

# Assessment of Stature from Hand Span - A Cross Sectional Descriptive Investigation among Undergraduate Medical Students

Mani Kathapillai<sup>1</sup>

<sup>1</sup>Department of Anatomy, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth (Deemed to Be University), Ammapettai, Chengalpattu, Tamil Nadu, India.

## ABSTRACT

### BACKGROUND

Hand size measurements are commonly used references when instruments are not available and still practiced in rural and even in urban areas of Tamil Nadu. Ancient literature evidences have adequate support for their usage. We wanted to correlate hand span length, hand breadth, and hand length with the stature of an individual. We also wanted to compare the level of correlation of hand span length between males and females.

### METHODS

214 students were recruited for this study as a convenient sample size. Male students were 122, females were 92. They were aged between 18 - 23 years of Shri Sathya Sai Medical College and Research Institute. Hand span is the distance between tips of the casually extended pollex and minimus.

### RESULTS

The results of Pearson's correlations were moderately significant between height and the hand breadth (0.315), between height and weight (0.340), and between height and hand length (0.387). The extent of correlation was significant between height and the hand span (0.954) in case of males. In case of females, value of the correlation was also moderately significant between height and the hand breadth (0.619), between height and weight (0.392), between height and hand length (0.515) and between height and the hand span (0.973).

### CONCLUSIONS

The stature was reliably estimated from the hand span length, and the same could be applied for the medicolegal, and forensic purposes.

### KEY WORDS

Hand Span, Stature, Medico Legal, Anthropometry

*Corresponding Author:*

*Dr. Mani Kathapillai,  
Department of Anatomy,  
Shri Sathya Sai Medical  
College and Research Institute,  
Sri Balaji Vidyapeeth  
Deemed to Be University,  
Ammappettai, Thiruporur,  
Chengalpattu - 603108,  
Tamil Nadu, India.  
E-mail: kathapillaimani@gmail.com*

*DOI: 10.14260/jemds/2021/125*

*How to Cite This Article:*

*Kathapillai M. Assessment of stature from hand span – a cross sectional descriptive investigation among undergraduate medical students. J Evolution Med Dent Sci 2021;10(09):577-582, DOI: 10.14260/jemds/2021/125*

*Submission 28-09-2020,  
Peer Review 04-12-2020,  
Acceptance 10-12-2020,  
Published 01-03-2021.*

*Copyright © 2021 Mani Kathapillai. This is an open access article distributed under Creative Commons Attribution License [Attribution 4.0 International (CC BY 4.0)]*

## BACKGROUND

Hand size estimations to be specific the hand length and hand breadth are usually utilised reference estimations, practiced in provincial zones, urban areas of Tamil Nadu in India, when instruments are not accessible. Ancient writing confirmations have sufficient backings for the use of hand estimations. Couplet which was composed by Avvaiyar - a female writer of Tamil language (in Thanipadal) the axiom which caught a spot, written in NASA. That was "What we have discovered resembles a hand full of earth: What we need to realise resembles the entire world"(translated). In this, Thanipadal consequently she said that "Even an Ant measures, 8 measures of its own hand span".<sup>1</sup> Anthropometric proportions of hand, including hand span (HS), hand breadth (HB) and hand length (HL) might be utilised as sufficient options for assessment of the body height since they are easy to gauge height anthropometrically. Different markers like femur length, tibia length are likewise accessible in the literature. Taking estimations of hand is currently done satisfactorily with the assistance of a digitalised vernier caliper. Despite the fact that various kinds of procedures were embraced to anticipate tallness of an individual utilising various measures of the different pieces of human body, results got from hand information specifically the HB, HL and HS estimations end up being the best and solid records in the assessment of stature of an individual.<sup>2,3</sup> Additionally this technique for figuring the range from hand measurements assumes a significant function in the branch of forensic medicine for recognising ruined real remains.<sup>4,5</sup>

Recognisable proof is more significant in dead obscure bodies and in mass catastrophe where just pieces of bodies may be accessible. Aside from recognisable proof, height estimation is required for evaluation of youngsters' growth,<sup>6</sup> computation of wholesome indices,<sup>7</sup> for expectation and normalisation of physiological measures, for example, lung volumes,<sup>8</sup> muscle strength,<sup>9</sup> glomerular filtration rate,<sup>10</sup> and resting metabolic rate,<sup>11</sup> and for alteration of medication dosage.<sup>12</sup> However, sometimes, estimation of height is troublesome or unthinkable because of deformities of the body or legs, lower appendage removal, or in patients who can't stand.<sup>13</sup> The dimensional connection between body fragments and height has been the focal point of researcher, anatomist and anthropologist for some years.<sup>14</sup> For this reason, numerous methodologies have been practiced, and the better known are Karl Pearson from Western nations and Singh and Sohal (1952) from India. Past investigations have announced the adequacy of utilising hand length and hand breadth in assessing stature.<sup>15</sup>

Incapacitated non-ambulant patients because of different reasons to be specific, spine cracks, long bone breaks, disabled patients, torpid patients, patients with inborn or obtained scoliosis or kyphosis just as lordosis, the hand estimation measures are the important instruments for estimating the stature of the patients. This ends up being a solid technique for anthropometric height assessment.<sup>16,17</sup> It is a nearly favoured philosophy than getting height from estimations for example foot estimations,<sup>18</sup> since critically ill patients are not happy to be controlled risking their grave circumstances like spine injury, pneumonic embolism, pelvic breaks and so on. This article intended to discover a connection between the hand measurements, for example, HB, HL and hand span length

(HSL) with the stature of a human through test for equity of differences and co-relation coefficient. Person's height is the key marker in the investigations of forensic medicine and also in the field of anthropometry. Ascertaining height through disfigured pieces of a body of a person, from a hard skeleton or from different parts assumes a significant function in net distinguishing proof of an individual. Individual personality is a crucial need during examinations of a severed, deformed and rotted pieces of an individual remains, is pertinent in the field of forensic medicine. It is appropriately justified in the present developed world's artificial catastrophes like airplane crashes, dread assaults, mass mishaps, avalanches and bomb impacts.<sup>19</sup> Circumstance may require the criminological specialists to gather definite subtleties of the skeletal survives from the casualties in the area of associated place of wrongdoing. This height estimations to the degree of 3D reproduction of the height of the suspect is needed in such situations.<sup>20</sup>

## METHODS

### Study Design

It was a cross sectional descriptive examination conducted from August 2019 to February 2020 using the information gathered from tertiary care medical college hospital of Tamil Nadu, India. In view of the past investigation led by Supare et al. absolute number of 214 understudies were enrolled for this examination as a helpful example size. Male understudies were 122, females were 92, aged between 18 - 23 years. The members were from different parts and with various and shifting social foundation from different conditions of India.

### Inclusion Criteria

Apparently typical, asymptomatic, sound clinical understudies matured between 18 - 23 years of age were remembered for this investigation. Since, the base expected development of an individual is accomplished in this time of an individual's life.<sup>21</sup>

### Exclusion Criteria

Individuals with imperilled general development and formative deformation are rejected from the investigation, for example orthopaedic issues like amputees, those with kyphosis or scoliosis, deformation brought about by mishaps and intrinsic peculiarities of upper and lower appendages are rejected from this examination. Members related with endocrinopathies are additionally avoided from this examination, for example acromegaly and achondroplastic people, rickets, pituitary dwarfs, and thyroid cretins are likewise prohibited from this examination.

The subject was asked to stand shoeless on the base of a stadiometer with a gauging machine in a standard standing position depicted by Vallois. The individual was told to stand shoeless, impact points are marginally isolated, and weight is borne uniformly on the two feet. Heels, bottom, and back acquire contact with the vertical surface. The head was situated to such an extent that the subject looks legitimately forward with the Frankfurt plane (the line joining the roof of the external auditory meatus to the lower edge of orbit) and bi-auricular plane being level. The headpiece of stadiometer was kept solidly over the vertex to pack the hair and tallness

was then estimated. The stature of the individual was estimated from vertex to the foundation of the foot of the standard manual stadiometer.<sup>22, 23</sup> Figure 1.

**Hand Breadth**

Hand was put on a level firm standard surface. Hand was set as the palm was put recumbent. Separation between the base of the pointer and minimus finger was fixed and estimated with a digital vernier caliper.

**Hand Length**

Hand was set on a level firm of an ordinary surface. Hand was set as the palm was set prostrate. This will help the creator to envision obviously the distal wrist wrinkle. The estimation (HL) taken as the separation between the distal wrist wrinkle and the tip of the medius.

**Hand Span**

Hand was set on a level firm of an ordinary surface. Hand was set as the palm was put inclined. This will help the creator to imagine the tip of the minimus just as the pollex. The estimation of HSL was taken as the separation between tips of the coolly spread pollex and minimus. The dependable estimation was recorded by an advanced vernier caliper.<sup>22, 23</sup> Figure 2.

**Statistical Analysis**

Statistical analysis was done by SPSS version 23. Descriptive statistics were done to ascertain the mean and standard deviation. Independent t tests were performed to compare the variables i.e. weight of the individual, hand breadth, hand length, hand span length with height. The results were tabulated with the significant P value of .000. In the (Table 1). Correlation was also done between statures of the individuals with weight of the individual, hand breadth, hand length and hand span to ascertain the degree of correlation. The variables and the significant r values are given in the Table 2.

**RESULTS**

Within the absolute number of 214 partook understudies in this examination in the wake of getting their oral assent, 57.01 % (122 / 214) were males, and 42.99 % (92 / 214) were females. Males' tallness was 185.40 cm to 148.40 cm. Females' tallness was 194.00 cm to 145.70 cm. Males' HSL was 23.20 cm to 18.50 cm. Females' HSL was 24.40 cm to 18.50 cm. Males' had a mean tallness of 163.63 cm with a standard deviation of 7.87 cm. Females had a mean tallness of 159.61 cm with a standard deviation of 7.31 cm. Males' had a mean HSL of 20.57 cm with a standard deviation of 0.98 cm, similarly females had a mean HSL of 20.11 cm with a standard deviation of 0.90 cm. (Table 1)

Males' body weight (BW) extended from 115 kg to 42.50 kg. Females' body weight (BW) was 150.00 kg to 35.00 kg. Males' HB was 189.63 cm to 65.21 cm. Females' HB was 88.63 cm to 61.68 cm. Males' had a mean BW of 67.87 kg with a

standard deviation of 14.84 kg. Females' had a mean BW of 71.28 kg with a standard deviation of 18.07 kg.

|               | N   | Minimum | Maximum | Mean     | Std. Deviation | P Value |
|---------------|-----|---------|---------|----------|----------------|---------|
| Height male   | 122 | 148.40  | 185.40  | 163.6343 | 7.87085        | .000    |
| Weight male   | 122 | 42.50   | 115.00  | 67.8664  | 14.84074       | .000    |
| HB male       | 122 | 65.21   | 189.63  | 79.9415  | 11.44770       | .000    |
| HL male       | 122 | 87.95   | 198.44  | 176.0456 | 11.91633       | .000    |
| HS male       | 122 | 18.50   | 23.20   | 20.5725  | .97968         | .000    |
| Age male      | 122 | 18.00   | 23.00   | 20.0738  | 1.30585        | .000    |
| Height female | 92  | 145.70  | 194.00  | 159.6130 | 7.31409        | .000    |
| Weight female | 92  | 35.00   | 150.00  | 71.2840  | 18.07299       | .000    |
| HB female     | 92  | 61.68   | 88.63   | 76.6307  | 5.13799        | .000    |
| HL female     | 92  | 156.04  | 194.01  | 173.8171 | 9.43672        | .000    |
| HS female     | 92  | 18.50   | 24.40   | 20.1104  | .90325         | .000    |
| Age female    | 92  | 18.00   | 24.00   | 19.8370  | 1.22499        | .000    |

**Table 1. Descriptive Statistics with P Value**

|                  | Test Variable | r Value | P Value |
|------------------|---------------|---------|---------|
| Height in male   | Weight        | 0.340   | 0.000   |
|                  | HB            | 0.315   | 0.000   |
|                  | HL            | 0.387   | 0.000   |
|                  | HS            | 0.954   | 0.000   |
| Height in female | Weight        | 0.392   | 0.000   |
|                  | HB            | 0.619   | 0.000   |
|                  | HL            | 0.515   | 0.000   |
|                  | HS            | 0.973   | 0.000   |

**Table 2. Correlation between Variables and Height**

Males' had a mean HB of 79.94 cm with a standard deviation of 11.45 cm, similarly females' had a mean HB of 76.63 cm with a standard deviation of 5.14 cm. Males' HL extended from 198.44 cm to 87.95 cm. Females' HL extended from 194.01 cm to 156.04 cm. Males' had a mean HL of 176.05 cm with a standard deviation of 11.92 cm, similarly females had a mean HL of 173.82 cm with a standard deviation of 9.44 cm.

In males the HL was 176.05 ± 11.92 cm and in females HL was 173.82 ± 9.44 cm. It was discovered HL of both males and females was measurably critical (P = 0.00). In males the height was 163.64 ± 7.87 cm and in females the stature was 159.61 ± 7.31 cm and was measurably noteworthy (P = 0.00). It was seen that the HSL of males was 20.57 ± 0.98 and in females the HSL was 20.11 ± 0.90 cm. It was seen that the HB of males was 79.94 ± 11.45 cm and in females the HB was 76.63 ± 5.14 cm were likewise factual. The weight of males was 67.87 ± 14.84 kgs and in females the weight was 71.28 ± 18.07 kg which was additionally measurable and noteworthy (P = 0.00) (Table 2).

Autonomous examples tests were performed with the rules of Levene's test for equality of fluctuations with the accessible examples independently for male and females. In males the height and the HSL noteworthy was 0.00. The height of males and females was contrasted the weight, HB, HL and HS (Table 2). The aftereffects of the Pearson's correlation are shown in Table 2. The estimation of the relationship was decently huge among height and the HB (0.315), somewhere in the range of height and weight (0.340), among height and HL (0.387). The degree of relationship was huge among height and the HSL (0.954) if there should be an occurrence in males. If there should arise an occurrence in females, estimation of the relationship was additionally decently critical among height and the HB (0.619), somewhere in the range of height and weight (0.392), among height and HL (0.515) and altogether among height and the HSL (0.973) higher than that of the male.

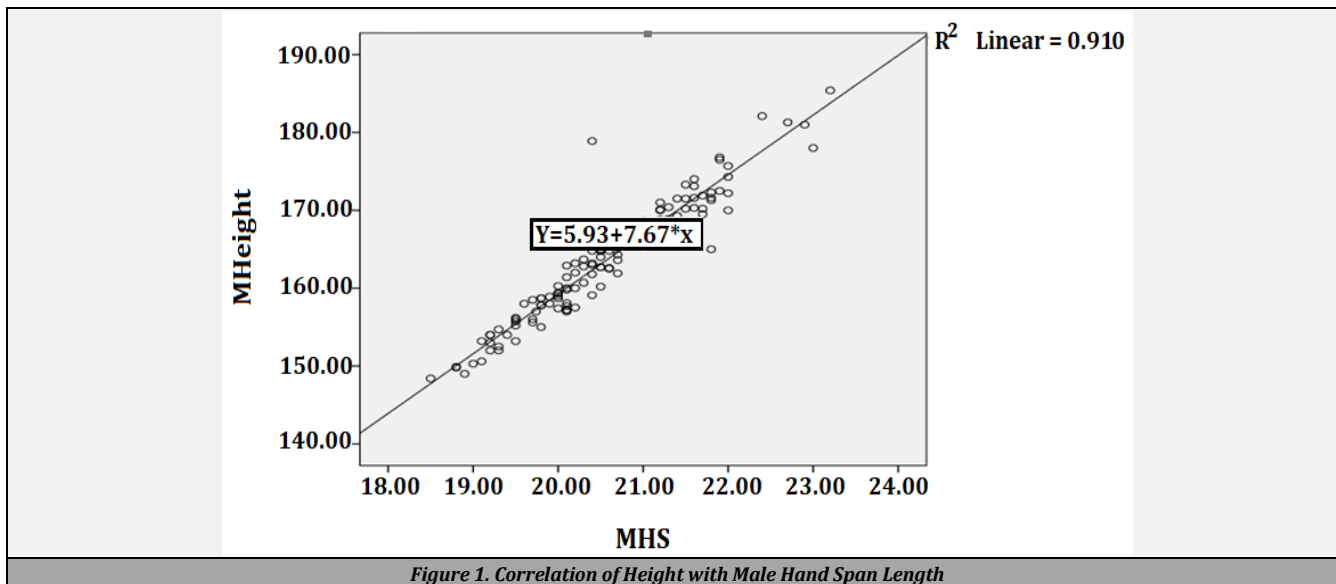


Figure 1. Correlation of Height with Male Hand Span Length

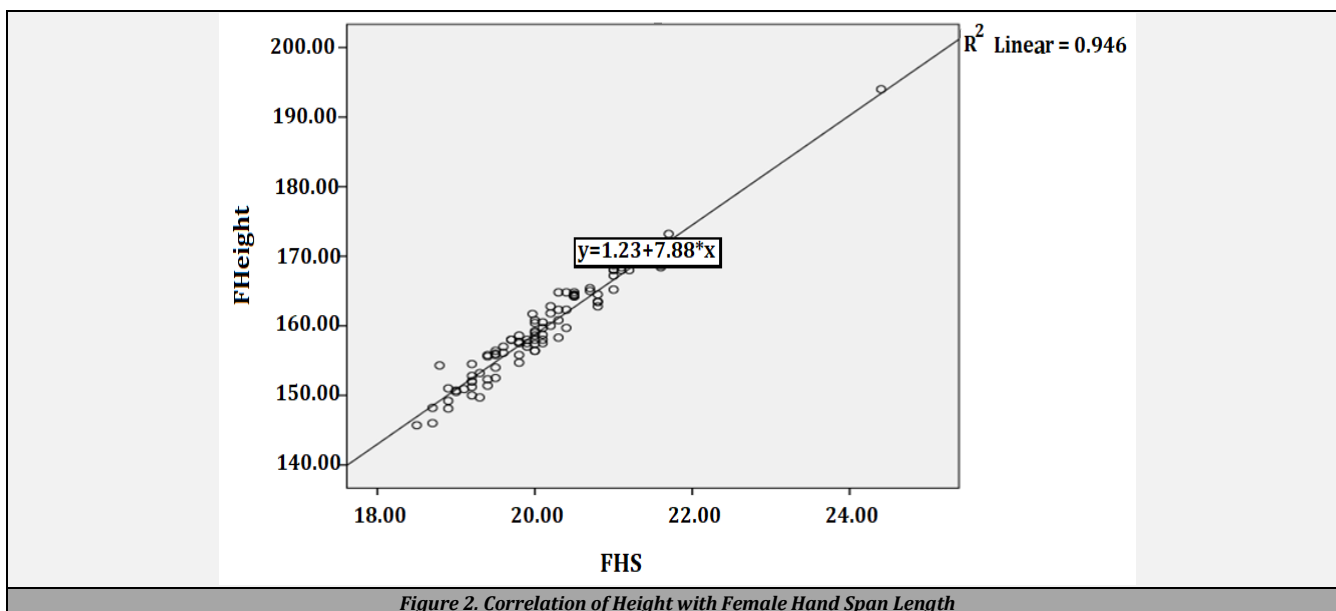


Figure 2. Correlation of Height with Female Hand Span Length

**DISCUSSION**

Hand estimations are utilised for different fields since antiquated days e.g. by the material merchants, models, and so on. In the current investigation we enrolled 122 male and 92 female students of age 18 – 23 years, since most extreme tallness is accomplished between 18 - 23. The improvement of these independent examples tests and correlation coefficients were broadly utilised in criminological assessments, helping specialists recognise dead individuals and cadavers after disastrous occasions or even to set up the natural characteristics of the people.<sup>24-28</sup> Writing confirmations state, writers expected to assess the height for healthful purposes, clinical issues, or even to read relations for creative or ethnic requests. Populaces convey inconsistencies in anthropometric measurements due to a few natural and hereditary elements.<sup>29,30,31</sup>

When contrasting our example hand estimations with other recently detailed estimations, especially the length and the HL, the sex-delineated methods were tantamount without

huge contrasts due to healthful, ethnic, climatic, and hereditary variables.<sup>32</sup> The consequences of our example and prior examination showed that the hand measurements of males were more prominent than those of females. The enthusiasm for the assessment of height for recognisable proof previously existed in ancient times. The skeleton is one aspect of the body that opposes all-natural affront for greatest time and in this manner, can be an important apparatus in recognisable proof. Height is a parameter that can be assessed even in mangled and dissected bodies, just as in fragmentary remains.<sup>33</sup>

The height assessed in this examination in males was  $163.63 \pm 7.87$  cm and in female was  $159.61 \pm 7.31$  cm. It was seen that males have more noteworthy height than females. This can be clarified by the hereditary constitution of men. Time of pubescence being 2 years after the fact in men when contrasted with females give them extra, an ideal opportunity for development. This proposes the equation of one sex can't be applied to appraise height for other sex. The height found by various creators in India in various districts or states is marginally extraordinary and this can be clarified by the

distinctive hereditary constitution, ecological components, and sustenance in various populace gatherings. In both, males and females, HL indicated positive estimation of connection coefficient, which proposes a moderate positive relationship between height, HL, and HB. Different examinations likewise demonstrated comparable aftereffects of positive relationship coefficient utilising HL. An examination done by the Sunil et al. utilising HL indicated a relationship coefficient of 0.60 in males and 0.70 in females, and an investigation by Kaur et al announced 0.58 in males and 0.55 in females. In the current examination, nearly HL indicated relationship with an estimation of 0.387 in males and 0.515 in females.

Chawla and Rajkumar found a relationship coefficient of 0.587 for right hand breadth (RHB) and 0.575 for left hand breadth (LHB) and Krishan et al. Sunil et al. Furthermore, Bhatnagar et al., distributed the data proposed, right-hand measurements are commonly more prominent than left-hand measurements. This shows if sex and race are known and side of the hand is realised then height can be assessed all the more exactly utilising any of the referenced recipes. In males' HL indicated more prominent connection than HB with that of height and in females, we found that HB demonstrated more noteworthy relationship coefficient than HL (Table 2). Prior investigations likewise announced arm range as most dependable body boundary to foresee height among all other considered factors. At the point when arm length is not utilised, HL demonstrated a superior connection with height than other body boundaries as appeared by considers. Like present examination, Ozaslan et al. likewise discovered HB has the most vulnerable relationship with height among contemplated factors, for example, HL, HB, wrist expansiveness, foot length, foot broadness, and lower leg breadth.<sup>34,35</sup>

In our examination, we have demonstrated that apart from HB and HL, hand span length was an additional and more solid boundary in the field of anthropometry. Despite the fact that we have taken just the correct hand estimations for this examination we have advocated by the prior investigation results saying there were no noteworthy contrasts among both ways of HS, HL, HB. Comparable investigation directed in Sri Lanka featured the centrality of hand span length with the height having the connection coefficient of 0.651 for males and 0.461 for females.<sup>36</sup> Present investigation found the connection estimation of 0.954 for males and 0.973 for females. It might likewise be stressed that all estimations show the high estimation of both genders and consequently offer a dependable gauge of height. This examination was done on clinical understudies of Government Medical College, which are from centre to higher financial class.

### CONCLUSIONS

Stature is a key feature in the fields of medicine, anthropometry, scientific medication, legal executive, human resource, sports and so on. Meriting circumstances in incapacitated cases, accessibility of body parts in clinical statute, height could be assessed with sensible exactness. Height can be precisely and agreeably assessed for medicolegal purposes. Restricted examinations are accessible, associating stature and hand span length.

Data sharing statement provided by the author is available with the full text of this article at jemds.com.

Financial or other competing interests: None.

Disclosure form provided by the author is available with the full text of this article at jemds.com.

### REFERENCES

- [1] <http://rprabhu.blogspot.com/2011/12/austere-avvaiyar-part-7.html>
- [2] Jantz LM. Secular change and allometry in the long limb bones of Americans from the Mid 1700 through the 1970s. University of Tennessee. Knoxville: TN. 1996.
- [3] Jantz LM, Jantz RL. Secular change in long bone length and proportion in the United States 1800-1970. *Am J Phys Anthropol* 1999;110(1):57-67.
- [4] Sunil, Dikshit PC, Aggrawal A, et al. Estimation of stature from hand length. *J Indian Academy For Medicine* 2005;27(4):219-21.
- [5] Agnihotri AK, Kachhwaha S, Jowaheer V, et al. Estimating stature from percutaneous length of tibia and ulna in Indo-mauritian population. *Forensic Sci Int* 2009;187(1-3):109.e1-e3.
- [6] WHO Multicentre Growth Reference Study Group. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: World Health Organization 2006.
- [7] Heymsfield SB, Gallagher D, Mayer L, et al. Scaling of human body composition to stature: new insights into body mass index. *Am J Clin Nutr* 2007;86(1):82-91.
- [8] Pellegrino R, Viegi G, Brusasco V, et al. Interpretative strategies for lung function tests. *Eur Respir J* 2005;26(5):948-68.
- [9] Hogrel JY, Decostre V, Alberti C, et al. Stature is an essential predictor of muscle strength in children. *BMC Musculoskelet Disord* 2012;13:176.
- [10] Schwartz GJ, Muñoz A, Schneider MF, et al. New equations to estimate GFR in children with CKD. *J Am Soc Nephrol* 2009;20(3):629-37.
- [11] Frankenfield D, Roth-Yousey L, Compher C. Comparison of predictive equations for resting metabolic rate in healthy nonobese and obese adults: a systematic review. *J Am Diet Assoc* 2005;105(5):775-89.
- [12] Kaestner SA, Sewell GJ. Chemotherapy dosing part I: scientific basis for current practice and use of body surface area. *Clin Oncol (R Coll Radiol)* 2007;19(1):23-37.
- [13] Chawla M, Rajkumar, Tomar S, et al. The relationship between arm span and height in adult males of north Indian Punjabi population. *J Evol Med Dent Sci* 2013;2(4):332-9.
- [14] Mukherjee JB. Personal identification. In: Mukherjee JB, ed. *Forensic Medicine and Toxicology*. 2<sup>nd</sup> edn. New Delhi: Arnold Associates 1994: p. 128-9.
- [15] Bass WM. Anthropology. In: Siegel JA, ed. *Encyclopedia of Forensic Sciences*. Vol. 1. London: Academic Press 2000: p. 194-284.
- [16] Guerra RS, Fonseca I, Pichel F, et al. Hand length as an alternative measurement of height. *Eur J Clin Nutr* 2014;68(2):229-33.

- [17] Hickson M, Frost G. A comparison of three methods for estimating height in the acutely ill elderly population. *J Hum Nutr Diet* 2003;16(1):13-20.
- [18] Oria RS, Igiri AO, Mathis AO, et al. Regression equations for estimating stature from anthropometric measurements of foot length and breadth in adults of efik ethnic group in cross river state. *J Exp Clin Anat* 2017;16(2):127-31.
- [19] Mansur DI, Haque MK, Karki RK, et al. Estimation of stature from length of the foot in adult Nepalese population and its clinical relevance. *Kathmandu Univ Med J* 2012;10(37):16-9.
- [20] Bhavna, Nath S. Use of lower limb measurements in reconstructing stature among shia muslims. *The Internet Journal of Biological Anthropology* 2009;2(2):86-97.
- [21] Agnihotri AK, Agnihotri S, Jeebun N, et al. Prediction of stature using hand dimensions. *J Forensic Leg Med* 2008;15(8):479-82.
- [22] Bagul AS, Supare MS, Pandit SV, et al. Estimation of stature from hand length and hand breadth in medical students of Maharashtra, India. *International Journal of Health and Allied Sciences* 2015;4(3):154-9.
- [23] Vallois HV. *Anthropometric Techniques*. Current Anthropology 1965;6(2):127-43.
- [24] Habib SR, Kamal NN. Stature estimation from hand and phalanges lengths of Egyptians. *J Forensic Leg Med* 2010;17(3):156-60.
- [25] Kim W, Kim YM, Yun MH. Estimation of stature from hand and foot dimensions in a Korean population. *J Forensic Leg Med* 2018;55:87-92.
- [26] Mahakizadeh S, Ghoroghi FM, Moshkdanian G, et al. The determination of correlation between stature and upper limb and hand measurements in Iranian adults. *Forensic Sci Int* 2016;260:27-30.
- [27] Paulis MG. Estimation of stature from handprint dimensions in Egyptian population. *J Forensic Leg Med* 2015;34:55-61.
- [28] Rastogi P, Nagesh KR, Yoganasimha K. Estimation of stature from hand dimensions of North and South Indians. *Leg Med* 2008;10(4):185-9.
- [29] Abdel-Malek AK, Ahmed AM, el-Sharkawi SA, et al. Prediction of stature from hand measurements. *Forensic Sci Int* 1990;46(3):181-7.
- [30] Malina RM, Little BB, Stern MP, et al. Ethnic and social class differences in selected anthropometric characteristics of Mexican American and Anglo adults: the san Antonio heart study. *Hum Biol* 1983;55(4):867-83.
- [31] Eveleth PB, Tanner JM. *Worldwide variation in human growth*. International Biological Programme 8. Cambridge: Cambridge University Press 1976.
- [32] Tang J, Chen R, Lai X. Stature estimation from hand dimensions in a Han population of Southern China. *J Forensic Sci* 2012;57(6):1541-4.
- [33] Krishan K, Sharma A. Estimation of stature from dimensions of hands and feet in a North Indian Population. *J Forensic Leg Med* 2007;14(6):327-32.
- [34] Koley S, Kaur N, Sandhu JS. A study on hand grip strength in female labourers of Jalandhar, Punjab, India. *Journal of Life Sciences* 2009;1(1):57-62.
- [35] Marfell-Jones MJ, Stewart AD, de Ridder JH. *International standards for anthropometric assessment*. Wellington, New Zealand: International Society for the Advancement of Kinanthropometry 2012.
- [36] Gunathilake KMTB, Manjika MS, Vidanapathirana M, et al. Estimation of the height by using hand-span: a clinical forensic study. *Medico-Legal Journal of Sri Lanka* 2018;6(2):64-9.