Estimating stature using human forearm and leg anthropometric data in an Australian female sample

Abstract

Stature is a key morphological characteristic used to identify deceased individuals in a forensic context. However, very few Australian-specific standards are published. This is likely due to a methodological difficulty in accounting for the significant level of ancestral admixture present in modern Australian populations. Here, we report new regressions predicting adult stature based on a morphologically discontinuous living female Australian sample. A total of n = 60 adult females born in Australia, n = 53 of which had at least one generation of Australian heritage, were examined for stature and extremity length using standard anthropometric methods. Maximum length of palpated ulnae, radii and tibiae were measured, yielding data for successful regression modeling. We report a total of 24 statistically significant models predicting stature from these measurements. The strongest simple and multiple linear regression models explain up to 66% and 62% data variation, achieving standard errors of estimate of 3.565 and 3.705 cm respectively. Our results are comparable to methods based on other populations. These new models expand current standards for identification of human remains in Australia, and complement global methods of stature estimation from fleshed human remains in mass disaster situations.

Key Words: Forensic Anthropology, Stature, Anthropometry, Biological Profile

Introduction

Estimating stature is a key component of biological profiling in forensic anthropology [1,2]. Most methods rely on extrapolating a single or combination of long bone measurement/s to ascertain the estimated total height (hereafter stature) of an individual [1,3]. The resulting stature estimate is then used in conjunction with biological sex, age-at-death, and ancestry information, to provide relevant agencies with a rudimentary identification of the deceased individual [1]. In cases of mass fatality scenarios, human remains can become separated from one another or comingled with other remains [4]. This can create difficulty in identifying the deceased through facial reconstructions, dental records or DNA analysis [1]. Numerous advancements in stature estimation techniques have been made over the last 50 years, using a variety of methodologies to predict total adult stature from different anatomical aspects of the human body [5-9]. Methods have included measuring fleshed body parts or body segments (e.g. leg, hand, foot length) [5,6,7], maximum long bone lengths [8], or fragmented bone in skeletonised remains [1,3,9]. However, most of these methods require known variables such as sex and/or ancestry to work effectively and are population specific, with Australia remaining largely unaccounted for [10]. Seeing as some human populations remain without stature estimation standards, they are often evaluated through methods based upon data from ancestrally distant populations. This limitation is likely to lead to a lack of accuracy and precision in stature estimates, ultimately highlighting a significant gap in current global forensic anthropology standards.

Given that human stature is a continuous polygenic trait [11-14], and a result of a combination of heritability, environmental, biological, and ecological factors [15-24], there is a need to compile and expand current methods so they are applicable in different countries. For example, previous studies show that genetic heritability in European populations can account for up to 80 per cent of attained stature [11-14]. Adolescent growth spurts or other ontogenetic disruptions [17,19], disease [16,20,21,23], resource availability (e.g. stunting) and variation in human ecology [15,18,22], play important roles in limiting or facilitating human ability to reach genetic potential for growth. To our knowledge, there are currently no stature estimation methods utilising anthropometric measurements and palpable landmarks of *both* the forearm and leg bones based on, and applicable to, an Australian population. Only one recent 2018 study [10], reported anthropometric measurements of the arm and the hand for the purposes of sex and stature estimation in a sample of living Australians. This is a significant gap in the forensic literature, possibly due methodological difficulties in accounting for the high level of ancestral admixture in modern Australians [25].

The geographical positioning of Australia along with its extreme climate conditions make it prone to a plethora of natural disasters, culminating in the need for rigorous forensic identification practices [26,27]. Despite this, stature is not routinely recorded or registered throughout Australia, nor is it commonly investigated in Australian forensic scenarios. Previous mass casualty scenarios have avoided estimating human stature when constructing biological profiles, as the equations available were more problematic and inconsistent than helpful [28]. Disaster victim identification (DVI) efforts in Australia (e.g. the 2009 Bushfires in Victoria) also excluded stature from biological profiling due to the ineffectiveness of available methods [27-29]. Blau and Briggs [28], and Cordner et al. [29] discuss the lack of effective stature methods available in an Australian context and argue for the exclusion of stature estimation in a biological profile altogether. Others argue that stature is perhaps most useful when grouped into short, medium and tall categories [30]. Simplified methods as such may allow a more straightforward separation of human remains, especially in forensic cases where analytical tools and resources are limited [31]. Others propose that if mathematical formulae with small error ranges are achieved, then population-specific stature equations can be considered more reliable than simple short-medium-tall categories [31].

Stature remains a key component of biological profiling in forensic anthropology and bioarchaeological methods globally [3-4], forming an important biological signature of a once living human. Efforts in the Australian forensic anthropology research scene should be made to not only create measurement databases, but to continue developing and investigating possibilities of stature estimation techniques. However, only a handful of stature related publications focus on an Australian sample. In the last decade, foot anatomy and foot print [5], as well as hand anatomy and hand print [6], analyses have been undertaken in Australian stature anthropometry, but neither of these studies used long bones of the limb to ascertain stature. As previously mentioned, only one recent 2018 study [10] reported anthropometric measurements of the arm and the hand for the purposes of sex and stature estimation in an Australian context. In summary, despite global advancements in stature estimation techniques, we are still limited in our ability to apply accurate stature estimation methods successfully in Australia.

Here, we aim to create new stature prediction equations for a morphologically discontinuous living female Australian population, adding to Australian forensic anthropology general standards, and expanding global methods of stature estimation from fleshed remains. Firstly, statistical relationships between living human stature and the palpated length of the tibia, ulna, and radius are investigated. Secondly, these data are used to create simple and multiple regression models for estimating Australian female stature. As creating equations that do not rely upon known ancestry, or equations that take into consideration populations with more than one prevalent ancestral background, would be beneficial to a toolkit of a forensic anthropologist working in Australia, we ran analyses on adult females born in Australia (Sample A), a sub-group of which (Sample A1) additionally had at least one generation of Australian heritage.

Materials and Methods

Sample background

A quantitative anthropometric study measuring Australian females was conducted across two university campuses. Ethics approval for this study was granted by the administering university. Due to a largely female dominated response to the call for participants, only females were studied to control for sex specific variation in stature. This resulted in a total of 60 participants, data from whom were deemed suitable for the study and are reported here. A questionnaire collecting ancestry, heritage and age information was distributed to participants prior to the anthropometric examination. All participants included in the study had to meet the condition of being born in Australia. Self-reported ancestry was categorised into four geographical regions (Table 1). There is a range of alternate ways to distinguish how ancestry and heritage data should be collected and interpreted. Categories can reflect geographical, geopolitical, cultural, or ethnicity research goals [32]. For the purposes of our study four key geographical categories best reflected the genetic and environmental underpinning to human stature of modern Australians. Participants had the option to select and specify mixed ancestry (under "other" – see Table 1).

Within the total sample of 60 there were 53 Australian born respondents who also had at least one generation of Australian heritage. Australian heritage was defined as a minimum of one generation representing one and/or both parents born and raised in Australia. For analytical purposes, we label this sub-group as "Sample A1" in this article. The remaining seven participants were Australian born only (their parents were not born in Australia and thus the participants were deemed as having no Australian heritage). Data for the total pooled 60 participants, increasing our overall sample size, are grouped into "Sample A" here. Out of the entire sample, n = 57 (95%) females self-reported to be of "European" ancestry, with three females noting "Australian", "Jewish", and "Asian" ancestry only. A further nine females of the "European" decent additionally self-reported Asian (n = 3), Russian (n = 1), Welsh (n = 1), and Australian (n = 4) admixture. Therefore, the entire sample can be treated to be of predominantly European ancestry. The result from our study will be applicable to Europeans born in Australia with and/or without Australian heritage. The respondents presented an age range of 18 – 59 years old at the time of data collection (2016), with a mean age of 25 years old (SD = 10.08) (Table 2). Our results are thus based on a young Australian female dataset.

Anthropometric measurements

Total stature and measurements of the left and right forearm and leg were taken using a stadiometer and tape measure, collecting data to a 1 mm level of precision (Table 2, Figure 1). Throughout the tables, all of the measurements from the forearm are represented by ulnae and radii, whereas the leg is represented by tibiae. These forearm measurements represent distance from the elbow to the wrist, whereas the leg data represent distance from the knee to the ankle. Measurements were collected between 3 – 5pm to account for diurnal variation in human height [33]. It was postulated that each respondent had been awake and mobile for a minimum of 6 hours, providing a sufficient time period for the spine to compress. A period of two hours allowed enough time to collect data, while also limiting the potential to introduce measurement error when replicating the method [34]. To ensure that no intra-observer error can be detected in these measurements, randomly selected participants were contacted and re-measured one month after the main phase of data collection had elapsed. Nine respondents were available for re-examination of their stature, and measurements of their left and right ulnae, radii, and tibiae.

All measurements followed standard anthropometric methods [10,36-40]. Stature was measured using a Charder HM200P Portable Height Rod stadiometer. Respondents were required to remove their shoes and stand upright, with their heels touching together on the base of the stadiometer. With the vertebral column fully extended, the respondent's head was positioned in the Frankfurt Plane (Figure 1). Stature was measured from the most superior (head) to the most inferior (feet) aspect of the body. All forearm and leg measurements were collected by palpating skeletal landmarks of the elbow, wrist, knee, and ankle areas. Prior to taking a seated position on a chair, respondents were instructed to remove any clothing and/or jewellery that could otherwise obscure anthropometric landmarks (e.g. the styloid processes on the radius and the ulna). The respondent was instructed to place both arms palm up, at a 90° angle, to avoid pronation and allow access to all palpable landmarks. Legs were flexed 90° at the knee. A tape measure was placed on the most proximal point of the olecranon process of the ulna and extended distally towards the styloid process (Figure 1). The respondent's arm was then extended to its most horizontal position to palpate the gap between the most proximal aspect of the radial head and the most distal aspect of the capitulum of the humerus. The tape measure was placed posteriorly on the most proximal aspect of the radial head and the respondent's arm was retracted to its original position. The tape measure was then extended towards the most distal aspect of the styloid process on the radius (Figure 1). Two palpable landmarks were used to ascertain tibial length: the medial condyle of the tibial plateau and the most distal aspect of the medial malleolus of the tibia. A tape measure was placed on the most proximal aspect of the medial condyle and extended distally to the anterior colliculus of the medial malleolus (Figure 1).

Statistical Analyses

Statistical analyses were conducted in IBM SPSS 22.0. Data were first cleaned to assess for normality using a Kolmogorov-Smirnov (K-S) test. Given the small sample size (n = 9) of the original and repeated measurements, we evaluated the correlation between data in overlay scatterplots and by the level of Spearman's Rho (with Rho = 1 meaning a complete overlap between the data) [33,34]. Inferential statistical analyses used were based on standard methods applicable to parametric data [41]. Bilateral asymmetry [41] was assessed via paired samples *t*-tests, bivariate correlations between all variables were tested using Pearson's r correlations [43], whereas simple linear and multiple regressions were run to create stature prediction models [10,50]. The strength and validity of the regression models were evaluated by r (coefficient of correlation) and r^2 (coefficient of determination) results. Where $r > 0.35$, the relationship between variables was considered to be of modest to moderate strength, whereas $r > 0.67$ indicated a strong correlation [43,44]. The results tables report both r and $r^{2,}$ but we only report r^2 in text, as the coefficient of determination is a better measure of data fitting variation explained by the models [43]. We also compared standard error of estimate (SEE) values to results reported in stature estimation standards using other populations [45,46].

Results

All descriptive data for age, stature, and forearm and leg bones are presented in Table 2. Results from the inferential analysis are presented in Tables 3-5. Data distribution in all variables was normal (df = 60, $p = 0.200$ across all variables including stature, left and right ulnae, radii, and tibiae), thus all inferential tests used throughout the study were parametric. An overall correlation between original and repeated data measurements was satisfied (Rho = 0.962). There were no statistically significant differences between any of the left and right bone lengths (radius: $t = -1.558$, df = 68, $p = 0.124$, tibia: $t = 0.762$, df = 68, $p = 0.449$), except for the ulna ($t = -2.858$, df = 68, $p = 0.006$). Correlations between measured stature and long bone lengths fell within a moderate to strong correlation range, with Pearson's r range of 0.635 – 0.784 (Table 3). Scatterplots demonstrate that all data are well distributed along the regression line, illustrating a positive association with stature (Figure 2). Given the bilateral asymmetry present in the ulna, regression models were produced for the left and right sides separately (Tables 4-5). A total of 24 regression equations are reported here, 12 of which were conducted on data from Sample A (n = 60), and the other 12 were created using data from Sample A1 (n = 53) only (Tables 4-5).

Simple regression models

All 12 models were statistically significant ($p < 0.05$) and consistently returned $r > 0.60$ indicating moderate to strong modeling [43] (Table 4). Within Sample A (n = 60) the strongest results were achieved for the tibia (left: $r^2 = 0.558$, SEE ±3.886; right: $r^2 = 0.603$, SEE ±3.818), followed by the ulnae (left: $r^2 = 0.440$, SEE ± 4.531; right: $r^2 = 0.404$, SEE ±4.677) and the radii (left: $r^2 = 0.418$, SEE ±4.620, right: $r^2 = 0.529$, SEE ±4.157). When considering Sample A1 (n = 53), the strongest results were also achieved for the tibia (left: $r^2 = 0.579$; right: $r^2 = 0.615$) which also had the lowest SEE values (left: SEE = ±3.875, right: SEE = ±3.705). This was followed by the ulnae (left: $r^2 = 0.442$, SEE ±4.461; right: $r^2 = 0.403$, SEE ±4.616) and the radii (left: $r^2 = 0.337$, SEE ±4.713; right: $r^2 = 0.529$, SEE ±4.100). The resulting simple regression equations (Table 4) use one selected bone length variable to estimate Australian female stature: *Stature in cm = Constant + (B) x bone length in cm.*

Multiple regression models

Twelve multiple regression equations are reported (Table 5). All models where two bone length variables are combined are statistically significant ($p < 0.05$), and also consistently returned $r > 0.60$ indicating moderate to strong modeling [43]. Those using three variables presented p values > 0.05, and so are not reported here. Statistical modeling on Sample A (n = 60) returned strong results for the ulna and radius (left: $r^2 = 0.530$, right $r^2 = 0.588$), ulna and tibia (left: $r^2 = 0.660$, right: $r^2 = 0.637$), and radius and tibia (left: $r^2 = 0.626$, right: $r^2 = 0.644$) (Table 5). Sample A1 (n = 53) achieved strong results when combining lengths of the ulna and radius (left: $r^2 = 0.510$, right: $r^2 = 0.599$), ulna and tibia (left: $r^2 = 0.651$, $r^2 = 0.648$), and radius and tibia (left: $r^2 = 0.614$, $r^2 = 0.656$) (Table 5). The equations in Table 5 use a combination of two long bone measurements to predict Australian female stature: *Stature in cm = Constant + (B) x 1st bone length in cm + (B) x 2nd bone length in cm.*

Discussion

The aim of this study was to create new stature prediction equations applicable to an Australian female population, expanding the current, limited standards of stature estimation in Australian forensic anthropology [10]. As bilateral asymmetry was identified in the ulnae measurements, with the right ulnae being longer than the left, the potential effect of right-handedness on the presented data [41] is accounted for by creating side-specific formulae.

Our sample of the forearm and leg bones demonstrated statistically significant correlations with stature, with all measurements explaining data variations to in a moderate to strong degree (Table 3). Within both Samples A and A1, the tibia was the best indicator of measured stature. This is largely in agreement with values of r^2 = 0.830 and r^2 = 0.673 reported by Dayal et al. [38] and Ahmed [39] also examining females. The data for tibiae also match Trotter and Gleser's [45,46] data where tibia measurements (tibia L: r^2 = 0.645; tibia R: r^2 = 0.650). It is worth noting that the applicability of tibia measurements from Trotter and Gleser's methods [45,46] has not been consistently successful across different recording practices [46]. However, newer additions and revisions [47] of data (including this study) continue the development and investigation into tibial length being deemed a suitable skeletal measure of stature. As outlined in our *Introduction*, population-specific models will expand our understanding of tibial length variability in humans [31,45,46]. Results from our study supply much needed, newer, formulae, which may account for allometric secular changes in long bones of modern populations [49].

Our measurements of the tibia achieve stature estimation results comparable to those obtained from classic measurements of the femur [3]. Therefore, in the absence of a femur when undertaking skeletal individuation, tibia(e) may be the next best bone(s) for stature estimation. Indeed, it has been previously suggested that a strong allometric relationship exists between stature and tibia length [31,49]. Globally, the femur has been traditionally studied in relation to stature due its approximate ¼ length of total stature regardless of ancestry [50-52]. Femoral length measurements will likely remain a favoured source of stature estimation for skeletonised remains, but forensic scenarios where fleshed body parts are recovered need a wider variety of analytical identification techniques. Anthropometric approaches where the proximal and distal end of a long bone needs to be palpated cannot ensure consistent replicability of identifying the femur in living people (e.g. exact location of the greater trochanter is sometimes difficult to identify through skin and the underlying adipose tissue). The strong tibia-stature association in our sample complements current standards that prioritise measurements of the femur [50-52], and we recommend it be considered when examining fully or partially fleshed remains. As future stature research unfolds in Australian contexts, the femur will hopefully be incorporated into new models.

Simple regressions here illustrate that the ulnae and radii are also reliable indicators of total measured stature, although they do not directly contribute to height in the same manner the tibia does. The SEE ranges for the ulnae and radii were comparable to data reported in the available literature considering other populations [3]. In forensic scenarios that require more precise stature estimates, or are focused on the analysis of fragmented remains, a combination of long bones may be more useful than simple regressions when extrapolating stature. Ideally, a combination of skeletal elements from the same body part (e.g. ulna and radius in the forearm) would be used, but as we demonstrate here, and others have shown previously [3,53-55], successful estimates can also be made using long bones from the forearm and leg combined.

We acknowledge that our study is limited in its sample size, but we relied solely upon the recruitment of participants. A larger scale study similar to ours, and including males, will no doubt prove useful in the future, expanding our results. Further, we did not specifically control for body mass variation in our group of females [56], except for ensuring that skeletal landmarks were easily palpable across the whole sample.

Conclusions

By undertaking anthropometric measurements of living Australian females, we sought to create new equations facilitating stature estimation from body parts in Australian forensic science contexts. We present adult stature and associated long bone length data for a sample of 60 predominantly European and Australian born females, 53 of which have at least one generation of Australian heritage. Twenty-four regression formulae are provided for the ulna, radius, and tibia, which can be used in the estimation of stature from known or estimated fleshed forearm and leg body parts.

These new data contribute to the Australian biological profile standards and may assist in human identification practices in forensic scenarios.

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FIGURE CAPTIONS

Figure 1

A: respondent standing upright on the stadiometer (left image – view from the side; right image – view facing forward), B: elbow flexed at 90° angle with tape measure extended down through both landmarks (olecranon process of the ulna on the left to styloid process of the ulna on the right), C: radius extended with tape measure on both landmarks (head of the radius on the left to styloid process of the radius on the right), D: knee bent at 90°angle with tape measure extended down from the medial tibial plateau to the medial malleolus (anterior colliculus) of the tibia.

Figure 2

Scatterplot of data correlations between stature and long bone length data (in cm) in Sample A and A1, showing positive linear relationships (see Table 3 for statistics).

Table 1. Key questions in relation to birth, ancestry, and heritage information collected as part of this study.

Question[1]	**Type**
"Identify your place of birth"	Open ended
"Do you have at least one generation of Australian heritage in your family?"	Open ended
"Which ancestry do you primarily identify with?"	Options of: European, African, Asian, Aboriginal/ Torres Strait Islander, Other (with instructions to specify if mixed/ other ancestry)

Table 2: Descriptive data for all measurements in cm (L – left, R - right).

Variable	**Minimum**	**Maximum**	**Mean**	**SD**
Age (years)	18	59	25.13	10.08
Stature	152.50	183.50	166.72	6.69
L ulna	25.10	34.70	28.99	2.00
L radius	19.80	29.20	24.63	1.69
L tibia	30.70	41.80	36.65	2.44
R ulna	24.60	34.90	29.34	1.97
R radius	21.30	29.40	24.83	1.66
R tibia	30.60	41.80	36.57	2.24

Table 3. Results from Pearson's correlations between the lower arm and leg bones and stature (L – left, R - right).

Bone length in cm correlated with stature in cm	Pearson's *r*	*p*
Sample A (n = 60)		
L ulna	0.664	<0.001
R ulna	0.635	<0.001
L radius	0.647	<0.001
R radius	0.727	<0.001
L tibia	0.767	<0.001
R tibia	0.776	<0.001
Sample A1 (N = 53)		
L ulna	0.665	<0.001
R ulna	0.635	<0.001
L radius	0.614	<0.001
R radius	0.727	<0.001
L tibia	0.761	<0.001
R tibia	0.784	<0.001

Table 4: Simple linear regression models for the Australia born Sample A (n = 60), and Sample A1 (n = 53) who were Australia born and had at least one generation of Australian heritage (L – left, R - right). Stature in cm = Constant + (B) x bone length in cm.

Bone lengths used for estimating stature in cm	***r***	r^2	**SEE ±**	**Constant**	**(B)**	***p***
Sample A n = 60						
L ulna	0.664	0.440	4.5306	104.741	2.140	<0.001
R ulna	0.635	0.404	4.6767	104.064	2.136	<0.001
L radius	0.647	0.418	4.6196	105.359	2.483	<0.001
R radius	0.727	0.529	4.1565	97.315	2.790	<0.001
L tibia	0.767	0.588	3.8855	91.249	2.049	<0.001
R tibia	0.776	0.603	3.8183	84.198	2.251	<0.001
Sample A1 n = 53						
L ulna	0.665	0.442	4.4614	104.433	2.139	<0.001
R ulna	0.635	0.403	4.6159	104.854	2.099	<0.001
L radius	0.614	0.337	4.7132	109.038	2.322	<0.001
R radius	0.727	0.529	4.0998	97.560	2.772	<0.001
L tibia	0.761	0.579	3.8754	92.020	2.026	<0.001
R tibia	0.784	0.615	3.7045	85.099	2.222	<0.001

Table 5: Multiple regression models for the Australia born Sample A (n = 60), and Sample A1 (n = 53) who were Australia born and had at least one generation of Australian heritage (L – left, R - right). Stature in cm = Constant + (B) x 1st bone length in cm + (B) x 2nd bone length in cm.

Bone combinations used for estimating stature in cm	***r***	***r*²**	**SEE ±**	***p***	**Constant**	**(B)**	**model *p***
Sample A n = 60							
L ulna + radius	0.728	0.530	4.1889	0.001; 0.002	83.969	1.068; 2.063	0.005; <0.001
L ulna + tibia	0.812	0.660	3.5647	0.001; <0.001	77.802	0.770; 1.806	0.036; <0.001
L radius + tibia	0.791	0.626	3.7353	0.020; <0.001	80.197	1.184; 1.553	0.018; <0.001
R ulna + radius	0.767	0.588	3.9229	0.006; <0.001	90.724	1.375; 1.466	0.001; 0.002
R ulna + tibia	0.798	0.637	3.6785	0.023; <0.001	79.467	1.058; 1.539	0.001; <0.001
R radius + tibia	0.803	0.644	3.6438	0.012; <0.001	83.391	0.983; 1.605	0.020; <0.001
Sample A1 n = 53							
L ulna + radius	0.714	0.510	4.2243	0.001; 0.012	92.665	1.485; 1.247	0.001; 0.012
L ulna + tibia	0.807	0.651	3.5657	0.002; <0.001	80.347	1.066; 1.506	0.002; <0.001
L radius + tibia	0.784	0.614	3.7476	0.038; <0.001	84.174	0.895; 1.640	0.038; <0.001
R ulna + radius	0.774	0.599	3.8226	0.005; <0.001	85.009	1.027; 2.076	0.006; <0.001
R ulna + tibia	0.805	0.648	3.5789	0.036; <0.001	76.661	0.811; 1.809	0.023; <0.001
R radius + tibia	0.810	0.656	3.5372	0.018; <0.001	79.848	1.225; 1.539	0.012; <0.001

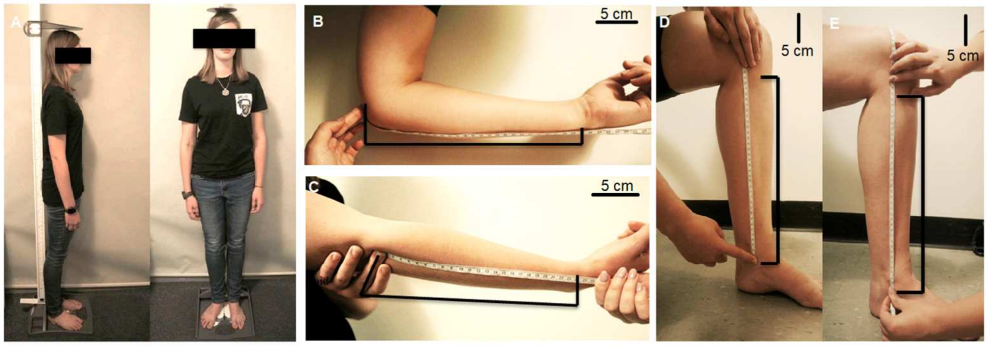
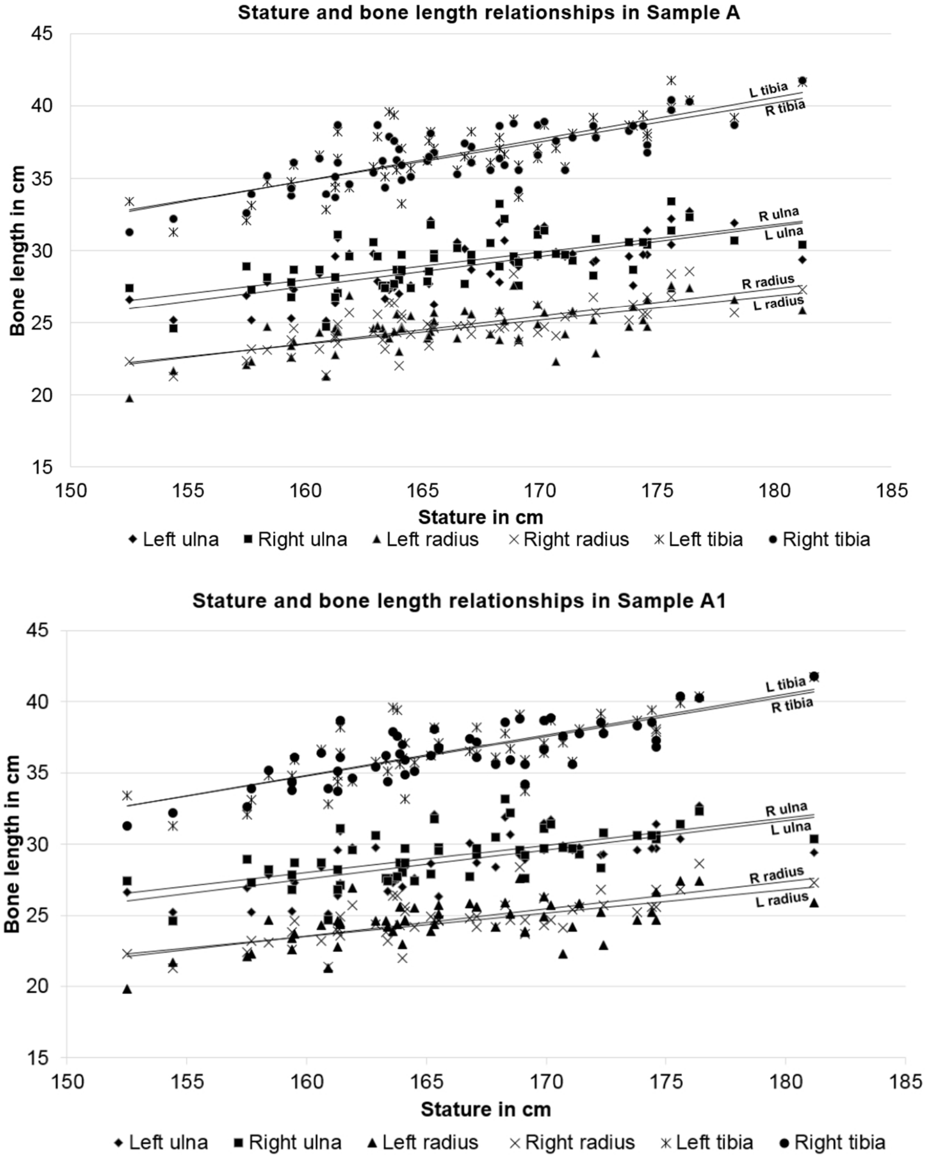


Figure 1
A: respondent standing upright on the stadiometer (left image – view from the side; right image – view facing forward), B: elbow flexed at 90° angle with tape measure extended down through both landmarks (olecranon process of the ulna on the left to styloid process of the ulna on the right), C: radius extended with tape measure on both landmarks (head of the radius on the left to styloid process of the radius on the right), D: knee bent at 90°angle with tape measure extended down from the medial tibial plateau to the medial malleolus (anterior colliculus) of the tibia.

255x89mm (144 x 144 DPI)



Stature and bone length relationships in Sample A

Stature and bone length relationships in Sample A1

Figure 2
Scatterplot of data correlations between stature and long bone length data (in cm) in Sample A and A1, showing positive linear relationships (see Table 3 for statistics).

164x201mm (182 x 182 DPI)