

## Accuracy of estimated height from ulnar length using MUST equation

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**Running Title** - Accuracy of estimated height from ulnar length using MUST equation

### Abstract

**Background & Aim:** Height is an important parameter in the assessment of nutritional status. Height is difficult to measure directly in critically ill patients; alternative methods are used to predict the height. One such method used in the Sri Lankan setting is the Malnutrition Universal Screening Tool (MUST) equations using ulnar length. But the accuracy of the estimated height from the ulnar length in local setting is not studied much. The present study is carried out as a pilot study in order to evaluate the equation for estimated height from ulnar length for the Sri Lankan population.

**Methods:** A single-centre cross-sectional study was carried out by using hospital staff in a base hospital in the central province of Sri Lanka during a staff clinic session. Height was measured by a stadiometer (Seca-203) and ulnar length non-stretchable tape. MUST equation was used to calculate the estimated height and it was compared with actual height to check the accuracy.

**Results:** The mean age of the males and females is 39.8 (SD  $\pm$  10.2) and 40.7 (SD  $\pm$  10.0) years, respectively. The actual height of males was 165.6 cm (SD  $\pm$  6.2) and 153.8 cm (SD  $\pm$  5.6) in females. The estimated height in males is 175.6 cm (SD  $\pm$  4.9) and in females 165.3 cm (SD  $\pm$  4.7). The mean difference of estimated height was positive 10.0 cm (SD  $\pm$  5.1) in males and in females, it is 11.5 cm (SD  $\pm$  4.4).

**Conclusions:** The estimated height from ulnar length in this subgroup differs significantly from the actual height. Therefore, MUST equation should be used cautiously until a further countrywide assessment is done to develop a population-specific equation to predict height using ulnar length.

**Keywords:** Estimated height, Ulnar length, Anthropometry, Sri Lanka, MUST equation

### Introduction

Height is a widely used anthropometric parameter. It is used to calculate body mass index (BMI), body surface area and ideal body weight (IBW). The standard method of height measurement is a stadiometer. But in an acute setting and when the patient can't stand, height measurement is not possible. There are

multiple indirect methods of estimation of height by using other anthropometric parameters like ulnar length, knee height, arm span and demi-span. Ulnar length is a relatively easy parameter to assess in most conditions and has a good correlation with height. Ulnar length is the measurement between the olecranon process and the styloid process (1). Several equations estimate height from the ulnar length, but the Malnutrition Universal Screening Tool (MUST) equation is more widely used to estimate height by ulnar length (2). It was developed by the Malnutrition Advisory Group, a standing committee of the British Association of Parenteral and Enteral Nutrition (BAPEN). The study population used to create the MUST equation is the white British population (2). Sometimes it is not compatible with other populations; countries like Vietnam, Nepal, Turkey and Portugal had found that the MUST equation is not compatible with their population and had developed country-specific equations (3)(4)(5)(6). Even though the MUST equation is commonly used in the Sri Lankan setup, the accuracy of the estimated height is not evaluated. This study was carried out to identify the accuracy of predicted height by MUST equation in Sri Lankan population.

## Methodology

The study was carried out in the central province of Sri Lanka in the base hospital Gampola by using hospital staff during a staff clinic session in early 2020. There were 368 (111–males, 255–females) participants. They all were adults between 18 and 60 years;

participants over 60 years and who had chronic illnesses or disabilities were excluded from the study. Stadiometer (Seca-203) and a non-stretchable tape were used to measure the height and ulnar length, respectively, by trained personnel using standard methods. The ulnar length was measured from the tip of the olecranon process to the midpoint of the styloid process, on the non-dominant hand by keeping the hand flexed and palm across the chest, fingers pointing to the opposite shoulder (8). Before the study, informed consent was taken from all participants, and ethical clearance was obtained from the national hospital Kandy ethics review committee. Estimated height and actual height were compared by using SPSS version 25.

The ulnar length was measured from the tip of the olecranon process to the tip of the styloid process, with the elbow flexed and the palm spread over the opposite shoulder.

## Results

The mean age of the males and females was 39.8 (SD  $\pm$  10.2) and 40.7 (SD  $\pm$  10.0) years, respectively. The actual height of males was 165.6 cm (SD  $\pm$  6.2) and 153.8 cm (SD  $\pm$  5.6) in females. The mean ulnar length of males was 26.8 cm (SD  $\pm$  1.4) and in females, 23.9 cm (SD  $\pm$  1.3).

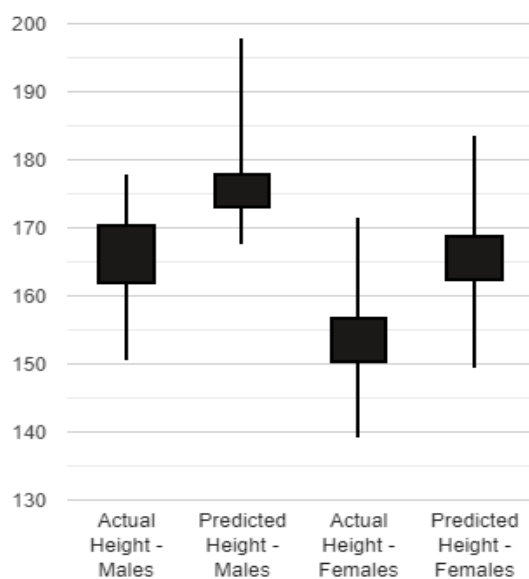
Predictive height was calculated using the MUST equation using ulnar length; males and females had two different equations (7).

$$\text{Predicted height males (cm)} = 79.2 + [3.60 \times \text{ulna length (cm)}]$$

$$\text{Predicted height females (cm)} = 95.6 + [2.77 \times \text{ulna length (cm)}]$$

The mean estimated height in males was 175.6 cm (SD  $\pm$  4.9) and in females 165.3 cm (SD  $\pm$  4.7). There was a positive 10.0 cm (SD  $\pm$  5.1) difference between means of estimated height and actual height in males and in females it was 11.5 cm (SD  $\pm$  4.4).

Table 1. Difference between actual height and estimated height in males and females



The correlation between actual height and ulnar length was showed a strong positive correlation in males ( $r = 0.6$ ) and in females ( $r = 0.66$ ); both had a p-value of  $<0.0001$ .

## Discussion

The findings suggest that there is a significant positive overestimation of predictive height when calculated using the MUST equation in this population. Sri Lanka is listed as one of the countries with the shortest average height (8). According to the world population review, the

average male height of the Sri Lankan population is 168 cm and females average height is 156 cm (8). But the British population height is significantly higher than this, which is around 178 cm for men and 163 cm for women (8). This height difference between the reference population for the equation development and the study population may be the cause for the estimated height difference from the actual height. But as this study population does not represent the entire Sri Lankan population, a large-scale countrywide study may give a better picture of the difference. This study's findings highlight the need for a population-specific equation to estimate height using ulnar length for the Sri Lankan population.

Along with the findings of other studies, it is almost certain that a single anthropometric equation does not fit for entire worlds population due to genetic, ethnic, dietary, climatic and other innumerable differences. It is high time to develop the country and population-specific equation to estimate height from ulnar length for the Sri Lankan population.

## Conclusion

- There is a strong positive correlation between ulnar length and actual height.
- Calculated height by using the MUST equation gives a significantly higher estimation of height in this subgroup of Sri Lankan adults.

- Population-specific equations to estimate height will give a more accurate estimation.

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### Conflict of Interest

None declared

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