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PREDICTION OF HEIGHT FROM VARIOUS LIMB MEASUREMENTS : A NARRATIVE LITERATURE REVIEW

Aisha Dinda Syafira,[1*] Fitri Agustina Huspa,[2] Kurnia Wahyudi[3]
[1]Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia
[2]Department of Forensic Medicine and Medicolegal, Universitas Padjadjaran, Bandung, Indonesia
[3]Department of Public Health, Universitas Padjadjaran, Bandung, Indonesia

ABSTRACTS

Height has an important role in forensic medicine and clinical context, namely for biological profile identification of missing or unknown individuals and to provide an easier way to assess nutritional status of bedridden patients or elderly. This literature review aims to explore the variations in height prediction formulas based on limb bone length and to identify the advantages and limitations of these prediction techniques. Scientific studies were selected from Google Scholar, Scopus, and PubMed. Boolean operators and filters were applied to limit only relevant studies. The inclusion criteria in this research are research published in journals in the period 2019-2024, in the form of articles and not pre-prints, in Indonesian or English, research conducted on living humans, full research access-text and free. The exclusion criteria in this research are child and elderly research participants, research participants who suffer from certain diseases, and research using supporting examinations or artificial intelligence. These studies were then selected by using PRISMA flow. 30 articles were included in this study from 367 results. Most of the studies show that there is a positive correlation between stature and limb bone length. Therefore, height can be predicted by limb bone length but should consider population variations such as age, gender, ethnicity, nutritional status, and medical conditions.

Keywords: stature, estimation, prediction, limb bone length

ABSTRAK

Tinggi badan memiliki peran penting dalam ilmu forensik dan aspek klinis, yaitu untuk mengidentifikasi profil biologis dari individu yang hilang atau tidak diketahui dan untuk mempermudah dalam menilai status gizi pasien yang terbaring atau lansia. Studi literatur ini bertujuan untuk mengeksplorasi variasi rumus prediksi tinggi badan berdasarkan panjang tulang ekstremitas dan mengidentifikasi keunggulan dan keterbatasan teknik prediksi tersebut. Studi dipilih dari Google Scholar, PubMed, dan Scopus dengan menggunakan operator Boolean dan menerapkan beberapa filter untuk membatasi studi yang relevan. Kriteria inklusi dalam penelitian ini adalah penelitian yang dipublikasikan pada periode 2019-2024, berbentuk artikel dan bukan preprints, dalam bahasa Indonesia atau Inggris, dilakukan pada manusia hidup, penelitian full access-text dan tidak berbayar. Kriteria eksklusi dalam penelitian ini adalah peserta penelitian anak dan lanjut usia, peserta penelitian yang menderita penyakit tertentu, dan penelitian yang menggunakan pemeriksaan penunjang atau kecerdasan buatan. Penelitian-penelitian tersebut kemudian diseleksi dengan menggunakan PRISMA. 30 artikel dimasukkan dalam penelitian ini dari 367 hasil. Sebagian besar penelitian menunjukkan bahwa terdapat korelasi positif antara tinggi badan dan panjang tulang ekstremitas. Oleh karena itu, tinggi badan dapat diprediksi berdasarkan panjang tulang ekstremitas namun harus mempertimbangkan variasi populasi seperti usia, jenis kelamin, etnis, status gizi, dan kondisi medis.

Kata kunci: tinggi badan, estimasi, prediksi, panjang tulang ekstremitas

*****Corresponding author:
Name: Aisha Dinda Syafira
Phone number: 081394079447
Email address: aisha21002@mail.unpad.ac.id

INTRODUCTION

Anthropometry comes from the Latin "anthropos" which means human, and "metron" which means measurement, referring to measuring the dimensions of the human body and often focusing on height as one of the important aspects.[1,2] Height is a biological characteristic usually used in forensic anthropology, both to help build a profile of an unknown individual and to support a suspected identification. [3] In a place with lots of natural and man-made disaster, forensic identification considers as important as it is used to find the victim's identity through the remaining body parts. [4] Height has an important role in determining a person's body stature as well as providing information for forensic comparisons in finding missing people. [2] In addition, height is also used in a clinical context to assess the nutritional status of patients with limited mobility, which is often difficult to measure directly.[5]

The two main methods for estimating height are the anatomical method and the mathematical method. The anatomical method involves direct measurements from the top of the head to the soles of the feet, while the mathematical method uses measurements of the length of one bone or body part using a regression formula. The anatomical method is considered accurate because it considers possible differences in body proportions, while the mathematical method is more efficient and allows for estimating body height from an incomplete skeleton, although it is

based on population averages grouped by race, sex, and age and does not consider the presence of differences in proportions between individuals.[6–8]

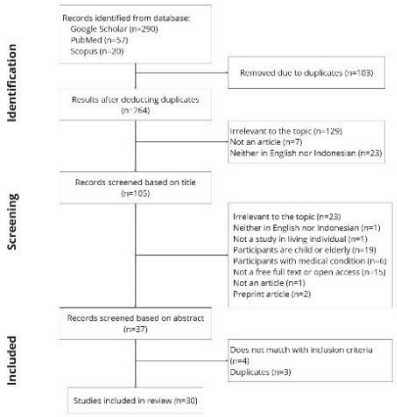
Over the past few years, there has been much research on estimating body height using bone length, due to the great benefits of this method. Many formulas for height estimation have been developed and tested with results showing variations in the level of accuracy caused by factors such as ethnicity, age, and gender. Therefore, it is important to understand the various existing methods and models to improve the accuracy and relevance of height estimation based on bone length. This literature review aims to explore the variations in height prediction formulas based on limb bone length and to identify the advantages and limitations of these prediction techniques.

METHODS

The design used in this research is a narrative literature review that aims to analyze and interpret the relationship between extremity bones and body height by reviewing existing literature sources. To ensure comprehensive coverage, several databases were selected as sources for literature searches, namely Google Scholar, PubMed, and Scopus. Keywords are also used in literature searches using Boolean operators and are chosen based on terms related to the research topic. There are five keywords used, namely "Height estimation models" AND "bone length", "Stature estimation" OR "height prediction" AND "extremity bones", "Height estimation" AND "limb bone length", "Height prediction" AND " ulna length", and "Height estimation" AND "ulna length".

To limit search results and ensure relevance, filters are applied to each database. In general, each database applies a publication year filter, namely in the 2019-2024 period. Specifically, each database has different filter availability, so some databases, such as PubMed and Scopus, have additional filters. In the PubMed database, additional filters were applied, namely, available in free full-text, in English or Indonesian, research conducted on the human species, and research participants aged 19-44 years. As for the Scopus database, additional filters used are field coverage limited to the medicine category, document types limited to articles, final publication stage, English language articles, and open access articles. In addition, inclusion and exclusion criteria are needed to support the relevance and suitability of the journal to the topic. The inclusion criteria in this research are research published in journals in the period 2019-2024, in the form of articles and not pre-prints, in Indonesian or English, research conducted on living humans, full research access-text and free. The exclusion criteria in this research are child and elderly research participants, research participants who suffer from certain diseases, and research using supporting examinations or artificial intelligence.

Relevant articles were initially identified based on title and abstract. Articles that meet the inclusion criteria will then be thoroughly evaluated based on the full text to ensure relevance to the topic under study. This screening process uses the PRISMA diagram to help illustrate the flow of literature selection from identification to articles included in the literature review. More on this is included in the diagram included below.



Result

After searching for scientific articles via Google Scholar, PubMed, and Scopus databases, 30 articles that met the inclusion criteria were found from a review of 367 records published between 2019 and 2024, namely as follows.

Table 1. Article Included [9–38]

Author (Year)	Participants and population	Method	Key Findings
Banyeh, M., Abdulai A., Shittu, S. O., Osei, E. E., Poku, E. O., Komla, A. A. (2022)	89 male and 102 female (18-30 years). Ghanaian	Cross sectional study. Height measured with stadiometer, while tibia and ulna length with sliding caliper. Data analyzed with SPSS 23.0 and GraphPad Prism version 8.0.	Height can be estimated using ulna and tibia length, but less biased with tibia in male, while ulna in female.
Sreenivasan, M., Ahmed, S. K. N. (2019)	112 male (21-30 years). Tamil	Height measured with stadiometer, while ulna length with digital sliding caliper. Data analyzed with SPSS 23.0.	Positive correlation between stature and right (r=0,822) and left ulna length (r=0,832)
Mutluay, D. Ş., Bozkır, M. G. (2019)	70 male and 70 female (19-21 years). Turkish	2D and 4D length measured with digital vernier caliper. Data analyzed with SPSS 21.0	Highest correlation with right 2D length in male (r=0,505) and left 2D length in female (r=0,596).
Saco-Ledo, G., Porta, J., Duyar, I., Mateos, A. (2019)	495 male (18-55 years). Spanish caucasian	Cross-sectional study. Stature and tibial length were measured by Harpenden stadiometer and Harpenden anthropometer. Data	Height and tibia length has higher relationship in calibration group than validation group.

		analyzed with SPSS 20.0	
Roli, O. I., Chukubueze, O. O., Mike, I. N. (2022)	115 male dan 107 female (18-65). Nigerian	Cross-sectional study. Percutaneous upper arm and forearm with vernier sliding caliper (intercondylar) and measuring tape (forearm and upper arm), while height with stadiometer. Data analyzed with SPSS 23.0	Positive correlation between stature and all anatomical measurement, but strongest correlation with ulna, followed by humerus.
Saco-Ledo, G., Porta, J., Monson, T. A., Brasil, M. F., Atamtürk., D., Duyar, I (2020)	351 female (18-55 years). Spanish	Cross-sectional study. Stature and tibial length were measured by Harpenden stadiometer and Harpenden anthropometer. Data analyzed with SPSS	Tibia length has strong correlation with height in both calibration and validation groups.
Mokhtari, S., Hajiahmadi, M., Esmaili, H., Ghadimi, R. (2021)	250 male and 250 female (20-40 years). Iranian	Cross-sectional study. Height measured by stadiometer, while ulna and tibia length with anthropometric tape. Data analyzed with SPSS 18.0	Higher correlation between height and ulna length than with tibia length in both genders.
Shamim, S., Ghimire, T. R. (2024)	100 male and 100 female (20-40 years). Nepalese	Height and ulna length measured by standard anthropometric measurement. Data analyzed with Microsoft Excel.	Positive relation between stature and ulna length (0,63).
Gul, H., Nizami, S. M., Khan, M. A. (2020)	100 participants (20-27 years). Pakistani	Cross-sectional study. Height measures by standing-height measuring instrument, while ulna length by digital sliding caliper. Data analyzed with SPSS 23.0.	Ulna length relatively accurate in estimating height.
Paul, M., Sengupta, O., Halder, S., Panda, U. K. (2020)	250 male and 250 female (20-50 years). Indian	Cross-sectional study. Height measured by stadiometer, while ulna by measuring tape.	Positive correlation between height and left (0,968) and right (0,974) ulna length.

		Data analyzed with SPSS 20.0.	
Pandey, N., Padhee, B. (2020)	57 male and 43 female (18-24 years). Nepalese	Cross-sectional study. Height measured by stadiometer and ulna length by measuring tape. Data analyzed by Microsoft Excel and SPSS 20.0	Ulna length is accurate in estimating height. Left ulna (r=0,491) and right ulna (r=0,473).
Yeasmin, N., Hossain, I., Chowdhury, M. A., Rocky, M. H., Rouf, A., Sokharanjan, S. (2020)	150 male and 150 years (21-60 years). Bangladeshi	Height measured by stadiometer, while ulna and shoulder elbow length by sliding caliper. Data analyzed by Microsoft Excel 2013 and SPSS 23.0.	Positive correlation between height and ulna and shoulder elbow length.
Kharisna, D., Wardah, Febtrina, R. (2021)	116 adult participants. Indonesian (specifically Pekanbaru)	Cross-sectional study. Instrument used are questionnaire, metlin, and microtoise.	Significant correlation between height and ulna length. Ilayperuma' sensitivity 63,4% and specificity 80%.
Williamson, H., Walsh, C., Nel, M., Berg, L. V. D (2022)	141 participants (20-50 years). South African	Cross-sectional study. Height measured by stadiometer, knee height by knee height sliding caliper, and arm-span, demi-span, ulna length, tibia length, fibula length, and foot length by measuring tape. Data was generated with SAS.	All measurements statistically significant in estimating height, but highest correlation with knee height for both genders and lowest in foot length and ulna length.
Mani, M. K. (2021)	100 participants (21-50 years). Ethiopian	Cross-sectional study. Ulna length measured by vernier caliper. Data analyzed by Sigma Stat 4.0.	Positive correlation between height and left and right ulna.
Sarma, A., Das, G. C., Barman, B., Patowary, A. J., Ropmay, A. D., Boruah, P., Baruah, et al. (2022)	118 male and 46 female (25-45 years). Indian (Khasi)	Observational prospective study. Height measured by stadiometer, while ulna by widespread caliper. Data analyzed by Microsoft Excel 2007	Positive correlation between height and ulna length in male (r=0,955) and female (r=0,915).

		and Microsoft Graph Chart.	
Karmalkar, A. S., Nikam, V. R. (2021)	500 male and 500 female (18-50 years). Kolhapur	Descriptive study. Height measured by sliding digital caliper, while other measurements by sliding caliper and measuring tape. Data analyzed by Microsoft Excel and RStudio v1.2.5001.	Positive correlation between ulna length, tibia length, foot length, and hand length, but strongest correlation with ulna. No correlation between height and foot breadth.
Mostafa, S., Elsaed, W., Elshaar, H. (2020)	500 male and 500 female (17-23 years). Egyptian	Height measured by stadiometer, foot length by spreading caliber, and forearm length by measuring tape. Data analyzed by SAS 9.0.	Positive correlation between height and foot and forearm length, but higher in foot length (0,69) than forearm (0,67).
Sreenivasan, M., Ahmed, S. K. N. (2019)	115 female (21-30 years). Tamil	Height measured by stadiometer, while ulna length by sliding caliper. Data analyzed by SPSS 23.0.	Percutaneous ulna length can be used to determine height.
Lestari, W., Witjaksono, F., Manikam, N. R. M., Wardani, W. I., Sutanto, K. (2023)	44 male and 46 female. Indonesian	Analytic cross-sectional study. Height measured by microtoise, while knee height by caliper. Data analyzed by SPSS.	Positive relation between actual and predicted height. Only Chumlea L1 and L2 are valid to estimate height in adult male. No Chumlea formula is valid for female.
Adhikari, R. M., Padhee, B. (2024)	198 participants (19-25 years). Nepalese	Descriptive cross-sectional study. Height measured by stadiometer, while ulna by measuring tape. Data analyzed by Microsoft Excel 2013.	Positive relation between ulna length and height.
Jan, S., Khanam, F., Akhtar, Z., Rashid, M. (2022)	49 male and 48 female (17-21 years). North Indian (Kathua)	Cross-sectional study. Instrument used are stadiometer, measuring tape, and questionnaire. Data analyzed by Microsoft	Strong correlation between height and left (r=0,832) and right (r=0,818) hand length.

		Excel and SPSS 22.0	
Kadel, M., Hada, S., Pant, S. N. (2020)	441 participants. Nepalese	Cross-sectional descriptive study. Arm-span measured by steel tape, while other measurements by stadiometer. Data analyzed by SPSS 24.0.	Height is strongly correlated with arm-span, leg length, and trunk length.
Ilham, R. D., Surdam, Z., Pramono, S. D., Nulanda, M., Gani, A. B. (2022)	26 participants (20-35 years). Indonesian (Bugis)	Cross-sectional study, analytic descriptive.	Positive relation between height and ulna length with high correlation coefficient (0,867).
Winata, A. H., Siregar, N. P. (2021)	54 participants. Indonesian (North Sumatra)	Cross-sectional study, analytic observational.	Height significantly related with right (0,915) and left (0,916) ulna length in both genders.
Jain, A., Kumar, A. (2019)	155 male and 85 female (20-50 years). Indian	Cross-sectional study. Height measured by stadiometer, while ulna length by vernier caliper. Data was analyzed by SPSS 23.0.	Ulna is correlated significantly with height, but more accurate with left ulna (0,6784) than right (0,6828) ulna in male, vice versa for female (left = 0,6617, right = 0,6275).
Ali, A., Modi, V., Mahato, P. K. (2022)	54 female (18-22 years). Indian (Indore)	Descriptive and analytic cross-sectional study. Measurements by stadiometer and vernier caliper. Data analyzed by Microsoft Excel.	Positive correlation between height and ulna length (male=0,977, female=0,979).
Sume, B. W. (2019)	286 male and 286 female (18-26 years). North West Ethiopia	Institutional-based, prospective, cross-sectional study. Height measured by stadiometer, while tibia length by measuring tape and sliding caliper. Data analyzed by EpiData 3.1 and SPSS 25.0.	Tibia length significantly correlated with height in male (right=0,634, left=0,632) and female (right=0,259, left=0,258).
Okwan, D. K., Abaidoo,	56 male and 62	Cross-sectional	Significant

C. S., Tetteh, J., Appiah, A. K. (2020)	female (17-35 years). Ghanaians	quantitative study. Height measured by Shahe height meter, while hand and footprint dimensions by Shahe caliper and Canon MF 500. Data analyzed by SPSS 20.0.	correlation between height and foot and hand dimension except heel-ball index.
Harith, S., Juhanis, L. (2020)	45 male and 73 female (30-55 years). Malaysian	Cross-sectional study. Height measured by stadiometer, while demi-span by measuring tape. Data analyzed by SPSS 20.0	Demi-span is accurate in predicting height for male (r=0,915) and female (r=0,929)

Discussion

This study examines the relationship between limb bone length and body height through a literature review of various relevant studies. The results showed that most studies found a significant positive correlation between the length of certain bones and body height. Prediction models generated from these studies show that bone length is a strong parameter for estimating body height. All studies conducted in this research used the same method, namely cross-sectional. Most of the measurements carried out are similar, namely using the same measuring instruments, including stadiometers, calipers, and measuring tapes, with data collection carried out by one or two of the same people with repeated measurements to prevent errors between observers or differences in measurement results due to measuring instruments. Several studies were also using ISAK-standard observers or conducting training on observers before data collection began. Other than that, some studies conducted data collection at the same time every day to reduce diurnal variation.

Some limitations in the studies above are that many studies were conducted on limited populations in terms of age and ethnic background, so the results may not be generalizable to a wider population. For example, considering those studies were not conducted on children and the elderly, they may not be accurate when applied to that age range. In terms of populations, each population has unique variations in characteristics, such as body and bone size, or certain conditions, such as malnutrition, which allow for differences in which bone length has greater accuracy for each population. In addition, although all studies were conducted on specific populations, some studies had very small sample sizes, which may limit the statistical power and reliability of the results. It may even be inaccurate or unable to represent the population itself, especially in populations with diverse ethnicities and races such as Indonesia.

The implications of these findings include benefits in forensic and clinical contexts. In a forensic context, the length of limb bones can help in the reconstructive identification of human limbs' skeletal remains to determine the main biological profile of an individual such as height, which can be useful for visum et repertum purposes. [39] Apart from that, in a clinical context, height has a role, including assessing the nutritional status of inpatients and the elderly who often face challenges, especially in measuring height accurately. Patients who are bedridden or have limited mobility make anthropometric measurements difficult. Although it is important to

calculate body mass index, measuring height is often impossible in elderly or bedridden patients with limited mobility.[5,40]

CONCLUSION

Predictive models of limb bone length can be used to estimate body height in individuals that cannot be measured directly. However, this research only included traditional measurements of height from bone extremities alone. Further research is needed to make this estimation formula applicable to various variations in population, age, gender, nutritional status, and medical conditions. Moreover, measurements may produce more accurate formulas when considering other factors such as fat mass, etc. Research using different measurement tools is also recommended in the hope of obtaining a more precise formula but remains affordable.

REFERENCES

1. Dul J, Weerdmeester BA (Bernard A). Ergonomics for beginners : a quick reference guide. Second Edition. Taylor & Francis; 2003. 142 p.
2. Ambarita EO, Setyawati I, Yulihastuti DA. Hubungan Antropometri Tulang Panjang Terhadap Tinggi Badan Mahasiswa Suku Batak Toba di Kota Bekasi. Simbiosis X. 2022;(1).
3. Schmitt A, Cunha E, Pinheiro J. Forensic anthropology and medicine: Complementary sciences from recovery to cause of death. Forensic Anthropology and Medicine: Complementary Sciences From Recovery to Cause of Death. 2006.
4. Koesbardiati T, Murti DB, Putri RS. Petunjuk Identifikasi Rangka Manusia. Koesbadiarti T, editor. Surabaya: Direktorat Cagar Budaya dan Museum Kementerian Pendidikan dan Kebudayaan Republik Indonesia; 2018.
5. Sutriani KT, Isnawati M. Perbedaan Antara Tinggi Badan Berdasarkan Panjang Ulna Dengan Tinggi Badan Aktual Dewasa Muda Di Kota Semarang. Journal of Nutrition College. 2014;3(1).
6. Dayal MR, Steyn M, Kuykendall KL. Stature estimation from bones of South African whites. S Afr J Sci. 2008;104.
7. Nath S, Badkur P. Reconstruction of Stature from Long Bone Lengths. The Anthropologist. 2002;4(2).
8. Steven N. Byers. Introduction to Forensic Anthropology. Fifth Edition. New York: Routledge; 2017.
9. Banyeh M, Abdulai AR, Shittu SO, Eric Osei E, Owusu Poku E, Adinyira Komla A. Sex and height estimation using percutaneous ulna and tibia length in a Ghanaian population: New data and a test of published equations. Forensic Science International: Reports. 2022 Dec 1;6.
10. Sreenivasan M, Nawaz Ahmed SK. A model for stature prediction from percutaneous ulnar length in adult males of tamil population. Medico-Legal Update. 2019;19(2).
11. Mutluay ŞD, Bozkır MG. Estimation of Stature from Second and Fourth Digit Lengths in Young Adults. The Bulletin of Legal Medicine. 2019;24(3).
12. Saco-Ledo G, Porta J, Duyar I, Mateos A. Stature estimation based on tibial length in different stature groups of Spanish males. Forensic Sci Int. 2019;304.
13. Chukubueze OO, Ibeabuchi NM. Determination of Sex and Stature from Percutaneous Anthropometric Dimensions of the Upper Arm and Forearm Bones in an Adult Nigerian

Population in Lagos. Article in Journal of Forensic Research [Internet]. 2022; Available from: https://www.researchgate.net/publication/363634331
14. Saco-Ledo G, Porta J, Monson TA, Brasil MF, Atamtürk D, Duyar I. Piecewise regression equations for estimating stature: an anthropometric study in Spanish females. Int J Legal Med. 2020;134(6).
15. Mokhtari S, Hajiahmadi M, Esmaili H, Ghadimi R. Height prediction based on the lengths of ulna and tibia in an Iranian population. Shiraz E Medical Journal. 2021;22(12).
16. Shamim S, Ghimire TR. Estimation of human height using ulnar length in the Muslim community of Golbazar Municipality, Siraha, Nepal. Nepalese Journal of Zoology. 2024 Jul 2;8(1):1–6.
17. Gul H, Mansor Nizami S, Khan MA. Estimation of Body Stature Using the Percutaneous Length of Ulna of an Individual. Cureus. 2020;
18. Paul M, Sengupta O, Halder S, Kumar Panda U. A Study for Estimation of Human Height from the Length of Ulna. International Journal of Research and Review (ijrrjournal.com). 2020;7(1).
19. Niraj P, Padhee B. Estimating the Height of An Individual from The Length of Ulna in Undergraduate Students of a Nepalese Medical College. Journal of Lumbini Medical College. 2020;(2020):185–9.
20. Yeasmin N, Hossain I, Chowdhury MA, Rocky MH, Rouf A, Sokharanjan S. Stature Estimation Using Ulnar Length and Shoulder Elbow Length in a Bangladeshi Population. SN Compr Clin Med. 2020;2(12).
21. Kharisna D, Wardah W, Febtrina R. Sensitivity And Specificity Of Crandal And Ilayperuma's Formula To Predict Adult Weight And Height. Dunia Keperawatan: Jurnal Keperawatan dan Kesehatan. 2021;9(1).
22. Williamson H, Walsh C, Nel M, van den Berg L. Predictive value of different body segments to estimate height in a South African adult hospital population. Clin Nutr ESPEN. 2022;47.
23. Mani M. Estimation Of Stature Using Ulnar Measurements In Adult Males of Ethiopian Population. J Cardiovasc Dis Res. 12(2021).
24. Sarma A, Das GC, Barman B, Patowary AJ, Ropmay AD, Boruah P, et al. An Anatomical Study on the Measurement of Stature From Ulnar Length in the Adult Ethnic Khasi Tribal Population of the North Eastern Region of India. Cureus. 2022;
25. Karmalkar AS, Nikam VR. Prediction of stature from long bones versus hand and foot measurements: A comparative study of the Kolhapur population. Natl Med J India. 2021;34(3).
26. El-Sayed S, Elsaed W, Elshaar H. Correlation between Body Height, Percutaneous Foot and Forearm Lengths in Adult Egyptians. The Egyptian Journal of Anatomy. 2020;43(1).
27. Sreenivasan M, Ahmed SKN. Estimation of stature from ulnar length in living adult females of tamil population. Indian Journal of Forensic Medicine and Toxicology. 2019;13(3).
28. Lestari W, Witjaksono F, Nurul Ratna Mutu Manikam, Wardhani WI, Krisadelfa Sutanto. External validation test of body height estimation on outpatient radiotherapy clinic of Dr. Cipto Mangunkusumo General Hospital. World Nutrition Journal. 2023;6(2).
29. Adhikari RM, Padhee B. Length of Ulna and Its Correlation with Stature in Nepalese Population. Scholars Journal of Applied Medical Sciences. 2024 Jul 2;12(07):826–30.

30. Jan S, Khanam F, Akhtar Z, Mubeen D, Corresponding R, Rashid M. Measurement of height from the length of hand: A cross-sectional study among medical students of North India. 2022;1303–5150. Available from: www.neuroquantology.com
31. Kadel M, Hada S, Pant SN. Analysis of Limb segment length to the total body height among the undergraduate students in a medical college of Nepal. Asian J Med Sci. 2020;11(2).
32. Dwiputri Ilham R, Surdam Z, Dwi Pramono S, Nulanda M, Beru Gani A. Hubungan antara Panjang Tulang Ulna dengan Tinggi Badan pada Mahasiswa Fakultas Kedokteran Universitas Muslim Indonesia yang Bersuku Bugis. Fakumi Medical Journal. 2022;2.
33. Kedokteran J, Nafis I, Hadi A, Penelitian WA, Hadi Winata A, Purnama Siregar N, et al. PERKIRAAN TINGGI BADAN BERDASARKAN PANJANG TULANG ULNA PADA MAHASISWA FK UISU ESTIMATION OF BODY HEIGHT BASED ON THE LENGTH OF THE ULNA BONE IN FK UISU STUDENTS.
34. Jain A, Kumar A. Estimation of Stature of Individual with the Help of Length of Ulna. International Journal of Anatomy and Research. 2019;7(1).
35. Ali A, Modi V, Mahato PK. An analysis of stature using the ulnar bone was performed on fifty-four women from the Indian population in a cross-sectional study. 2022;20:1091–4.
36. Sume BW. Estimation of body height from percutaneous length of tibia in Debre Markos University students, North West Ethiopia. Egypt J Forensic Sci. 2019;9(1).
37. Okwan DK, Abaidoo CS, Tetteh J, Appiah AK. Forensic Application of Hand and Foot Biometrics as Models for Height, Weight and Sex Determination among Ghanaians. International Journal of Anatomy and Research. 2020;8(2).
38. Harith S, Juhanis L. Validation of Predictive Equation for Height Using Demi-Span among Universiti Sultan Zainal Abidin Staff. Iinternational Journal of Allied Health Sciences. 2020;4(2).
39. Poluan B, Tomuka D, Kristanto EG. Hubungan tinggi kepala dengan tinggi badan untuk identifikasi forensik. e-CliniC. 2016;4(1).
40. De Lima MFS, De Oliveira LP, De Araujo Cabral NL, Liberalino LCP, Bagni UV, De Lima KC, et al. Estimating the height of elderly nursing home residents: Which equation to use? PLoS One. 2018;13(10).