

# Measurement Error in Anthropometric Studies and its Significance in Forensic Casework

Dear Sir,

Estimation of the biological profile of a deceased is a prerequisite during the identification process of human remains. Highly decomposed, dismembered, and commingled remains are often brought for forensic examination in cases of high-impact bomb blasts, terrorists' attacks, homicides, airplane, road and train accidents, and natural disasters such as tsunamis, earthquakes, landslides, and fires. Estimation of stature is an important component of biological profile of the deceased along with other parameters such as estimation of age, sex, and ethnicity. For the same reason, researchers have taken up studies on stature estimation from different body parts. A strong relationship between arm span and stature of a person has been reported in literature.<sup>[1-3]</sup> Sometimes, in incidents involving mass fatalities, the upper part of the body including arms and hands is available for forensic analysis and stature can be estimated using arm span. In this regard, research by Supare *et al.*<sup>[4]</sup> in *Annals of Medical and Health Sciences Research* is a useful addition to the existing literature.

Anthropometry is a highly objective method and reliable in the hands of trained anthropometrists. Anthropometric studies should be accurate and reproducible. When anthropometric measurements are reproduced or repeated, there may be variability in the measurements due to the differences in the inherent physical characteristics of the individuals and populations<sup>[5]</sup> that is known as intra-individual and inter-individual variability. Such differences in measurements of the human traits due to natural biological variations are unavoidable. However, the variations due to measurement error (ME)/technical error (TE)/personal error can be avoided or at least controlled to some extent for the precision and accuracy of the anthropometric studies. These errors often arise due to the improper calibration of equipments, inter-observer and intra-observer biases. Estimation of the ME/technical error of measurement (TEM)/TE thus, becomes an important part of any anthropometric study involving living beings, human, or skeletal remains. ME/TEM/TE is a measure of reproducibility and accuracy in anthropometric studies and studies conducted without its estimation are prone to major errors. The accuracy and precision of a study can be controlled by calculating the errors, which results in a more reliable data.<sup>[6-8]</sup> Hence, it becomes essential for the researchers to calculate ME/TE/TEM

in anthropometric studies meant to establish forensic standards based upon anthropometric methods. Minor deviations in the observed values are likely to affect the standards and ultimately erroneous reporting in a forensic casework.

Anthropometric methods require a good deal of experience before actually starting data collection. The control of precision and accuracy becomes crucial in case of measurements such as arm span and stature where a strict methodology is followed whereas measuring an individual to reduce the chances of MEs based on the methodology involved. Hence, certain international standards<sup>[9,10]</sup> are followed in locating the landmarks involved and taking the various measurements. In studies involving the arm span and stature, there is a likelihood of variability in position of arms. In this regard, the very important issue of observer bias also needs to be addressed. Noninclusion of aforementioned technical aspects in the study<sup>[4]</sup> can be considered as one of the weak links in terms of the study results.

The study pertains to the standards of the estimation of stature from arm span in living subjects. The arm span is likely to vary pre and postmortem due to the difference between living muscles and muscles that have tightened due to rigor mortis. Hence, the utility of these standards on the deceased individuals and human remains will be limited. There are marked differences in the methodologies as well as in the measurements involved on dead bodies in supine position as well as in the living individuals/standing posture. While living subjects cooperate in placing the body in a particular position required for taking a particular measurement especially in measuring the arm span that is taken with both the arms outstretched, breaking the rigor to obtain a particular position may in itself be a cumbersome procedure. The differences may be well marked in cases of stature<sup>[11]</sup> and arm span as explained earlier due to the methodology in taking these measurements. Most certainly anthropometric methodologies followed on the living cannot be applied on the dead as considerable differences exist between the pre and postmortem measurements. The measurement standards would be more appropriate and applicable in forensic situations if the measurements were taken on the dead bodies.

Another potential source of error in the original manuscript pertains to the fact that all measurements were conducted on medical students, who probably tend to be better nourished, have better access to healthcare and thus, healthier overall compared to the average and/or poor individuals. The observations of the study by Supare *et al.*<sup>[4]</sup> thus, may have a limited applicability on the general population in the region. A truly random sample population regarding ethnicity, socioeconomic status, and nutrition, etc., may thus be necessary to determine a reliable level of error in this regard.

The present communication emphasizes on the very essential methodological issues involved in taking measurements in anthropometric studies used in establishing forensic standards. Our observations and suggestions should help the researchers in taking up these issues in future studies pertaining to the use of anthropometry in identification of individuals.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## Kewal Krishan, Tanuj Kanchan<sup>1</sup>

*Department of Anthropology, Panjab University, Chandigarh, <sup>1</sup>Department of Forensic Medicine and Toxicology, Kasturba Medical College (Affiliated to Manipal University), Mangalore, Karnataka, India*  
E-mail: [gargkk@yahoo.com](mailto:gargkk@yahoo.com)

## References

1. Zverev YP. Relationship between arm span and stature in Malawian adults. *Ann Hum Biol* 2003;30:739-43.
2. Singh A, Kumar A, Chavali KH, Harish D. Use of arm-span and foot length for estimation of height of the person. *J Punjab Acad Forensic Med Toxicol* 2012;12:87-91.
3. Popovic S, Bjelica D, Molnar S, Jaksic D, Akpinar S. Body height and its estimation utilizing arm span measurements in Serbian adults. *Int J Morphol* 2013;31:271-9.
4. Supare MS, Bagul AS, Pandit SV, Jadhav JS. Estimation of Stature from Arm Span in Medical Students of Maharashtra, India. *Ann Med Health Sci Res* 2015;5:218-21.
5. Perini TA, de Oliveira GL, Ornellas JS, de Oliveira FP. Technical error of measurement in anthropometry. *Rev Bras*

*Med Esporte* 2005;11:86-90.

6. Krishan K, Kanchan T, Menezes RG, Ghosh A. Forensic anthropology casework-essential methodological considerations in stature estimation. *J Forensic Nurs* 2012;8:45-50.
7. Krishan K, Kanchan T, Passi N. Estimation of stature from the foot and its segments in a sub-adult female population of North India. *J Foot Ankle Res* 2011;4:24.
8. Krishan K, Kanchan T, Asha N. Estimation of stature from index and ring finger length in a North Indian adolescent population. *J Forensic Leg Med* 2012;19:285-90.
9. Vallois HV. Anthropometric techniques. *Curr Anthropol* 1965;6:127-44.
10. Tan MP, Bansal SK. The arm span to height relationship and its health implications. In: Preedy VR, editor. *Handbook of Anthropometry-Physical Measures of Human Form in Health and Disease*. London, UK: Springer Science+ Business Media LLC; 2012. p. 741-54.
11. Krishan K, Sharma JC. Intra-individual difference between recumbent length and stature among growing children. *Indian J Pediatr* 2002;69:565-9.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

### Access this article online

#### Quick Response Code:



Website: [www.amhsr.org](http://www.amhsr.org)

DOI:  
10.4103/2141-9248.180277

**How to cite this article:** Krishan K, Kanchan T. Measurement error in anthropometric studies and its significance in forensic casework. *Ann Med Health Sci Res* 2016;6:62-3.