

Analysis of Limb segment length to the total body height among the undergraduate students in a medical college of Nepal



Muna Kadel¹, Shanta Hada², Shambhu Nath Pant³

¹Associate Professor, Department of Anatomy, Nepalese Army Institute of Health Sciences, Sanobharyang, Kathmandu, Nepal, ²Lecturer, Department of Anatomy, KIST Medical College, Lalitpur, Nepal, ³Professor, Department of Community Medicine, Nepalese Army Institute of Health Sciences, Kathmandu, Nepal

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ABSTRACT

Background: Total body height is important for calculating body mass index, drug dosages calculations and other patient care issues. Total height estimation from different body measurements are surrogate measures of stature which is very useful when only fragmentary remains of a human body are found. **Aims and Objective:** The aim of this study is to develop the relationship of total body height with arm span, leg length and trunk length in Nepalese Medical students. **Materials and Methods:** A descriptive cross-sectional study was conducted in 441 medical students in the Department of Anatomy, KIST Medical College and Teaching Hospital, Lalitpur, Nepal from January to June 2019 after taking ethical approval. Body height, arm span, leg length and trunk length were measured and regression and correlation analysis between them were done. **Results:** The mean standing height, arm span, trunk length and leg length were 161.85 ± 9.14 , 165.37 ± 10.5 , 84.80 ± 4.23 , 77.06 ± 6.5 cm respectively. Correlation coefficient of standing height with arm span, trunk length and leg length were 0.87, 0.76 and 0.90 respectively. Regression coefficient for standing height and trunk length, standing height and arm span and standing height and leg length were 1.65, 0.76 and 1.27 respectively. Regression equations for standing height were determined. **Conclusions:** Total body height shows strong correlation with arm span, trunk length and leg length.

Key words: Arm; Body height; Body mass index; Leg; Regression analysis

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INTRODUCTION

Total body height is defined as the vertical distance from the heel to the vertex in a subject standing erect. Measurements of standing height in elderly people, bedridden patients, and the people with skeletal deformity is difficult.¹

Obtaining standing height is important for calculating body mass index, pulmonary function, drug dosages calculations, renal clearances, and other patient care issues.² Total height estimation from different body measurements such as arm span, leg length and trunk length are surrogate measures of stature which is very useful in the establishment of the identity of an individual when only fragmentary remains of a human body is found.^{3,4}

The relationship between limb segments and total height varies across the populations which show the need for the development of population-specific correlation equations.⁵ So, this study aimed to develop the relationship of total body height with arm span, leg length and trunk length in the students of a Medical College of Nepal.

MATERIALS AND METHODS

A cross-sectional observational study was conducted among the undergraduate students of KIST Medical College from January 2019 to June 2019 after getting ethical approval from the Institutional Review Committee of KIST Medical College. All the participants were informed about the objectives of the study and verbal consent was

Address for Correspondence:

Dr. Muna Kadel, Associate Professor, Department of Anatomy, Nepalese Army Institute of Health Sciences, Sanobharyang, Kathmandu, Nepal. **Phone:** +977-9841832818. **E-mail:** muna997@hotmail.com.

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taken. The list of MBBS and BDS students was obtained from the academic section of the college and the samples were chosen using computer generated random numbers. Based on the study of, Digssie A et al.(2018)¹ sample size was calculated using formula $n=Z^2\sigma^2/d^2$ (n = sample size, $Z= 1.96$ at 95% confidence interval, Standard deviation of 9.20 and margin of error of 1 cm). The sample size was calculated as 325 and a total of 441 students were included.

Individuals with skeletal deformities, past history of skeletal injuries or bone disease were excluded from the study. Standing height was measured by stadiometer recorded to the nearest 0.1 cm. During the measurement, head of participants was kept in a Frankfurt Plane, knees straight, and the heels, buttocks, and the shoulders blades touching the vertical surface of the stadiometer with bare foot.

Sitting height was measured after sitting on standard laboratory stool of known height placed against the stadiometer. Then, trunk length was obtained by subtracting the height of stool from reading of the stadiometer.

Leg length was calculated as the difference between standing height and trunk length. Arm span was measured with steel tape from the tip of the middle finger on one hand to the tip of the middle finger on the other hand with the individual leaning against the wall with both arms abducted at 90°.

The data was collected, tabulated and the analysis was carried out using SPSS version-24. Mean and standard deviations were obtained for different anthropometric variables. The relationships between body height, arm span, leg length and trunk length were determined using simple correlation coefficients. Then a linear regression analysis was performed to examine the extent to which arm span, trunk length and leg length can reliably predict

body height. Finally, these relationships were plotted as scatter diagram.

P values <0.05 were considered as statistically significant.

RESULTS

The results for the standing height, trunk length, leg length and arm span of total populations are shown in Tables 1.

Out of 421 students, the study population comprised of 179 (42.5%) males and 242 (57.5%) females with the mean age of 19.80 ± 1.32 years. The mean standing height, arm span, trunk length and leg length were 161.85 ± 9.14 , 165.37 ± 10.5 , 84.80 ± 4.23 , 77.06 ± 6.5 cm respectively. The mean standing height was 4cm less than the arm span. The mean standing height, arm span, trunk length and leg length in male were 169.0 ± 7.3 , 174.57 ± 7.479 , 87.62 ± 3.36 , 81.4 ± 5.9 cm respectively. In female, the mean standing height, arm span, trunk length and leg length were 156.56 ± 6.26 , 158.57 ± 6.483 , 82.71 ± 3.56 , 73.85 ± 4.85 cm

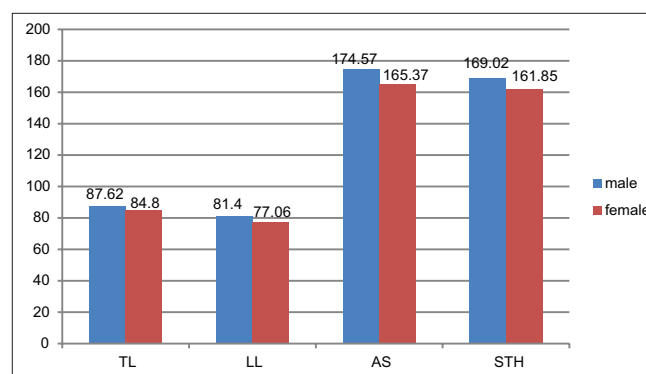


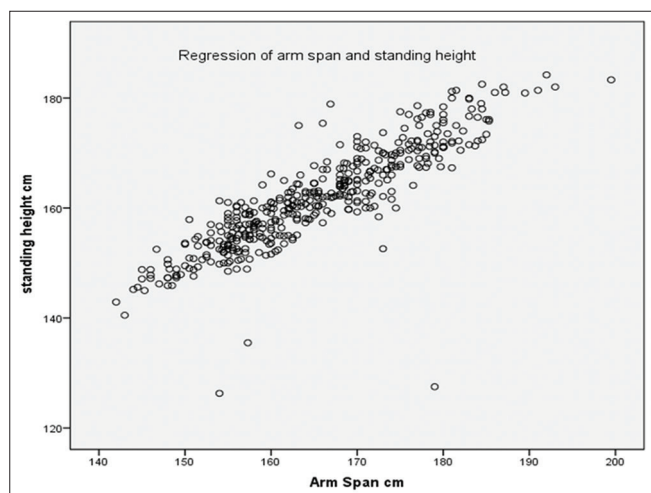
Figure 1: Histogram comparing the means of different parameters. (TL- Trunk Length, LL-Leg Length, AS- Arm Span, STH- Standing height)

Table 1: Descriptive Statistics in relation to age, standing height, trunk length, leg length and arm span

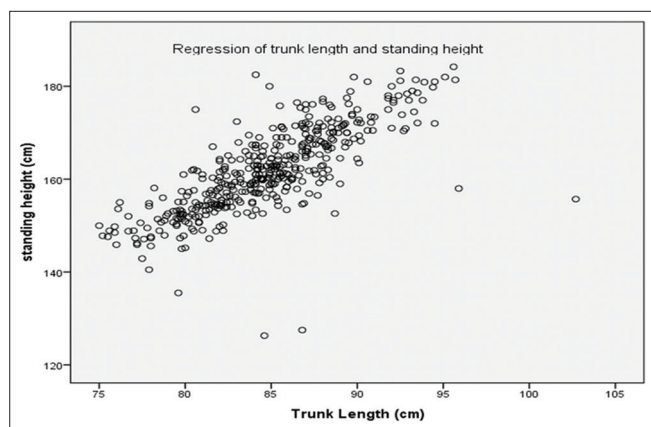
Variables	Minimum	Maximum	Mean	Std. Deviation
Age (years)	17	25	19.80	1.315
Standing Height (cm)	126	184	161.85	9.148
Trunk Length (cm)	75	103	84.80	4.238
Leg Length (cm)	41	98	77.06	6.500
Arm Span (cm)	142	200	165.37	10.515

Table 2: Correlation and linear regression analysis and between standing height and different variables

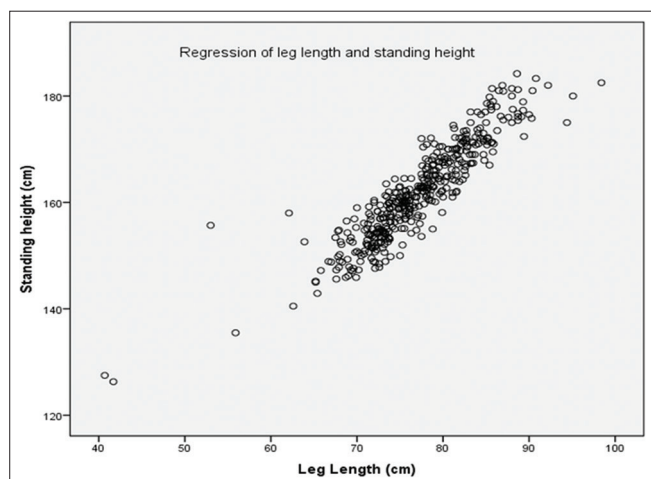
Variables	Regression analysis				Correlation analysis	
	Regression coefficient	P value	R- square(%)	Constant	Correlation coefficient	P value
Standing height and trunk length	1.653	0.000	58.6	21.677	0.766	0.000
Standing height and arm span	0.759		76.1	36.271	0.873	
Standing height and leg length	1.278		82.4	63.407	0.908	



AQ1 **Figure 2:** Scatter diagram showing relationship between arm span and standing height



AQ1 **Figure 3:** Scatter diagram showing relationship of trunk length and standing height



AQ1 **Figure 4:** Scatter diagram showing relationship between leg length and standing height

respectively shown in the Figure 1. The means of different parameters between male and female were statistically significant ($P < 0.000$).

The results of linear regression analysis and correlation coefficients are shown in Table 2. The estimated regression equations for standing height were obtained as:

$$\text{Standing height (cm)} = 36.271 + 0.76 \text{ Arm span (cm)}$$

$$\text{Standing height (cm)} = 21.677 + 1.65 \text{ trunk length (cm)}$$

$$\text{Standing height (cm)} = 63.407 + 1.278 \text{ leg length (cm)}.$$

DISCUSSION

When the accurate measurement for stature is unobtainable, it is necessary to use other surrogates. Several studies have been done to estimate the standing height using different anthropometric parameters like arm span, length of ulna, nasal length, length of foot and craniometric measurements in a variety of populations.^{3,5-8} So this study tried to establish the correlation between stature and different parameters like arm span, leg length and trunk length. Regression equations were then developed to predict stature.

The arm span was nearly 4 centimeters more than the body height in this study which is similar to the white and Nigerian population. Correlation of arm-span and height for Black subjects was 0.852 which is almost same as the finding of this study (0.87).⁹

Leg length of South Indian woman is comparable to the leg length of female Nepalese Medical student in this study (73.8 cm).⁵ Poor childhood health, insufficient diet, adverse family circumstances and maternal smoking during pregnancy are each known to reduce leg length.¹⁰ This study showed the positive correlation between length and standing height. The correlation and regression coefficient for standing height and leg length were 0.90 and 1.27 respectively. These findings were similar to the findings of Mohanty SP et al. in which the correlation and regression coefficient values were 0.84 and 1.24 respectively.⁵

This study showed the positive correlation between trunk length and total height. In 17 years Brazilian males, trunk length was 96 cm which is slightly more than that of Nepalese male Medical student which is 87.6cm.¹¹

LIMITATIONS

In this study, ethnic or regional specific values for different parameters were not derived. So, further studies can be done with larger samples including different ethnic groups of Nepal.

CONCLUSION

Standing height shows strong correlations with arm span, trunk length and leg length. Any of these anthropometric

parameters can be used to calculate the standing height by using above mentioned regression equation.

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Author's Contribution:

MK- Concept and design of the study, reviewed the literature, manuscript preparation and critical revision of the manuscript; **SH**- Concept, collected data and review of literature and helped in preparing first draft of manuscript; **SNP**- Conceptualized study, statistical analysis and critical revision of the manuscript.

Work attributed to: Department of Anatomy, Nepalese Army Institute of Health Sciences Kathmandu, Nepal.

Orcid ID:

Dr. Muna Kadel - <https://orcid.org/0000-0002-9179-3274>

Miss. Shata Hada - <https://orcid.org/0000-0002-2612-8104>

Mr. Sambhu Nath Pant - <https://orcid.org/0000-0001-8762-7022>

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Author Query???

AQ1: Kindly cite Figures 2-4

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