Original Article

# A Study of Estimation of Stature by Anthropometric Measurements of the Head



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## ABSTRACT

**Objective:** The purpose of this study was to examine the estimation of height using head circumference and to develop a linear regression formula.
**Study Design:** Cross-sectional study
**Place and Duration of Study:** This study was conducted at the Dow University of Health Sciences, Civil Hospital, Karachi from 01.01.2024 till 01.06.2024.
**Methods:** Through non-probability consecutive sampling, 50 participants, aged 18 years and above, both genders were recruited. Anthropometric measurements of the head (Head circumference) were obtained.
**Results:** For males, the equation was S = -0.15083HC + 187.48522, where 'S' represents stature and 'HC' represents head circumference. Conversely, for females, the equation was S = 0.48272HC + 132.69883.
**Conclusion:** Our findings suggest that, for both sexes, head circumference is a fairly accurate measure of height.
**Key Words:** Stature, Anthropometric, Head, Head Circumference

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## INTRODUCTION

Stature, also known as standing height, refers to the vertical distance between the highest point of the head (vertex) and the surface on which a person is standing[1]. Stature prediction plays a crucial role in anthropological study and forensic identification analysis after accidents, crimes, genocide, or natural catastrophes, since it offers valuable information for individual identification[2]. Given the limited availability of some body parts and bones for forensic testing, it becomes imperative to utilise alternative regions of the body, such as the head and face[3]. However, few research investigations have been undertaken specifically on the cephalo-facial area in relation to the height assessment. Forensic anthropologists assist in the analysis of evidence related to the cause or method of death when identifying human remains[4]. Indentations on skeletal remains provide crucial insights into the cause of death[5]. Given the presence of skeletal trauma, it is crucial to identify and differentiate between ante mortem accurately (before death), perimortem (around the time of death), and postmortem (after death) injuries[6]. Several researches have been conducted on the estimate of height solely based on the skull. It has been demonstrated that each race requires a unique method for estimating stature. Different geographical locations exhibit racial and ethnic disparities within their populations[7]. Incisions on the skeletal structure provide crucial insights into the cause of death. The purpose of this study was to examine the estimation of height using head circumference and to develop a linear regression formula. Additionally, the study aimed to demonstrate that head circumference is a dependable indicator for estimating stature.

## METHODS

After ethical approval from the institution review board, this cross-sectional study was conducted at Dow University of Health Sciences, Civil Hospital, Karachi, from 01/01/2024 till 01/06/24. Through non-probability consecutive sampling, 50 participants, aged 18 years and above, both genders were recruited. Anthropometric measurements of the head (Head circumference) were obtained using standardized techniques and instruments, including callipers and anthropometers. Stature was measured using a stadiometer or anthropometer. Data on demographic

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variables, such as age and sex were also recorded. SPSS version 21 was utilized to perform linear regression.

# RESULTS

The mean head circumference for males was found to be 55.65±1.29cm, while for females, it was slightly lower at 55.25 ±2.1cm. In terms of height or stature, males had an average of 179.09±2.59, significantly taller than females who averaged 159.3 ±3.04cm. Two regression equations were derived from the data to predict stature based on head circumference, with constants 'a' and 'b' determining the relationship. For males, the equation was S = -0.15083HC + 187.48522, where 'S' represents stature and 'HC' represents head circumference. Conversely, for females, the equation was S = 0.48272HC + 132.69883. These equations provide predictive models for estimating stature based on head circumference, with different slopes and intercepts for males and females, reflecting the sexual dimorphism in these anthropometric measures.

**Table No.1: Variables**

| Variables | Males (n=25) | Female (n=25) |
|---|---|---|
| Head Circumference (HC) (cm) | 55.65±1.29 | 55.25±2.1 |
| Height/Stature(s) (cm) | 179.09±2.59 | 159.3±3.04 |
| Constant a | 187.48 | 132.69 |
| Constant b | -0.15 | 0.48 |
| Equation | S = -0.15083HC + 187.48522 | S = 0.48272HC + 132.69883 |
| Correlation coefficient (r) | 0.075 | 0.344 |

Equation calculation summary
Sum of $X$ = 1391.39
Sum of $Y$ = 4477.27
Mean $X$ = 55.6556
Mean $Y$ = 179.0908
Sum of squares ($SS_X$) = 40.2068
Sum of products ($SP$) = -6.0643

Regression Equation = $\hat{y} = bX + a$
$b = SP/SS_X$ = -6.06/40.21 = -0.15083
$a = M_Y - bM_X$ = 179.09 - (-0.15*55.66) = 187.48522
$\hat{y}$ = -0.15083$X$ + 187.48522 ( for Males)

Sum of X = 1381.39
Sum of Y = 3984.29
Mean X = 55.2556
Mean Y = 159.3716
Sum of squares (SSX) = 112.8988
Sum of products (SP) = 54.4981

Regression Equation = $\hat{y}$ = bX + a
b = SP/SSX = 54.5/112.9 = 0.48272
a = MY - bMX = 159.37 - (0.48*55.26) = 132.69883
$\hat{y}$ = 0.48272X + 132.69883

# DISCUSSION

There are several approaches to estimating stature. In the present study, we observed a non-significant positive correlation of head circumference in determining the stature in both males and females (0.075 vs. 0.334). Our results are consistent with a study conducted by Preneth and Babu (2022), they observed a correlation value of 0.48 for men and 0.43 for females (8). The results were also consistent with those from earlier research, where the linear regression equation for men was Y = 2.81x + 137.39, r = 0.57, while for females it was Y = 0.49x = 155.39, r = 0.39, indicating little or no association.[9]
Another study indicated that total facial height (TFH) in men had a correlation value of 0.038, indicating little or no association. Contrarily, the correlation coefficient for nasal height (NH) in men was shown to be 0.034, indicating a weak or nonexistent association. Stature (cm)=156.86+3.01xNH in men, and stature (cm)=156.34+1.28xTFH in women, are the respective linear regression equations for total facial height and male height, respectively. The female total facial length (TFH) and nasal height (NH) correlation coefficients were 0.026 and 0.038, respectively, indicating little or no association. Alternatively, for females, stature (cm) = 144.96+1.12xTFH is the linear regression equation. Alternatively, for female NH, the linear regression equation is given by stature (cm) =142.71+3.11xNH[10]. There was a moderate degree of correlation between the two variables in another study: the right forearm length (RFL) and stature (cm) were determined to be (2.887xRFL+95.82) with a correlation coefficient of 0.500, and the left forearm length (LFL) and stature (cm) were determined to be (2.128xLFL+116.5) with a correlation coefficient of 0.615. In contrast, the North Karnataka population determined that the linear regression equation for RFL in females was height (cm) =2.427xRFL+99.46 and for LFL in females was stature (cm) =2.632xLFL+95.08[11]. When it came to estimating height from head circumference, the current study's sample size was too small. We hope to expand the sample size and include more age groups in future measurements.

# CONCLUSION

Our findings suggest that, for both sexes, head circumference is a fairly accurate measure of height.

**Author's Contribution:**

| | |
|---|---|
| Concept & Design or acquisition of analysis or interpretation of data: | Lubna Riaz, Ashhad Mazhar Siddiqui, Muhammad Noman Rashid |

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|---|---|
| Drafting or Revising Critically: | Riaz Ahmed Shahid, Nasrul Huda, Nazia Shahab |
| Final Approval of version: | All the above authors |
| Agreement to accountable for all aspects of work: | All the above authors |

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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