Hossain Parash *et al.*
Egyptian Journal of Forensic Sciences (2022) 12:20
https://doi.org/10.1186/s41935-022-00277-3

Egyptian Journal of Forensic Sciences

ORIGINAL ARTICLE

Open Access

Simple linear regression approach for evaluating models to estimate stature based on upper limb dimensions of adult Bangladeshi males

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Abstract

Background: The stature of a living human reflects the nutritional, genetic, and disease patterns of individual experiences. This study adopted a simple linear regression method and R^2 values to identify the preferred model for stature estimation based on the lengths of the arm, radius, ulna, and hand; breadth of the hand; and circumference of the wrist of the adult Bangladeshi male population. This cross-sectional study was performed in the Anatomy Department of Sir Salimullah Medical College, Dhaka, from January 2009 to June 2011. One hundred right-handed adult Muslim Bangladeshi males aged 25 to 45 years participated in the study.

Results: The regression model using right and left ulnar length explained 63% of the measured stature with the least standard error of the estimate (0.435 and 0.436), the model using left and right arm length explained 60%, the model using left and right radius length explained 51%, and the model using left- and right-hand length explained 44% of the measured stature. However, the models using left and right handbreadth and wrist circumference explained only 11 to 13% of the measured stature with a higher standard error of the estimate (6.66 to 6.73). For 25- to 45-year-old Bangladeshi Muslim males, the ulnar length of both sides was the best predictor of stature.

Conclusions: Linear regression equations in estimating stature effectively may encourage its application in future studies addressing different age groups, sexes, nutritional statuses, religions, and ethnicities of Bangladesh.

Keywords: Identification, Stature, Linear regression, Anthropometry, Bangladeshi

Background

Stature is one of the critical features of a person's biological profile. The stature of a living human reflects the nutritional, genetic, and disease patterns of individual experiences. The stature of dead humans or parts of the dead gives characteristic features of a population for archaeological materials (Austin and King 2016). Radiological studies of the hand and wrist provide information about bone age (Hashim et al. 2018). Identification of age, sex, stature, ancestry, and ethnicity represents forensic anthropology's "big four." The forensic scientist can consolidate the probable victim list that compliments any investigation by estimating stature (Zulkifly et al. 2018).

Stature is directly proportional to different body parts and shows a definite biological and genetic relationship. In forensic cases, stature (or body height) is typically estimated using "anatomical" and "mathematical" techniques (Kamal and Yadav 2016; Venkatachalam and Felix 2019).

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Researchers have established a relationship between stature and measurements of different body parts, often represented using linear regression equations derived from these measurements. The relationship between various dimensions of the upper limb, such as the arm, forearm, finger, and phalanges, and stature, has been reported in numerous related studies (Kwon et al. 2009; Akhlaghi et al. 2012; Lee and Jung 2015; Mayor et al. 2017; Wang et al. 2017; Uzun et al. 2019).

Populations affect the stature and length of long bones. Ethnic variations also exist in the population. Stature and the length of the long bones are affected by many factors, such as genetics, nutrition, environment, sex, age, and physical activity, that widely differ between different ethnic origins (Kamal and Yadav 2016, Dayal et al. 2008; Perkins et al. 2016; Galofré-Vilà et al. 2018). Researchers demonstrated that upper limb bones and height dimensions varied in different ethnicities, sexes, and age groups and even for opposite sides of the body (Mumtaz and Sharma 2015; Ekezie et al. 2015).

In Bangladesh, Laila et al. (2010), Hossain et al. (2010), and Asadujjaman et al. (2019) estimated stature from upper limb measurements. Laila et al. (2010) demonstrated a significant correlation between stature and forearm length among adult Bangladeshi Muslim females. Hossain et al. (2010) also demonstrated a significant correlation between hand length and breadth with stature among Christian Garo adult females between 25 and 45 years of age. The researchers estimated stature using the multiplication factor. İşcan (2005) and Krishan et al. (2012) demonstrated that stature estimations using the regression analysis method yielded minor error in estimation compared to the multiplication factor and confirmed that "the regression analysis method is better than multiplication factor analysis in stature estimation."

Asadujjaman et al. (2019) estimated stature from hand dimensions using simple and multiple linear regression of 18- to 60-year-old male and female participants. These researchers suggested multiple regression as the preferred method, as it demonstrated a lower standard error of the estimate and more excellent *R*- and R^2 values than simple linear regression. Nevertheless, the equation involves multiple predictors in multiple regression, which increases the R^2 value (Zellner, 2001). Again, multiple regression would require discovering the upper limb or its skeleton in an entire state without missing any parts or bones after any mishap, which is not feasible in all cases.

At present, there is a paucity of data regarding the most effective model to estimate stature from upper limb dimensions in the adult Bangladeshi male population. Hence, this study adopted a simple linear regression method and R^2 values to identify the preferred model for stature estimation based on the lengths of arm, radius, ulna, and hand; breadth of hand; and circumference of the wrist of the adult Bangladeshi male population.

Methods

This cross-sectional study was performed in the Anatomy Department of Sir Salimullah Medical College, Dhaka, from January 2009 to June 2011. One hundred right-handed adult Muslim Bangladeshi males 25 to 45 years of age participated in the study.

Selection of subject

Inclusion criteria

The present study was confined to a small group of people with similar nutritional status, religion, and ethnicity. Bangladesh is the country with the fourth-highest Muslim population in the world. Among them, approximately half of the population is male (Mubashar 2017). Muslims have generalised food habits. They are not classified as vegetarian or nonvegetarian. Food habits and climate affect the stature and growth of long bones.

The nutritional status of people affects the stature and upper limb dimensions. Expenditure on food items is reflected in overall growth. According to the household income and expenditure survey 2016 conducted by the Bangladesh Bureau of Statistics (2019), all the subjects belonged to the lower-income group. (Income groups were determined based on monthly household income reported in taka; lower-income group: up to 5188 takas). Each subject was asked about average monthly income and expenditures. This information was noted in the checklist.

Ossification is an essential factor in the growth of long bones. Generally, all long bones are completely ossified by the twenty-fifth year of life, and bone loss begins after the forty-fifth year of life (Berendsen and Olsen 2015). Therefore, subjects between 25 and 45 years of age were selected for the study.

Exclusion criteria

Persons who were tribal or mixed in origin and had a history of genetic disorders (e.g., achondroplasia, Marfan's syndrome), endocrine disorders (e.g., acromegaly, dwarfism, DM), any acquired trauma that can affect stature or other (e.g., RTA), neurological findings that can affect the extremities (e.g., CVD) and limb defects (e.g., meromelia, polydactyly, or syndactyly) were excluded from the study.

Number and sampling of the subject

The minimum sample size was calculated to be 61 using G*power 3.1, (Faul et al. 2009) where the effect size (f2) was 0.35, α was 0.05, power (1-β) was 0.80, and the number of predictors was 12. To achieve 61 respondents on an anticipated 50% dropout rate, a total of 122 persons were selected through simple random sampling. Later, due to incomplete data and subject unavailability, the sample number was 100.

Procedure

The subject was cordially received, and the procedure of taking measurements was explained. The subject was assured that the procedure would not harm him. The subject's questions regarding the procedure were clarified. The subject was asked to answer according to the checklist. Written informed consent to measure the different physical measurements were obtained from each subject. All the subjects of the present study were right-handed, which was confirmed as noted on the checklist.

The stature or standing height was measured using a stadiometer. After removing the footwear and socks, the participants stood on the wooden platform, and the heels were kept together. The participant's heels, buttocks, shoulders, and head touched the upright portion of the instrument. The arms were allowed to hang freely by the sides with the palms facing the thighs. The head was maintained in Frankfurt's horizontal plane, and the participant looked forward. The head plate of the stadiometer was brought into firm contact with the vertex along the midsagittal plane. After asking the subject to take a deep breath and holding it, readings were taken to the nearest 0.1 centimetres (Mohanty et al. 2001).

The arm's length was measured using a spreading calliper from the most lateral point on the end of the acromial process of the shoulder girdle to the most distal point on the capitulum of the humerus while flexing the forearm at right angles to the arm. The measurement was recorded in centimetres to the nearest 0.5 cm (Hossain 2009).

Callipers were used to measure the length of the radius. First, the subject extended the elbow, revealing a well-marked depression to the posterolateral side of the elbow. Then, the subject was asked to pronate and supinate the forearm to locate the radial head in that depression (Frank et al. 2010). Finally, from the back of the subject, the researcher placed one end of the calliper at the radial head and another end at the most distal end on the styloid process of the radius. The measurement was recorded in centimetres to the nearest 0.5 cm (Hossain 2009).

The ulna length was measured using a spreading calliper from the olecranon process tip to the styloid process tip while the subject was sitting with the forearm resting comfortably on a table, bending the elbow at 90°. The measurement was recorded in centimetres to the nearest 0.5 cm (Mondol et al., 2009).

The researcher measured the hand's length as the distance between the distal-most point of the middle finger and distal wrist crease using a sliding calliper. The value was recorded in centimetres to the nearest 0.1 cm (Sanli et al. 2005).

The hand's breadth was measured as the distance between the lateral surfaces of the second metacarpal to the medial surface of the fifth metacarpal at the level of the knuckles with a sliding calliper. At the same time, the participant held his four fingers together abducted the thumb to the side. The measurement value was recorded in centimetres to the nearest 0.1 cm (Agnihotri et al. 2006).

The wrist circumference was measured using a tension-gated flexible measuring tape positioned over the Lister tubercle of the distal radius and the distal ulna (Capizzi et al. 2011).

The principal researcher recorded all the measurements twice and later calculated the average measure. Hence for the reliability and validity of the measurements, only intra-observer reliability and validity tests were carried out (Pederson and Gore 2004).

The relationship between stature and each variable was calculated using a regression equation (stature = constant + regression coefficient × variable).

Statistical analysis

The measurements' reliability was assessed by the intraclass correlation coefficient (ICC). The instruments' precision, accuracy, and validity were evaluated by absolute and relative technical error of measurement (TEM and rTEM) and coefficient of reliability. The relationship between the dependent variable (measured stature) and independent variables (right and left arm length, radius length, ulna length, hand length, handbreadth, and wrist circumference) was analyzed using simple linear regression. The constant and beta coefficients for each variable were also calculated. An unpaired t-test was used to investigate the differences in the mean between the measured stature and estimated stature. R^2 values and standard errors of the estimates were used to compare different models. Statistical analyses were performed using IBM SPSS Statistics 16.

Results

Table 1 demonstrates the lengths of the right and left arm, radius, ulna, and hand; breadths of the right and left hand; right and left wrist circumference; and the intra-rater reliability and validity tests. The ICC for all the parameters ranged from 0.990 to 0.998. The values of the ICC indicate the significant ($p < 0.001$) correlation between the two readings for each parameter taken by the researcher. Researchers suggested that the lower the TEM obtained, the better the appraiser's precision to perform the measurement (Arroyo et al. 2010). The TEM

Table 1 Upper limb dimensions and reliability, precision, accuracy and validity test of the measurements

Variable		Mean ± SD (cm)	ICC	TEM	rTEM (%)	*R*
Stature		162.87 ± 7.14	0.998*	0.141	0.09	0.996
Arm length	Right	30.14 ± 2.61	0.991*	0.314	1.04	0.985
	Left	30.13 ± 2.63				
Length of radius	Right	22.08 ± 1.68	0.990*	0.314	1.42	0.965
	Left	22.07 ± 1.69				
Length of ulna	Right	25.19 ± 1.72	0.990*	0.314	1.24	0.967
	Left	25.18 ± 1.70				
Length of hand	Right	17.90 ± 1.38	0.990*	0.141	0.80	0.980
	Left	17.94 ± 1.38				
Breadth of hand	Right	7.59 ± 0.53	0.991*	0.071	0.93	0.982
	Left	7.59 ± 0.54				
Wrist circumference	Right	16.32 ± 0.86	0.997*	0.071	0.43	0.993
	Left	16.33 ± 0.87				

ICC intra-class correlation coefficient, *TEM* technical error of measurement, *rTEM* relative technical error of measurement, *R* coefficient of reliability

* Significant at $p < 0.001$ level

Table 2 Constants, coefficients, and relationships of upper limb dimensions with stature ($n = 100$)

Variable		Constant	Regression coefficient (*B*)	Relationship with stature (*R*)
Arm length	Right	98.846	2.124	.776*
	Left	98.987	2.121	.782*
Length of radius	Right	95.433	3.055	.721*
	Left	95.771	3.040	.719*
Length of ulna	Right	79.504	3.309	.798*
	Left	79.504	3.309	.798*
Length of hand	Right	79.352	4.717	.664*
	Left	79.825	4.679	.665*
Breadth of hand	Right	127.394	4.675	.345*
	Left	125.999	4.858	.367*
Wrist circumference	Right	114.019	2.993	.361*
	Left	112.576	3.081	.373*

R = square root of R^2

*Relationship is significant at $p < 0.01$ level (2-tailed)

of the breadth of the hands and wrist circumference was the lowest (0.071). However, all the instruments demonstrated an acceptable (< 1.5%) rTEM value for all the measurements (Pederson and Gore 2004). Again based on the R values (> 0.95), the measurements were sufficiently precise (Ulijaszek and Kerr 1999).

Constants, coefficients, and relationships of upper limb dimensions with stature are tabulated in Table 2. The scatter diagram (Fig. 1) demonstrates the association between height and various upper limb measurements. For example, both right and left ulnar length showed the highest association ($R = 0.798$) with stature, whereas the lowest association was between noted stature and right-hand breadth ($R = 0.345$) followed by right wrist circumference ($R = 0.361$).

The difference between the measured stature and estimated stature is reported in Table 3. Although both handbreadths and wrist circumferences showed the most negligible association, the estimated statures from all the upper limb measurements were not significantly different ($P > 0.05$) from the measured stature of the individuals. The lowest mean differences were observed between the measured stature and the estimated stature from the right and left ulna length (− 0.012), followed by right-hand length (− 0.008) and right arm length (− 0.007).

The results tabulated in Table 4 demonstrate that the regression model using right and left ulnar length explained 63% of the measured stature with the least amount of standard error of the estimate (0.435 and 0.436), the model using left and right arm length explained 60%, the model using left and right radius length explained 51% and the model using left and right-hand length explained 44% of the measured stature. However, the models using left and right-hand breadth and wrist circumference explained only 11 to 13% of the measured stature with a higher standard error of the estimate (6.66 to 6.73).

Discussion

The present study was conducted on different upper limb dimensions of 100 adult Bangladeshi males. The stature; length of the arm, radius, ulna, and hand; breadth of

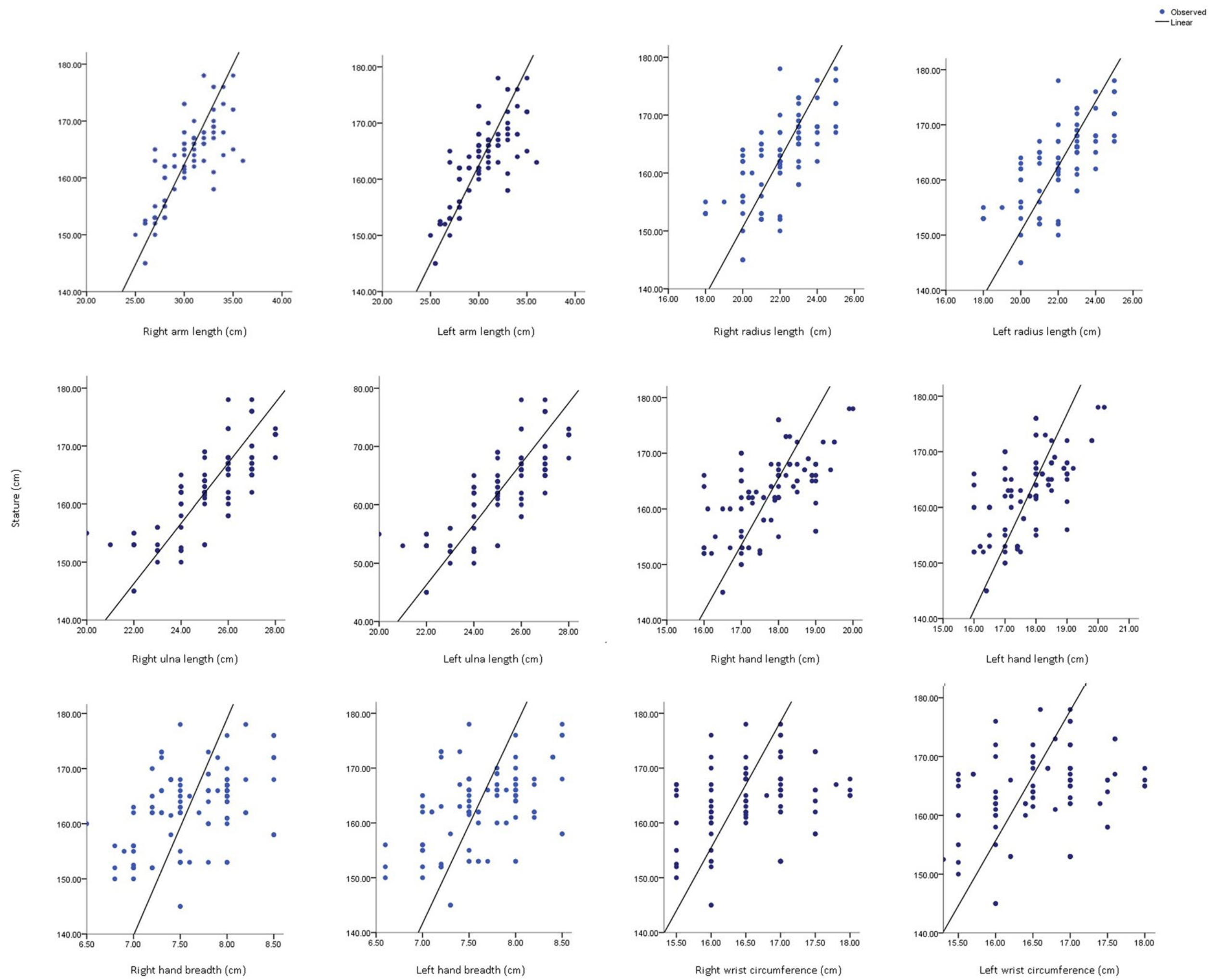

Fig. 1 Scatter diagram with regression analysis showing association of the stature with lengths of the right and left arm, radius, ulna, and hand; breadths of the right and left hand; and right and left wrist circumference

hand; and wrist circumference of both sides were measured by direct physical methods. Stature had a significant positive relationship with all the upper limb dimensions measured in this study. Stature was estimated by simple linear regression based on different upper limb variables. The estimated values were compared with measured values to evaluate the efficacy of estimating stature from upper limb measurements. R^2 value and standard error of the estimate (S.E.E.) were the goodness-of-fit measures used to evaluate the efficacy of the models.

The current study results showed that the association between stature and upper limb measurements was highly significant and positively related, implying the possibility of using regression equations to estimate stature from upper limb measurements. The highest association was noted between the ulnar length of both sides and the stature ($R = 0.798$). Ahmed (2013) and Ilayperuma et al. (2010) also obtained similar findings. Researchers found that the association between ulnar length and stature was highly significant, where R ranged from 0.670 to 0.970 (Mondol et al., 2009; (Ilayperuma et al. 2010; Ahmed 2013; Issa et al. 2016; Okai et al., 2019; Gul et al. 2020).

The level of association between stature and left arm length ($R = 0.782$) and right arm length ($R = 0.776$) in this study was the next greatest after ulnar length (Table 1). This level was lower in the study performed by Ahmed (2013), where the association was also the second greatest compared with other parts of the upper limb. The relationship between left arm length and stature was even lower in the study conducted by Akhlaghi et al. (2012). The radial length of both sides (left side $R = 0.719$, right side $R = 0.721$) demonstrated the level of association with stature, which was lower than that noted for ulnar length.

Table 3 Difference between measured stature and estimated stature ($n = 100$)

Independent variables	Estimated stature in cm (mean ± SD)	Mean difference†	Std. error	95% CI of the difference		*t*	df	*p*
				Lower	Upper			
Right arm length	162.86 ± 5.54	− .007	.904	− 1.789	1.776	− .007	198	.994 ns
Left arm length	162.89 ± 5.58	.012	.906	− 1.775	1.800	.013	198	.989 ns
Right radius length	162.87 ± 5.14	.002	.880	− 1.733	1.737	.002	198	.998 ns
Left radius length	162.86 ± 5.14	− .006	.879	− 1.741	1.728	− .007	198	.994 ns
Right ulna length	162.85 ± 5.70	− .012	.913	− 1.813	1.789	− .013	198	.989 ns
Left ulna length	162.85 ± 5.70	− .012	.913	− 1.813	1.789	− .013	198	.989 ns
Right hand length	162.87 ± 6.76	− .008	.857	− 1.698	1.682	− .010	198	.992 ns
Left hand length	162.52 ± 1.83	− .006	.857	− 1.697	1.684	− .008	198	.994 ns
Right hand breadth	162.87 ± 2.46	.002	.755	− 1.487	1.492	.003	198	.997 ns
Left hand breadth	162.86 ± 2.62	− .004	.761	− 1.503	1.496	− .005	198	.996 ns
Right wrist circumference	162.86 ± 5.54	− .002	.759	− 1.499	1.494	− .003	198	.998 ns
Left wrist circumference	162.89 ± 5.58	.003	.762	− 1.499	1.506	.004	198	.997 ns

† Mean difference between estimated stature and measured stature (162.87 ± 7.14 cm)

ns Not significant at $P < 0.05$ level

Table 4 The goodness-of-fit measure of the models

Upper limb dimension	Model	R^2	Adjusted R^2	S.E.E.	*F*
Right arm length (RAL)	98.846 + RAL × 2.124	0.603	0.599	4.52	148.72*
Left arm length (LAL)	98.987 + LAL × 2.121	0.612	0.602	4.47	154.28*
Right radius length (RRL)	95.433 + RRL × 3.055	0.519	0.514	4.98	105.80*
Left radius length (LRL)	95.771 + LRL × 3.040	0.518	0.513	4.98	105.12*
Right ulna length (RUL)	79.504 + RUL × 3.309	0.637	0.633	4.32	171.86*
Left ulna length (LUL)	79.504 + LUL × 3.309	0.637	0.633	4.32	171.86*
Right hand length (RHL)	79.352 + RHL × 4.717	0.441	0.435	5.36	77.24*
Left hand length (LHL)	79.825 + LHL × 4.679	0.442	0.436	5.36	77.54*
Right hand breadth (RHB)	127.394 + RHB × 4.675	0.119	0.110	6.73	13.23*
Left hand breadth (LHB)	125.999 + LHB × 4.858	0.135	0.126	6.67	13.23*
Right wrist circumference (RWC)	114.019 + RWC × 2.993	0.130	0.121	6.69	14.67*
Left wrist circumference (LWC)	112.576 + LWC × 3.081	0.139	0.131	6.66	15.86*

S.E.E. standard error of the estimate

* Significant at $P < 0.01$ level

Issa et al. (2016) and Okai et al. (2019) obtained similar findings where radial length had a lower association with stature than the ulna.

With respect to the relationship between stature and hand dimensions of both sides, hand length demonstrated a more significant association (left side $R = 0.665$, right side $R = 0.665$) than left wrist circumference ($R = 0.373$), left-hand breadth ($R = 0.367$), and right wrist circumference ($R = 0.361$), where right-hand breadth demonstrated the most negligible association ($R = 0.345$). Akhlaghi et al. (2012), Asadujjaman et al. (2019), and Pal et al. (2016) also observed that the relationship between hand length and stature was the highest among hand dimensions. The association between hand length and stature ($R = 0.688$) observed by Pal et al. (2016) and by Akhlaghi et al. (2012) ($R = 0.696$) was marginally higher. The same association was observed by Asadujjaman et al. (2019) but was lower ($R = 0.545$ and 0.544) than that in the present study. No difference in the association ($R = 0.535$) between right- and left-hand breadth with stature was noted in the study conducted by Pal et al. (2016). However, Asadujjaman et al. (2019) found that the level of the relationship between the left-hand breadth and the stature ($R = 0.285$), which was similar to the findings ($R = 0.310$) of Akhlaghi et al. (2012), was much lower than that noted for the right hand ($R = 0.405$). Although the association between wrist circumferences and stature demonstrated a better relation in this study, it was not feasible to compare with other studies due to the paucity of data. The association between stature and different dimensions of the upper limb varied. Ahmed (2013) observed the same variability in his study. He observed that various components of the upper limb did not exhibit exact variability with the variation of the stature, which was even observed within the same population. Krishan and Sharma (2007) and Vercellotti et al. (2009) previously attributed this variation to environmental, nutritional, and ethnic factors that influence actual body size or proportions attained by adults.

As a measure of efficacy for estimating stature from different hand dimensions using a linear regression model, an unpaired t test was performed to observe the difference between the measured stature and estimated stature. The mean difference ranged from 0.012 to − 0.012, and no significant ($P > 0.05$) difference was noted between the estimated and measured stature. This finding corresponds to those of Akhlaghi et al. (2012) and Ahmed (2013), implying the efficacy of the linear regression model to estimate stature.

While evaluating the models, the R^2 value was the highest (0.637; adjusted $R^2 = 0.633$) with a minimum S.E.E. [4.32] for the model using the ulnar length of both sides. Hence, ulnar length was the most influential factor in predicting stature among the upper limb dimensions in this study. This finding agrees with that of Ahmad (2013), where ulnar length predicted 53% ($R^2 = 0.525$) of the measured stature. Vercellotti et al. (2009) found that proximal limb bones are a better predictor than distal limb bones. However, Ozaslan et al. (2006) demonstrated that forearm length was a better predictor than arm's length, and Akhlaghi et al. (2012) found hand length to be the best predictor for stature. Vercellotti et al. (2009) and Akhlaghi et al. (2012) compared the correlation coefficient (r) to determine the most predictive part of the upper limb to estimate the stature. Ozaslan et al. (2006) and Ahmed (2013) compared the R^2 and S.E.E. to identify the ideal model. The greater the S.E.E., the greater the model's predictive ability. Asadujjaman et al. (2019) considered the R^2 and S.E.E. to evaluate the most predictive model for the adult Bangladeshi population, but their research was exclusively limited to the hand. In their study based on hand dimensions, the highest R^2 was obtained for right-hand length (0.297) with the lowest S.E.E. (5.35). In the present study, the values of R^2 and S.E.E. for right-hand length were 0.441 and 5.36, respectively. Therefore, hand dimensions could explain only 44% of the measured stature, whereas ulnar length could explain more significant than 60%.

The researchers of this study focused on finding the most effective model to predict stature from upper limb dimensions. The present study was limited to a particular population with similar nutritional status, religion, and ethnicity. Although the research considered both sides of the limbs, sex variation was not addressed. Although several researchers recommended multiple linear regression over simple linear regression, this study was limited to simple linear regression, given that the data did not fulfil the assumptions for the former. However, based on the findings of other studies, it is evident that multiple regression could have yielded a more predictive model than the present study's simple linear model (Ahmed 2013; Ozaslan et al. 2006; Asadujjaman et al. 2019).

Therefore, it can be concluded that depending on the availability of the upper limb, estimation of stature should be attempted. If the entire upper limb is available, then multiple linear regression is the ideal model; otherwise, a simple linear regression model should be adopted if only a portion of the limb is available for measurement.

Conclusions

For the 25- to 45-year-old adult Bangladeshi Muslim male, the ulnar length of both arms was the best predictor of stature. Linear regression equations for the practical estimation of stature based on this parameter may be applied in future studies addressing different age groups, sexes, nutritional statuses, religions, and ethnicities of Bangladesh.

Abbreviations

CVD: Cerebrovascular disease; DM: Diabetes mellitus; ICC: Intra-class correlation coefficient; LAL: Left-arm length; LHB: Left-hand breadth; LHL: Left-hand length; LRL: Left radius length; LUL: Left ulna length; LWC: Left wrist circumference; RAL: Right-arm length; RHB: Right-hand breadth; RHL: Right-hand length; RRL: Right radius length; RTA: Road traffic accident; rTEM: Relative technical error of measurement; RUL: Right ulna length; RWC: Right wrist circumference; S.E.E.: Standard error of the estimate; TEM: Technical error of measurement.

Acknowledgements

The authors are grateful to American Journal Experts for their service in editing proper English language, grammar, punctuation, spelling, and overall style. The authors would also extend their gratitude to all the participants of the study for their contribution.

Authors' contributions

MTHP and SCS drafted the manuscript. MTHP performed the statistical analysis. MMR and SH conceived of the study and collected data and helped to draft the manuscript. HN participated in its design and coordination and helped to draft the manuscript. All authors contributed to the final text and approved it.

Funding

The authors did not receive any funding for this research.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Institutional Ethical Committee (IEC) of Sir Salimullah Medical College, Dhaka, provided permission to perform this study (SSMC/IEC: 2010/6). Written informed consent to measure the different physical measurements was obtained from each subject.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Received: 24 August 2021 Accepted: 27 March 2022
Published online: 04 April 2022

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