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Correlation of Stature with Cephalofacial Measurements

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Abstrak

Tinggi badan merupakan parameter antropometri yang dapat digunakan dalam penentuan status gizi dan identifikasi jenazah. Pada individu dengan kondisi yang tidak memungkinkan dilakukan pengukuran tinggi badan secara konvensional dibutuhkan suatu metode pengukuran tinggi badan alternatif. Salah satu metode pengukuran tinggi badan alternatif yaitu *surrogate height measurement. Surrogate height measurement* dapatdiukurmenggunakan formula khusus berdasarkan ukuran tulang, misalnya ukuran antropometri *cephalofacial*. Jenis penelitian ini adalah deskriptifobservasionaldengandesainpotong-lintang. Pengambilan data dilakukan melalui pengukuran lebar maksimal kepala, lingkar kepala horizontal, lebar minimal dahi, dan tinggi badan pada 110 subjek perempuan dan 57 subjek laki-laki. Data dianalisis dengan uji normalitas *Kolmogorov-Smirnov*, uji korelasi *Pearson* antara tinggi badan dan parameter antropometri *cephalofacial*, dan uji regresi linier untuk mendapatkan model prediksi tinggi badan.Hasil uji korelasi *Pearson* antara lingkar kepala horizontal dan tinggi badan, baik dengan atau tanpa stratifikasi jenis kelamin bermakna signifikan (p<0,05). Hasil uji korelasi *Pearson* antara lebar maksimal kepala dan tinggi badan pada populasi total dan kelompok perempuan bermakna signifikan (p<0,05), sementara pada kelompok laki-laki korelasi tidak bermakna signifikan (p>0,05). Hasil uji korelasi *Pearson* antara lebar dahi minimal dan tinggi badan, baik dengan atau tanpa stratifikasi jenis kelamin tidak bermakna signifikan (p>0,05).Tidak terdapat korelasi yang signifikan antara lebar minimal dahi dan tinggi badan.Terdapat korelasi yang signifikan antara lingkar kepala horizontal danlebarmaksimalkepalaterhadaptinggi badan.

Kata kunci:*surrogate height measurement*, tinggi badan, ukuran*cephalofacial*

Abstract

Stature, as one of the anthropometry measurements, can be used for determination of nutritional status and corpse identification. Surrogate height measurement as one of the alternative measurement for height is required in a person whose conventional height measurement cannot be performed. This alternative measurement consists of specific formula using bone measurements, one of which is cephalofacial measurement. This is a descriptive observational study with a cross-sectional approach. Data were taken by measuring maximum head breadth, horizontal circumference of head, minimum frontal diameter, and stature from 110 females and 57 males. Normality test was carried out using Kolmogorov-Smirnov test, continued with *Pearson* correlation test on cephalofacial measurements and stature followed by linear regression to estimate stature. *Pearson* correlation tests between horizontal circumference of head and stature on all subjects with or without sexual stratification showed significant results (p<0.05). *Pearson* correlation tests between maximum head breadth and stature on all subjects and female group are significant (p<0.05), meanwhile the correlation is insignificant (P>0,05) in the male group. *Pearson* correlation tests between minimum frontal diameter and stature on all subjects with or without sexual stratification are insignificant (p>0.05). There is no significant correlation between minimum frontal diameter and stature. There are significant correlations between horizontal circumference of head and maximum head breadth toward stature.

Keywords: surrogate height measurement, stature, cephalofacial measurement

1. Introduction

Anthropometry is the study of measurements of the human body in terms of the dimensions of bones, muscles and fat tissue. The body size that can be described by anthropometry includes body weight, head circumference, body width, and stature.[1] Stature can be used in various medical fields such as corpse identification and assessment of nutritional status through calculation of body mass index (BMI).[2]

Stature measurement is generally done bymeasuring the head's peak to the lowest point of the foot.[2]In individuals with certain conditions such as being unable to stand upright or mutilated corpse, stature measurement cannot be done directly. Measurement of stature in individuals who experience abnormal posture will also provide inappropriate interpretations on the assessment of nutritional status through BMI calculation.[3,4] These findings trigger the development of an alternative method of stature measurement to get an easier measurement with better accuracy.

Surrogate height measurement is one alternative to the measurement of stature. The stature measurement procedure is carried out through a stature prediction model that is calculated based on various sizes of body parts such as hands, body, legs, upper and lower limbs, and cephalofacialmeasurement.[5]

Several previous studies attempting to associate cephalofacialmeasurement and stature. Research by Krishan and Kumar concluded that cephalofacialmeasurement has a strong correlation to predict stature.[5,6] The studyby Jervas et al produced a stature prediction model based on cephalofacialmeasurement.[7]Datta and Vishnu research showed a difference correlation between cephalofacial measurement and stature with a target population of different races.[8]

Research on the correlation betweencephalofacialmeasurement and stature in Indonesia is still very little. The prediction model for stature is also very dependent on the target population. These finding trigger the researchers to conduct this research.

2. Method

This research is an observational descriptive cross-sectional design. The study was conducted at the Faculty of Medicine University of Sriwijaya (FK Unsri) in October 2018 − January 2019. Based on total sampling, 110 female subjects and 57 male subjects met the inclusion criteria: over 20 years old and were undergraduate students at FK Unsri.Exclusion criteria are having a history of

Table 1. Distribution of Cephalofacial Measurement, Statureand Data Normality

Measurement	Gender	Mean	SD	Total	P *value**
Stature	Male	169,4579	5,57443	57	0,491
	Female	156,3945	6,37457	110	0,560
	Total	160,8533	8,70413	167	0,259
Minimum frontal diameter	Male	12,2912	0,79450	57	0,319
	Female	12,3985	0,74492	110	0,688
	Total	12,3619	0,76152	167	0,414
Horizontal circumference of head	Male	56,5300	2,01380	57	0,606
	Female	54,9609	1,74473	110	0,093
	Total	55,4965	1,98085	167	0,190
Maximum head breadth	Male	14,6549	0,69676	57	0,378
	Female	14,6827	0,62502	110	0,065
	Total	14,6732	0,64855	167	0,493

* Normality test*Kolmogorov-Smirnov*, p>0,05

Table 2. Correlation of Stature withCephalofacial Measurement

Measurement	Gender	*Pearson* coefficient correlation (r)	P*value*
Minimum frontal diameter	Male	0,211	0,115
	Female	0,058	0,549
	Total	0,027	0,730
Horizontal circumference of head	Male	0,426	0,001*****
	Female	0,407	0,000*
	Total	0,535	0,000*
Maximum head breadth	Male	0,179	0,184
	Female	0,345	0,000*
	Total	0,187	0,016*

*significant correlation (p<0,05)

skull, face, spine, pelvis, or lower limb fractures, having spinal arch abnormalities (lordosis, kyphosis, scoliosis), having a history of hormonal disorders during the development period, or did not agree to be the subject of the study.

Data collection was performed by measuring minimum frontal diameter, horizontal circumference of head, maximum head breadth, and stature on all subject. Minimum frontal diameter is the most medial distance from the frontotemporal point. Horizontal circumference of head is the maximum head circumference measured from glabella to opisthocranion. Maximum head breadth is the distance of the two most lateral points of the parietal bone (biparietal diameter). Stature is measured from the highest point of the head (vertex) to the lowest point in the calcaneus bone (calcanei tuberosity). Cephalofacial measurement was measured using a measuring tape and calipers, while stature was measured using stature meter.[2,9]

Data distribution is presented descriptively with mean and standard deviation for normal or median data distribution and minimum − maximal value for abnormal data distribution. Data analysis was performed using*Pearson* correlation test to determine the correlation between cephalofacialmeasurement and stature. Linear regression test was carried out to determine the stature prediction model based on cephalofacialmeasurement.

3. Results

Table 1 presents the distribution of cephalofacialmeasurement and stature as well as the normality test with gender-based groupings. Table 2 presents the *Pearson* correlation test between minimum frontal diameter and stature, where no significant correlation was found between the two with or without grouping according to gender (p> 0.05).The *Pearson* correlation test in table 2 shows a significant correlation between horizontal circumference of head and stature, with or without grouping by gender (p <0.05). Based on the *Pearson* correlation test between the maximum head breadth and stature in table 2, there is asignificant correlation between the two in groups of

Table 3. Stature Prediction ModelBased on Cephalofacial Measurement

Variabel	Total	Laki-laki	Perempuan
Maximum Head Breadth	124,086+ (2,506 x MHB*)	-	104,787+ (3,515 x MHB*)
Horizontal Circumference of Head	30,424+ (2,350 x HCoH**)	102,750+ (1,180 x HCoH**)	74,694+ (1,487 x HCoH**)

*Maximum Head Breadth

**Horizontal Circumference of Head

Table 4. Comparison of Research on Correlation of CephalofacialMeasurement and Stature

Study	Population	Total	Gender	MFD**	HCoH***	MHB****
Agnihotri (2011)	Indo-Mauritian	75	Male	0,103	0,494*	0,015
		75	Female	0,255*	0,375*	0,193
Krishan (2007)	India Utara	252	Male	0,515*	0,773*	
Kumar (2013)	Haryanvi	400	Male		0,181*	0,321
		400	Female		0,122*	0,008
Sahni (2010)	Barat Laut India	173	Male	0,124		
		127	Female	0,253		
Ezekie (2015)	Igbo	88	Male			0,285*
		123	Female			0,023
		211	Total			0,058
Penelitian ini	South Sumatran	57	Male	0,211	0,426*	0,179
		110	Female	0,058	0,407*	0,345*
		167	Total	0,027	0,535*	0,187*

*significant correlation (p<0,05)
** Minimum Frontal Diameter
*** Horizontal Circumference of Head
**** Maximum Head Breadth

female and the entire population (p <0.05), but did not correlate significantly in the male group. Linear regression tests were performed on cephalofacialmeasurement and stature, and height prediction models were obtained based on table 3.

4. Discussion

Based on table 1, the mean of stature and horizontal circumference of head in maleare greater than female. These results are similar to those of Agnihotri et al which found that male stature and horizontal circumference of head were greater than female.[10]This difference was due to sexual dimorphism that arises when a person experiences growth spurt. Acceleration of growth in female occurs earlier and ends faster than male. The growth period in male also lasts longer so that men will tend to be larger in size than female.[11]

The results of the study also showed that the average minimum frontal diameter and maximum head breadth in femaleare greater than male. Several previous studies have resulted in a comparison of different mean values for the two cephalofacial anthropometric parameters. Based on researches by Ekezie et al. and Sahni et al., it was concluded that the average minimum frontal diameter and maximum head breadth in femalewere greater than that of male.[12,13]In the Agnihotri et alstudy, the two mean cephalofacial anthropometric parameters were greater in male.[10] This difference may be due to dimorphism which also affects the size of a person's head. The fact that there are differences in results from other studies shows the possibility of maximum head breadth and minimum frontal diameter varying more than the size of stature and horizontal circumference of head.

Based on table 2, it can be concluded that there is no significant correlation between minimum head breadth and stature, either with or without grouping by gender. This result is similar to the study by Sahni et al which states that there is no significant correlation between the minimum width of the forehead and height with gender-based stratification.[13] However, some previous studies also showed that a significant correlation was found between minimum head breadth and stature. Research by Krishan and Kumar showed a significant correlation between minimum frontal

diameter and stature.[6]Agnihotri et al in their study found differences in correlation with grouping by gender, wherein female there was a significant correlation, while in male no significant correlation was found.[10]

A significant correlation between horizontal circumference of head and stature both with and without gender grouping is presented in table 2. These results are similar to previous studies conducted by Krishan and Kumar, Agnihotri, and Kumar and Gopichand which state that there is a significant correlation between horizontal circumference of head and stature.[6,10,14]

Pearson correlation analysis test results in Table 2 show a significant correlation between the maximum head breadth and stature on female's groups and the whole subject. This is similar to findings in previous studies where there were differences in the significance of the correlation analysis with gender stratification.The study by Ekezie et al showed a significant correlation between maximum head breadth and stature in male, while in the same population, no significant correlation was found in female and in overall subjects of the study.[12] Research by Kumar and Gopichand, and Agnihotri et al showed no significant correlation between maximum head breadth and stature in both gender.[10,14]

The significant result of correlation analysis on horizontal circumference of head and stature indicates that the greater the horizontal circumference of head, the higher the stature. This is in accordance with the theory that the head will represent approximately 6% of adult height.[15,16] Head and body have different growth speeds so that the proportion of the body will continue to change with growth. Head growth takes place more quickly, especially at the age of gestation until the early age of toddler.[17]Head growth will be followed by height growth in childhood and puberty where the child will experience growth spurt that cause the growth rate takes place faster. At the end of the growth period, where there is no growth in height and head size, the body will reach a peak height and the size of the head can represent part of the height. Head growth is also determined primarily by genetic factors through local epigenetic factors, such as brain growth. Due to the determination of the genetic height of an individual, it can be ascertained that there is a correlation between cephalofacialmeasurement and stature.[10]

The result of correlation analysis of height and two other cephalofacial anthropometric parameters (maximum head breadth and minimum frontal diameter) that did not significantly correlated indicate the existence of uncertainty in the study of correlation between stature and the two cephalofacial anthropometric parameters. This can be due to the large variation in the measurement of the two cephalofacial anthropometric parameters. This variation may not be bound to a person's growth rate so that they do not significantly correlate with stature.

Based on table 3, a person's height can be predicted if the size of the head circumference is horizontal or the maximum width of the head is known. For example, if someone named A has a horizontal head circumference of 60 cm, then based on the height prediction model without gender stratification, the prediction of A's height is 30.424+ (2,350 x 60) = 171,424 cm.

5. Conclusion

Based on the results of this study, the conclusions are as follows:

1. There is no significant correlation between minimum frontal diameter and stature.
2. There are significant correlations between horizontal circumference of head and maximum head breadth toward stature.

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