyses in this study. Correlation (r) was checked using Pearson's correlation coefficient, based on the data distribution. Possible variations based on demographic characteristics were also checked by subgroup analyses.

RESULTS

The study included 55 individuals, with 47 being males (85.5%) and 8 being females (14.5%). Nineteen people (or 34.5% of the total) were in the 26-35 age bracket, sixteen people (or 29.1% of the total) were in the 36-45 age bracket, and twenty people (or 36.4% of the total) were in the 46-55 age bracket. The participants' average age was 40.4 ± 9.06 years, as shown in Table 1.

Table 1: Distribution of age and gender percentages in study participants

Variables	Category	N(%)
Gender	Female	8(14.5%)
	Male	47(85.5%)
Age Groups	26-35	19(34.5%)
	36-45	16(29.1%)
	46-55	20(36.4%)
	Mean ± SD	40.4 ± 9.06

Table 2 demonstrates a strong and statistically significant positive connection (r = 0.899, p < 0.001) between the length of the forearm plus little finger and the length of the femur.

Table 2: Correlation between forearm and little finger length in relation to femoral length

Variables	Mean ± SD	Correlation Coefficient (r)	P value
Forearm + Little finger length (cm)	40.66 ± 1.70	0.899	< 0.001
Femoral Length (cm)	40.85 ± 2.23		

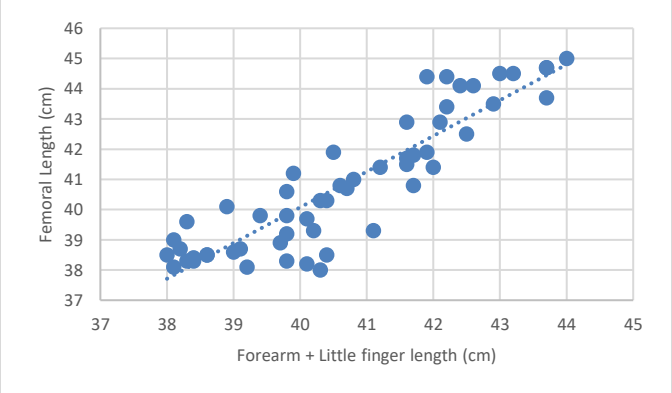
Among males, the correlation coefficient was 0.908 (p < 0.001), while among females, it was 0.796 (p = 0.018). The participants aged 26-35 years had the strongest connection (r = 0.939, p < 0.001) among all age categories given in table 3.

Table 3: Examining the correlation forearm and little finger length (LFL) in relation to femoral length (FL) in cm

Variables	Forearm + (LFL)	Femoral Length	r	p value
Male	40.7 ± 1.73	41.0 ± 2.29	0.908	<0.001
Female	40.1 ± 1.49	39.8 ± 1.57	0.796	0.018
26-35	40.7 ± 2.01	40.9 ± 2.36	0.939	<0.001
36-45	40.9 ± 1.65	41.4 ± 2.32	0.901	<0.001
46-55	40.4 ± 1.47	40.3 ± 2.01	0.854	<0.001

The scatter plot shows a strong positive correlation between forearm plus little finger length and femoral length, indicating that as forearm and little finger length increase, femoral length also increases.

Figure 1: Linear correlation between the forearm and little finger length in relation to femoral length



DISCUSSION

The distance from the superior aspect of the larger trochanter to the proximal end of the condyles which form part of the femoral is the actual femoral length. As

such it has been known to be a vital marker of the lower limb anatomy, Bodyweight support and biomechanical function.[11-14] The present results are in agreement with Naik et al. (2013) who also found the same tendency towards male dominance and similar average age, as well as similar ranges and average values of forearm length, little finger length, and femoral length.[10] In addition, our study and Jan et al. (2017) also demonstrated that male patients accounted for the majority (85. 5% vs. 90%) and the patients' mean age was also comparable (40. 4 years vs. 42. 1 years).[15] Our research confirms findings of Shahzad et al. (2019), where positive effect of forearm and little finger length was observed as correlated with femoral length ($r = 0.899$, $p < 0.001$).[16] Both studies show a favorable relationship as did Saif et al. (2015). According to Saif et al. ($r = 0.970$, $p = 0.01$) and our study ($r = 0.899$, $p < 0.001$), there is a high association between these two skeletal dimensions.[17] Our study corroborates Salahuddin et al.'s (2018) findings, showing a significant correlation ($r = 0.899$, $p < 0.001$) indicating a strong anatomical relationship between upper and lower limb dimensions.[18] Our findings align with those of El-Sayed et al. (2020) and Jouzdani et al. (2020), demonstrating a significant correlation contributing to the understanding of skeletal proportions across diverse populations.[19,20,21]

CONCLUSION

Our study establishes a significant positive correlation of forearm and little finger length in relation to femoral length.

LIMITATIONS

One limitation of the study is the potential for measurement errors in forearm.

SUGGESTIONS / RECOMMENDATIONS

Future studies should involve large-scale research to validate the findings.

CONFLICT OF INTEREST / DISCLOSURE

None.

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REFERENCES

1. Ali Gallant GG, Jimenez ML, Monaghan BA. Anatomy of the Forearm, Wrist, and Hand. Rev Hand Surg. 2021 Jul 20;16(4):1.
2. Gill D, Lyer S, Alexiou C, Fried F, Buder T, et al. Anatomical study of all carpal and adjoining bones of the wrist using 3D CT reconstruction–Finding the ultimate biomechanical theory. Ann Anat. 2022 Jun 1;242:151909.
3. Eschweiler J, Li J, Quack V, Rath B, Baroncini A, Hildebrand F, et al. Anatomy, biomechanics, and loads of the wrist joint. Life. 2022 Jan 27;12(2):188.
4. Weintraub MD, Hansford BG, Stilwill SE, Allen H, Leake RL, Hanrahan CJ, et al. Avulsion injuries of the hand and wrist. Radiographics. 2020 Jan;40(1):163-80.
5. Chandola S, Jain A, Gupta N, Kabra M, Jana M. Hand Radiographs in Skeletal Dysplasia: A Pictorial Review. Indian J Radiol Imaging. 2024 Apr 1;34(2).
6. Orr CM, Atkinson R, Ernewein J, Tocheri MW. Carpal kinematics and morphological correlates of wrist ulnar deviation mobility in nonhuman anthropoid primates. Am J Biol Anthropol. 2024 Mar;183(3):e24728.
7. Tan RE, Lahiri A. Vascular anatomy of the hand in relation to flaps. Hand Clin. 2020 Feb 1;36(1):1-8.
8. da Silveira EE, Ramos HT, Pollon AL, de Assis Neto AC. Anatomical study of the forelimb of capybara (Hydrochoerus hydrochaeris Linnaeus, 1766). Zoomorphology. 2024 Feb 19:1-3.
9. Lepich T, Karaś R, Kania K, Machnik-Broncel J, Barszczewski K, et al. Anatomical and clinical aspects of the posterior interosseous nerve of the forearm. Med Stud. 2024 Jan 1;40(1):61-8.
10. Nazir A, Roy S, Mathur K, Alazzawi S. Estimation of femoral length for intramedullary nail using forearm as reference. J Bone Joint Surg Br. 2009;91(Suppl-1):37.
11. Su Z, Adam A, Nasrudin MF, Ayob M, Punganan G. Skeletal fracture detection with deep learning: A comprehensive review. Diagnostics. 2023 Oct 18;13(20):3245.
12. Nethander M, Movérare-Skrtic S, Kämpe A, Coward E, Reimann E, et al. An atlas of genetic determinants of forearm fracture. Nat Genet. 2023 Nov;55(11):1820-30.
13. Akinmokun OI, Ibeabuchi NM, Akinsulire AT, Nwachukwu FC. Estimation of femoral head size from palpable bony prominences of the femur. West Afr J Med. 2020 Apr 1;37:173-7.
14. Gidna AO, Domínguez-Rodrigo M. A method for reconstructing human femoral length from fragmented shaft specimens. Homo. 2013 Feb 1;64(1):29-41.
15. Jan GU, Mahmood F, Ullah S, et al. Correlation Between the Forearm Plus Little Finger Length and The Actual Femoral Length in Orthopedic Patients Presenting with Femoral Shaft Fractures. Ann PIMS-Shaheed Zulfiqar Ali Bhutto Med Univ. 2017;13(4):345-8.
16. Shahzad A, Khan FA, Ahmed N, Chishti JA, Bashir Z, Tariq Z. Correlation of Femoral Length and Forearm Plus Little Finger Length for Measurement of Intramedullary Nail Length for Femoral Fracture Fixation. http://jsmdc.pk/wp-content/uploads/2020/01/Correlation-of-Femoral-Length-and-Forearm-Plus-Little-Finger-Length-for-Measurement-of-Intramedullary-Nail-Length-for-Femoral-Fracture-Fixation.pdf
17. and Forearm Plus Little Finger Length for Measurement of Intramedullary Nail Length for Femoral Fracture Fixation. J Sharif Med Dent Coll Lahore, Pak. 2019;5(02).
18. Saif-Ur-Rehman FN, IMRAN M. Correlation Between the Forearm Plus Little Finger Length and The Actual Femoral Length. J Fatima Jinnah Med Univ. 2015;9(1).
19. Mohd Salahuddin A, Tarun G, Shobha SA, Rashmi M. Relationship of Anatomical Lengths of Forearm plus Hand to the Length of Femur in Healthy Subjects. J Surg Acad. 2018;8(1):23-7.
20. El-Sayed SM, Elsaed W, Elshaar H. Correlation between Body Height, Percutaneous Foot and Forearm Lengths in Adult Egyptians. Egypt J Anat. 2020 Jun 1;43(1):174-84.
21. 20. Jouzdani AF, Madadi S, Abbas MA, Razavi H, Alizamir T. The comparison stature estimation from forearm, hand length and foot length between Iranian and Pakistani medical students. AIMS Med Sci. 2022;9(4):496-511.