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The Correlation of Body Height Estimation ond Forearm Length of The Mandailing Batak Tribe in Medan City

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Abstract

The victim identification process is needed to recognize and differentiate the victim from another one. Formulation height estimation is one of the components that can be identified. Long bone measurements such as the forearm are determined to have better results for measuring the height estimation. This study aims to determine the correlation of height estimation with forearm length measurement of the Mandailing Batak tribe in Medan City. A cross-sectional study was performed using 86 sample people. Chi-square Pearson and Spearman tests were used for statistical analysis. There was a significant correlation of height estimation with forearm length with p <0.05.

Keywords: Anthropometry; Height; Identification; forearm length

I. INTRODUCTION

Forensic medicine is a medical science that is useful for identifying irregularities and crimes related to the human body, living or dead. The victim identification process is needed to recognize victims and differentiate one victim from another.[1]

There are some identification methods with high accuracy such as DNA testing, odontology (using dental medical records), and fingerprints.[2] However, not all victims were found with their bodies intact, and forensic identification cannot be done completely for identification the victims. In several cases such as plane explosions, mutilations, bombings, and natural disasters including earthquakes, landslides, and so on, most of the victims only found some parts of their bodies. These conditions made it difficult for forensic identification. Therefore, Disaster Victim Identification (DVI) was created for mass identification of victims who have died in disaster.[2]

The number of mutilation victims is reported to increase. It makes the author think that a victim identification process is needed for investigators to reveal the identity of the mutilation victims.

One component that can be identified to distinguish one victim from another is measuring body height.[3] Height is the measurement of a person when he is still alive, while body length is the measurement of a person (corpse) after death. Therefore, the identification process of estimating a person's height when he was still alive can be done by measuring the body length of the corpse (the length of the corpse) after death. Measuring the length of a corpse if it is still intact is easy for identification, but if the corpse is fragmented or very badly damaged, it is difficult for identification.[4,5]

For the accuracy of the estimation of height, experts have formulated a formula for determining height based on the length of the long bones. Some formulas are formulated based on European (Western) measurements, so when used on Indonesians, the correction factors must be considered. The height estimation can be done by measuring the length of one of the long bones that are still covered with muscle and skin, such as the forearm segment which is formed by 2 long bones (radius and ulna).[4]

Based on this background, researchers want to try to identify the height estimation based on forearm length in the Mandailing Batak tribe. This study's results are hoped can be useful to support forensic identification.

II. METHODS

This research method is observational with a cross-sectional research design. The independent and dependent variables are observed at the same time.

This study was performed using 86 people (total population) including men and women of the Mandailing Batak tribe in the HIMKATANA (Tanggabosi and Boruna Children Association) organization in Medan City. The range age is 21-40 years.

Inclusion criteria are men and women, age group 21-40 years, physically and mentally healthy, native Mandailing Batak tribe, and willing to be research subjects. The native Mandailing Batak tribe are people who are descendants of the Mandailing tribe for three generations without any intermarriage with other tribes. Exclusion criteria are having experienced a fracture or bone disorder that could interfere with measurement results or having a posture disorder.

The tools and materials used in this study are a height meter (Microtoise / Staturmeter) branded GEA SH-2A with a maximum

length of 200 cm, a sliding caliper branded Tricle Brand with a length of 30 cm, informed consent and data sheets for the results of subjects' measurements.

III. RESULT AND DISCUSSION

The variables of this study are shown in descriptive data. The distribution data of respondents is shown in Table 1-3. The correlation of Age, Gender, Right Forearm Length, and Left Forearm Length with Height is shown in Table 4. The regression formula for the correlation between forearm length in males and females is shown in Table 5-6. Comparison of Right Forearm Length Conversion Results Against the Researcher's Formula and Several Existing Formulas are shown in Table 7-8.

TABLE 1. FREQUENCY DISTRIBUTION OF RESPONDENTS' AGE.

Variable	Frequency	Percentage (%)
Age (year)		
21-25	9	10,5
26-30	19	22,1
31-35	27	31,4
36-40	31	36,0
Count	**86**	**100,0**

The largest age group was 36-40 years with a frequency of 31 people (36.0%) and the least was 21-25 years with a frequency of 9 people (10.5%) as shown in Table 1.

TABLE 2. FREQUENCY DISTRIBUTION OF RESPONDENTS' GENDER.

Variable	Frequency	Percentage (%)
Gender		
Male	46	53,5
Female	40	46,5
Count	**86**	**100,0**

The largest gender was male 46 people (53.5%) and the least was female 40 people (46.5%) as shown in Table 2.

TABLE 3. DISTRIBUTION OF AGE, RIGHT FOREARM LENGTH, LEFT FOREARM LENGTH, AND RESPONDENTS' BODY HEIGHT

Variable	Min	Max	Average	Deviation Standard
Age	21	40	32,55	5,054
Right Forearm Length	23,3	31,4	26,23	1,479
Left Forearm Length	23,2	30,5	26,05	1,465
Height	149,2	185,1	161,58	6,411

Table 3 shows 86 respondents with minimum age is 21 years and maximum age is 40 years with a mean of 32.55 ± 5.054 years. The shortest right forearm length was 23.3 cm, and the longest was 31.4 cm with a mean of 26.23 ± 1.479 cm. The shortest left forearm length was 23.2 cm, and the longest was 30.5 cm with a mean of 26.05 ± 1.465 cm. The lowest height was 149.2 cm, and the highest height was 185.1 cm with a mean of 161.58 ± 6.411 cm.

TABLE 4. THE CORRELATION OF AGE, GENDER, RIGHT FOREARM LENGTH, AND LEFT FOREARM LENGTH WITH HEIGHT.

Variable	Height		
	Frequency (n)	*p*	Correlation value *(r)*
Age	86	0,009[a*]	0,280
Gender	86	0,000[a*]	-0,586
Right Forearm Length	86	0,000[b*]	0,774
Left Forearm Length	86	0,000[b*]	0,858

a Spearman Correlation Test
b Pearson Correlation Test
*Significant

Table 4 revealed there was a correlation between respondent's age and height with $p<0.05$. Spearman correlation value (r) was 0.280. It showed that there is a very weak positive correlation between gender and height. Regarding the respondent's gender, it is known that there is a correlation between

gender and height (p<0.05). The Spearman correlation value (r) is -0.586 which showed a weak negative correlation between gender and height. For the right forearm length, it was found that there was a correlation between the right forearm length and height (p<0.05). The Pearson correlation value (r) is 0.774, which means there is a strong relationship between the right forearm length and height. The left forearm length and height analysis showed there was a correlation (p<0.05). The Pearson correlation value (r) was 0.858, which means there is a strong correlation between the left forearm length and height.

TABLE 5. REGRESSION FORMULA FOR THE CORRELATION BETWEEN FOREARM LENGTH IN MEN.

Forearm	Regression formula	*p*	r^2
Right Forearm	87,150 + 2,905 (Right Forearm)	0,000	0,507
Left Forearm	66,323 + 3,700 (Left Forearm)	0,000	0,746

Table 5 showed the regression formula for the right forearm has a p-value <0.05, meaning that the resulting regression formula is worthy of use. The r^2 value obtained was 0.507, meaning that the regression formula was able to explain height with 50.7%, and 49.3% explained by other variables that were not studied in this research. The regression formula for the left forearm has a p-value <0.05, meaning that the resulting regression formula is suitable for use. The r^2 value obtained was 0.746, meaning that the regression formula could explain 74.6% of height, and 25.4% was explained by other variables not studied.

TABLE 6. REGRESSION FORMULA FOR THE RELATIONSHIP BETWEEN FOREARM LENGTH IN WOMEN

Forearm	Regression formula	*p*	r^2
Right Forearm Length	88,134 + 2,717 (Right Forearm length)	0,000	0,540
Left Forearm Length	91,540 + 2,609 (Left Forearm Length)	0,000	0,504

Table 6 revealed the regression formula for the right forearm has a p-value <0.05, meaning that the resulting regression formula is suitable for use. The r^2 value was 0.540, meaning that the regression formula was able to explain height by 54.0%, and 46.0% was explained by other variables not studied. The regression formula for the left forearm also has a p-value <0.05, meaning that the resulting regression formula is suitable for use. The r^2 value obtained was 0.504, meaning that the regression formula was able to explain height by 50.4%, and 49.6% was explained by other variables not studied.

This study showed a significant correlation consistent with the other research which correlated forearm length with height by Trotter-Glesser (1958) by a regression formula; Height = 3.48 x (Ulna) + 77.5 ± 4.8, UGM Physical Anthropology with the regression formula; Height = 819 + 3.15y (Right Ulna) and Height = 847 + 3.05y (Left Ulna), and Amri Amir with the regression formula; Height = 2.88 x (Ulna) + 91.27 (Male-male) and Height = 2.85 x (Ulna) + 86.75 (Female).

TABLE 7. COMPARISON OF RIGHT FOREARM LENGTH CONVERSION RESULTS AGAINST THE RESEARCHER'S FORMULA AND SEVERAL EXISTING FORMULAS.

Subject	Right Frearm Length 9cm)	Actual Height (cm)	Researcher's Formulation (cm)	Trotter Glesser (cm)	Physical Antrhopology (cm)	Amri Amir (cm)
RS.06 (M)	27.0	166.8	165.6	166,6-176.3	166.9	169.0
RS.32 (F)	25.8	159.2	158.2	162.5-172.1	163.2	160.3
RS.48 (M)	29.3	176.3	172.3	174.7-184.3	174.2	175.6
RS.55 (F)	23.5	154.3	151.9	154,5-164.1	155.3	153.7
RS.83 (M)	25.9	160.7	162.4	162.8-172.4	163.5	165.9

TABLE 8. COMPARISON OF LEFT FOREARM LENGTH CONVERSION RESULTS AGAINST THE RESEARCHER'S FORMULA AND SEVERAL EXISTING FORMULAS.

Subject	Right Frearm Length 9cm)	Actual Height (cm)	Researcher's Formulation (cm)	Trotter Glesser (cm)	Physical Antrhopology (cm)	Amri Amir (cm)
RS.06 (M)	26.5	166.8	164.4	164,9-174.5	165.5	167.6
RS.32 (M)	25.2	159.2	157.3	160.4-169.9	161.5	158.5
RS.48 (M)	29.3	176.3	174.7	174.7-184.3	174.1	175.6
RS.55 (M)	23.6	154.3	154.3	154,8-164.4	156.7	154.0
RS.83 (M)	25.6	160.7	160.7	161.8-171.4	162.9	164.9

Information :
RS: Research Subject
M: Male
F: Female

Table 7 and Table 8 showed the significant results for the regression formula performed with the actual height estimation. Therefore, the regression formula created by researchers can add a new vocabulary in terms of determining height estimation based on the forearm length, especially if the forearm is still complete (still wrapped by muscle and skin). So this researcher's regression formula can be carried out on mutilation victims whose bodies are still intact (not only bones/skeletons).

IV. CONCLUSION

This study used 86 samples taken randomly from the population. There is a relationship between age and height of respondents with a value ($p < 0.05$) with a Spearman correlation value (r) of 0.280 which indicates that there is a very weak positive correlation for the relationship between age and height of respondents. There is a relationship between gender and height of respondents with a value ($p < 0.05$) and the Spearman correlation value (r) of -0.586 which indicates a weak negative correlation for the relationship between gender and height of respondents. From the results of this study, it can be seen that the longer the respondent's right lower arm, the taller the respondent's body, and the same applies to the length of the respondent's left lower arm.

The linear regression formula in women for the right lower arm has a p-value <0.05 and the r2 value obtained is 0.540, meaning the regression formula can explain height by 54.0%, the remaining 46.0% is explained by other variables that were not studied. While the left upper arm regression formula also has a p value <0.05 and the r2 value obtained is 0.504, the regression formula can explain height by 50.4%, the remaining 49.6% is explained by other variables that were not studied. The results of this study showed that the length of the lower arm and height in women had a significant correlation, with a very strong correlation.

There is a wide variation in estimating height from forearm length measurements of people from different regions and races. Therefore, further research is needed and with a larger sample among people from different regions and ethnicities so that height estimation becomes more reliable and individual identity is easy to determine.

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