CORRELATION BETWEEN DIMENSION OF FINGERS PHALANX PROXIMAL AND HEIGHT IN THE AGE OF 18-45 YEARS OLD

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Abstract: Height is one of the data needed in forensic identification process of a remains that is difficult to identify in an incomplete condition. Height estimation can be determined by the proximal phalanx of the fingers which are long bones. This study was conducted on 113 men and 125 women in several places in Riau Province age 18 - 45 years. The height and dimensions of the proximal phalanx of the fingers are measured to get the correlation and linear regression formula for height. There are 6 dimensions measured on the fingers of the left and right hand. The study design was cross sectional. The statistical test used is Pearson correlation to determine the correlation between dimensions of the proximal phalanx on fingers with height and linear regression analysis for height regression formula. The results show that some dimensions of the proximal phalanx of the fingers are significantly correlated with height.

Keywords: identification, height, dimensions of the proximal phalanx bone fingers, correlation, regression formula.
INTRODUCTION

Forensic identification is a process that has an primary role in the examination of someone who has died due to several events such as accidents, natural disasters, killing, and parts of the human body or a mutilated, amputated and decomposed framework. Identification process can be more demanding when the corpse condition is heavily damaged, mutilated, or only as the bones that made it hard to be identified. One way to do forensics identification is identifying the bones, using human bones. Bones identification can be used to prove that the bone or skeleton found is human bone or skeleton, approximation of height, race, gender, age, and special marks.

In a certain condition, the corpse height can not be determined, and need another parameter from the other body parts to approximate the height. Determination of height can use certain long bones and complementary bones because the proportion of body parts can represent an estimate of height. The existence of this relationship is very important in anthropology and medicolegal in determining height and based on race. The principle of identifying the framework for estimating body height is to utilise the formula for approximating the height of certain body parts. Determining the specific features and similarities of a race can also be done through approximating the body height using bone. The three main races in human population spreaded all over the word are caucasian, negroid, and mongoloid. Trotter and Gleser stated that there are differences in the correlation of heigth and the length of long bone in those three races, so that a proper regression equation is needed to determine a person's height that belongs to a racial group.

Human height after aged 45 years old will be shorten around 0.16 cm in every year that determination of height approximation using certain bone will be more accurate if the respondence is under 45 years old. The corpse from natural disasters, traffic accidents, or crimanal doing often in an incomplete condition and found only for some of the body parts. This condition causes the investigators face difficulties to identify the victim. The victim who is found only some of his body parts needs skeleton identification through determination of approximated height whis is the main step in medicolegal because if there is an error in identifying victim, will make a fatal result in the justice process.

Although there has been some study about height approximating using the size of fingers phalanx, but the regression formula is different because done in different country and race. The coefisien value of the proximal phalanx size to height in the study result shows the most significant than medial and distal phalanx.

The need to find a regression model to find the approximate height formula using the dimensions of the phalanx fingers is still needed because there are different regression formulas in different populations and countries and this research has never been done in Indonesia. Shintaku et al in 1990 examined estimates of height based on proximal phalanx bone length in 213 Japanese women aged 18-39 years. The results obtained are a significant correlation with the correlation coefficient (r) 0.521 - 0.696. In 2010, Habib and Kamal conducted a study of approximated height and length of hands and fingers on 159 students (77 women and 82 men) who live in Egypt. The results obtained are significant (p <0.05) indicating that the phalanx bone can be used as a benchmark in measuring a person's height. Based on the description that has been described, the researcher wants to conduct a study to analyze the correlation and determine the approximate height formula using the dimensions of the proximal phalanx bone size of the fingers in Riau Province.

RESEARCH METHOD

This research is an analytic – cross sectional research, aimed to determine the
correlation between the dimensions of the proximal phalanx fingers and human body height, and to determine the formulas of body height approximation based on the dimension of proximal phalanx fingers according to its gender. The population was people who lives in Riau with age range 18 – 45 years old. There were 238 samples (113 of men and 125 of women) taken using accidental sampling technique. The research tools were vernier caliper, staturemeter, and quisineer. The variables were dimensions of the proximal phalanx fingers and human body height. Inclusion criteria in this research was people in 18 – 45 years old, mongoloid, Riau’s people, and agreed to be a sample and fulfill the research procedure and signed the informed consent. The exclusion criteria was having bones abnormality that can affect body height and deformity of phalanx proximal of finger. The obtained data was analyzed using statistic computer and served as table.

RESULTS AND DISCUSSION

Characteristics of research respondents are listed in Table 1, which obtained a total sample of 238 people (113 men and 125 women).

Table 1 The Characteristics of Respondents based on Genders and Ages

| Gender       | Age (y.o) |        |        |
|--------------|-----------|--------|--------|
|              | Median    | Min    | Max    |
| Male (n=113) | 21        | 18     | 45     |
| Female (n=125)| 22        | 18     | 45     |

Table 2 shows descriptive statistics of height measurements and Table 3 shows descriptive statistics of the dimensions of the proximal phalanx bones of the fingers of male and female respondents.

Table 2 Respondents Height based on Genders

| Variable | Male (n=113) | Female (n=125) |
|----------|--------------|----------------|
|          | Median       | Min | Max | SD | Median | Min | Max | SD |
| TB       | 166.277      | 155 | 181 | 5.870 | 156.808 | 145 | 171 | 5.375 |
### Table 3: Dimension Value of Phalanx Bone Proximal Fingers Size Left Hand and Right Hand by Gender

| Variable (cm) | Left (n=113) | Right (n=113) | Left (n=125) | Right (n=125) |
|---------------|--------------|---------------|--------------|---------------|
|               | Median       | SD            | Median       | SD            |
| Thumb (D1)    |              |               |              |               |
| D1P           | 4.64         | 0.32          | 4.60         | 0.39          |
| D1LBs         | 2.10         | 0.22          | 2.15         | 0.26          |
| D1TBs         | 2.08         | 0.24          | 2.15         | 0.21          |
| D1LKr         | 1.37         | 0.18          | 1.38         | 0.15          |
| D1LKp         | 1.63         | 0.20          | 1.70         | 0.19          |
| D1TKp         | 1.40         | 0.14          | 1.45         | 0.18          |
| Index Finger (D2) |          |               |              |               |
| D2P           | 5.73         | 0.41          | 5.73         | 0.39          |
| D2LBs         | 2.05         | 0.36          | 2.06         | 0.33          |
| D2TBs         | 2.19         | 0.27          | 2.26         | 0.23          |
| D2LKr         | 1.37         | 0.18          | 1.41         | 0.15          |
| D2LKp         | 1.52         | 0.18          | 1.58         | 0.15          |
| D2TKp         | 1.43         | 0.43          | 1.45         | 0.17          |
| Middle Finger (D3) |         |               |              |               |
| D3P           | 6.18         | 0.55          | 6.24         | 0.45          |
| D3LBs         | 1.71         | 0.30          | 1.79         | 0.28          |
| D3TBs         | 2.26         | 0.40          | 2.37         | 0.38          |
| D3LKr         | 1.31         | 0.16          | 1.33         | 0.16          |
| D3LKp         | 1.54         | 0.18          | 1.58         | 0.17          |
| D3TKp         | 1.47         | 0.16          | 1.55         | 0.17          |
| Ring Finger (D4) |             |               |              |               |
| D4P           | 5.71         | 0.41          | 5.77         | 0.35          |
| D4LBs         | 1.48         | 0.25          | 1.48         | 0.27          |
| D4TBs         | 2.00         | 0.32          | 2.09         | 0.38          |
| D4LKr         | 1.21         | 0.17          | 1.25         | 0.18          |
| D4LKp         | 1.44         | 0.18          | 1.48         | 0.15          |
| D4TKp         | 1.40         | 0.14          | 1.45         | 0.15          |
| Little Finger (D5) |          |               |              |               |
| D5P           | 4.66         | 0.41          | 4.80         | 0.48          |
| D5LBs         | 1.63         | 0.34          | 1.79         | 0.37          |
| D5TBs         | 1.80         | 0.28          | 1.86         | 0.32          |
| D5LKr         | 1.15         | 0.13          | 1.18         | 0.15          |
| D5LKp         | 1.26         | 0.14          | 1.31         | 0.21          |
| D5TKp         | 1.19         | 0.16          | 1.24         | 0.14          |

D1: Proximal thumb phalanx  
D2: Proximal phalanx of the index finger  
D3: Proximal phalanx of middle finger  
D4: Proximal phalanx of ring finger  
D5: Proximal phalanx of little finger  
P: Proximal phalanx bone length  
TBs: Thick base of proximal phalanx  
LKr: Width of corpus proximal phalanx  
LKp: The width of the proximal phalanx head  
TKp: The thick of proximal phalanx head  
LBs: Base width of proximal phalanx  
SB: Standard deviation
There are differences in results between the genders: the size is greater for male respondents than for women. This is because there are differences in sexual dimorphism in terms of duration and a faster growth rate in men than women. Another theory states that the ratio of the difference in height of men and women is 100:90 so that there are indirectly differences in the dimensions of the size of the proximal phalanx of the fingers based on gender. The difference in the average value of the dimensions of fingers proximal phalanx between the male and female in Mahakkanukrauh P studies compared by the researchers was based on the state of the bones when measured. The Mahakkanukrauh P study was carried out directly on the proximal phalanx bone in dry conditions, while the researchers took measurements of the condition of the tissue that was still clad in skin, muscle, cartilage, and joints. The correction factor for proximal phalanx bone size has not yet been found so that the results of this research are better applied to the condition of intact fingers.

The analysis result of correlation between the dimensions of the size of the proximal phalanx of the fingers based on gender served in Table 4. The correlation coefficient obtained in varies. In male respondents, the highest correlation value (r) dimension of the proximal phalanx bone of the left hand was the length of the proximal phalanx of the left index finger (D2P) which showed a positive correlation with moderate correlation strength, which was 0.475 and the significance value (p) <0.01. On the right side, the highest correlation coefficient (r) for female respondents was the length of right proximal phalanx bone (D4P) which showed a positive correlation with moderate correlation 0.494 and the significance value (p) <0.01.

From female respondents obtained the correlation value (r) the highest dimension of the proximal phalanx of the left hand finger was width of proximal phalanx base of the left ring finger (D4LBs) which showed a positive correlation with moderate correlation, which was 0.398 and the significance value (p) <0.01. On the right side, the highest correlation coefficient (r) for female respondents was the length of right proximal phalanx bone (D4P) which showed a positive correlation with moderate correlation 0.494 and the significance value (p) <0.01. Research by Habib SR and Kamal NN as well as Jasuja OP and Singh G also found the length of proximal phalanx of ring finger (D4P) as a dimension the proximal phalanx bone size with the highest correlation of the length of the other fingers proximal phalanx to height but on the left. Correlation coefficient (r) in both studies were 0.36611 and 0.4796 (medium correlation strength), respectively.

The difference in correlation between the size dimensions of the proximal phalanx of male and female respondents in this study might be due to differences in the number of respondents, height, and the determination of anatomical points of the dimensions of the size of the proximal phalanx bone of the fingers. The difference in the value of the correlation coefficient (r) of this study with previous studies is due to location and different ethnic types. Factors that influence height growth include ethnic or race. Each race has different bone characteristics and density so that it affects body height.
| Variable (cm) | Male (n=113) | Female (n=125) |
|--------------|--------------|----------------|
|              | Left         | Right          | Kiri          | Left          |
| D1P          | 0.410**      | 0.000          | 0.518**      | 0.000         | 0.191*     | 0.033 | 0.044 | 0.627 |
| D1LBs        | 0.298**      | 0.001          | 0.243**      | 0.010         | 0.107     | 0.234 | 0.208* | 0.020 |
| D1TBs        | 0.318**      | 0.001          | 0.376**      | 0.000         | 0.235**   | 0.008 | 0.367** | 0.000 |
| D1LKr        | 0.110        | 0.246          | 0.123        | 0.195         | 0.180*    | 0.045 | 0.157    | 0.081 |
| D1Lkp        | 0.362**      | 0.000          | 0.297**      | 0.001         | 0.047     | 0.606 | 0.213*   | 0.017 |
| D1TKp        | 0.172        | 0.069          | 0.025        | 0.792         | 0.214*    | 0.017 | 0.245** | 0.006 |
| Index Finger (D2) |            |                |              |               |           |       |         |     |
| D2P          | 0.475**      | 0.000          | 0.539**      | 0.000         | 0.365**   | 0.000 | 0.199*   | 0.026 |
| D2LBs        | 0.221*       | 0.019          | 0.194*       | 0.039         | -0.167    | 0.063 | -0.106   | 0.240 |
| D2TBs        | 0.238*       | 0.011          | 0.315**      | 0.001         | 0.142     | 0.114 | 0.352**  | 0.000 |
| D2LKr        | 0.288**      | 0.002          | 0.273**      | 0.003         | 0.229*    | 0.010 | 0.184*   | 0.040 |
| D2Lkp        | 0.270**      | 0.004          | 0.255**      | 0.006         | 0.146     | 0.104 | 0.131    | 0.145 |
| D2TKp        | -0.008       | 0.929          | 0.224*       | 0.017         | 0.197*    | 0.027 | 0.277**  | 0.002 |
| Middle Finger (D3) |            |                |              |               |           |       |         |     |
| D3P          | 0.402**      | 0.000          | 0.583**      | 0.000         | 0.394*    | 0.000 | 0.188*   | 0.036 |
| D3LBs        | 0.209*       | 0.026          | 0.146        | 0.122         | 0.141     | 0.117 | 0.229*   | 0.010 |
| D3TBs        | 0.453**      | 0.000          | 0.405**      | 0.000         | 0.057     | 0.530 | 0.243**  | 0.006 |
| D3LKr        | 0.260**      | 0.005          | 0.257**      | 0.006         | 0.310*    | 0.000 | 0.318**  | 0.000 |
| D3Lkp        | 0.348**      | 0.000          | 0.299**      | 0.001         | 0.113     | 0.209 | 0.064    | 0.480 |
| D3TKp        | 0.280**      | 0.003          | 0.143        | 0.130         | 0.317**   | 0.000 | 0.317**  | 0.000 |
| Ring Finger (D4) |            |                |              |               |           |       |         |     |
| D4P          | 0.430**      | 0.000          | 0.475**      | 0.000         | 0.380*    | 0.000 | 0.494**  | 0.000 |
| D4LBs        | 0.105        | 0.266          | 0.258**      | 0.006         | 0.398*    | 0.000 | -0.070   | 0.436 |
| D4TBs        | 0.369**      | 0.000          | 0.293**      | 0.002         | 0.075     | 0.409 | 0.120    | 0.182 |
| D4LKr        | 0.315**      | 0.001          | 0.225*       | 0.016         | 0.225*    | 0.012 | 0.185*   | 0.039 |
| D4Lkp        | 0.344**      | 0.000          | 0.293**      | 0.002         | 0.063     | 0.482 | 0.086    | 0.340 |
| D4TKp        | 0.284**      | 0.002          | 0.195*       | 0.039         | 0.251**   | 0.005 | 0.257**  | 0.004 |
| Little Finger (D5)  |            |                |              |               |           |       |         |     |
| D5P          | 0.440**      | 0.000          | 0.329**      | 0.000         | 0.288**   | 0.001 | 0.471**  | 0.000 |
| D5LBs        | 0.261*       | 0.005          | 0.175        | 0.064         | -0.416**  | 0.000 | -0.229*  | 0.010 |
| D5TBs        | 0.395**      | 0.000          | 0.295**      | 0.002         | 0.235**   | 0.008 | 0.183*   | 0.041 |
| D5LKr        | 0.250**      | 0.008          | 0.265**      | 0.004         | 0.234**   | 0.009 | 0.163    | 0.070 |
| D5Lkp        | 0.199*       | 0.034          | 0.184        | 0.051         | 0.150     | 0.095 | 0.180*   | 0.045 |
| D5TKp        | 0.108        | 0.253          | 0.283**      | 0.002         | 0.237**   | 0.008 | 0.285**  | 0.001 |

**Significant at level 0.01 (2-tailed)  
*Significant at level 0.05 (2-tailed)

LBs: Base width of proximal phalanx  
TBs: Thick base of proximal phalanx  
LKr: Width of corpus proximal phalanx  
LKP: The width of the proximal phalanx head  
TKp: The thick of proximal phalanx head  
r: Coefficient of correlation  
p: Value of significance (p value)
The length of the proximal phalanges in each finger was the dimension that most correlated with height in the results of this study. This discovery was due to a relationship between the growth of long bones in line with human height. Estimates of height in forensic identification are more often used to measure the length of the long bones because they have a stronger correlation with minimal errors. Methods of measuring height using long bones for the purposes of forensic identification are increasingly being developed. The reason is that the condition of the corpse is in a fragmented state and only in the form of remains of certain body parts which will make examination and analysis for medicolegal purposes more difficult. The remaining parts of the body that are found are not always in the form of the bones of the upper limbs, lower limbs and arm bones which are long bones so that it is necessary to develop various new measurement methods with other long bones, one of which is the phalanx. The results of the correlation analysis in this study indicate that the proximal phalanx bone can be used as a new method in the application of forensic identification because it has a significant correlation with height on several measurement dimensions, especially the length of the proximal phalanx bone.

Linear regression analysis in this study is listed in Table 5. The formulas for estimating height obtained using linear regression are obtained using the dimensions of the bone size of the proximal phalanx of the fingers which have a significant correlation. This research was conducted in the age range 18-45 years, so a correction factor is needed for the use of the formula for estimating height at over 25 years of age of 0.16 cm per year.

The comparison of the results of the height of this study with the Jasuja OP-Singh G and Habib SR-Kamal NN formulas is listed in Table 6. The Jasuja OP-Singh G formula was carried out in 2004 with a total of 60 respondents from the population of the Jat Sikh tribe in North India who are the Mongoloid race. The Habib SR-Kamal NN formula was carried out in 2009 with a total of 159 respondents in the population in Egypt and various unknown races.

The regression formula that can be compared is that there is a variable length size of the proximal phalanx of the index finger to the little finger. From the comparison of formulas in Table 5, the difference in height results is quite large in the use of the Jasuja OP-Singh G and Habib SR-Kamal NN formulas than the researchers' formulas when compared to actual height. The difference between the results of the researcher's formula and the actual height is not that far and can still represent a person's height. Meanwhile, the Jasuja OP-Singh G and Habib SR-Kamal NN formulas showed very different height results. This is based on the average height of respondents in the Jasuja OP-Singh G and Habib SR-Kamal NN studies with different researchers and carried out on populations in different countries. Height growth is influenced by ethnicity and race, which means that the application of the height regression formula should be adjusted according to the origin of the population in the research that has been carried out in order to obtain more accurate results. Gender is also a factor that differentiates human height growth, so it is necessary to determine a regression formula for estimating height according to sex. Variations in determining body height based on bone have been widely used, but the most accurate and reliable is the linear regression method.
Table 5 Formulas for Estimating Height with Dimensions of the Proximal Phalanx Bone Size of the Fingers based on Gender

| Gender | Variable | \( r \) | Linear Regression | SEE  |
|--------|----------|--------|-------------------|------|
| Male   | Left     |        |                   |      |
|        | D1P      | 0.410  | \( TB = 131.69 + 7.45(D1P) \) | 5.38 |
|        | D1LBs    | 0.298  | \( TB = 149.60 + 7.95(D1LBs) \) | 5.63 |
|        | D1TBs    | 0.318  | \( TB = 150.03 + 7.80(D1TBs) \) | 5.59 |
|        | D1LKp    | 0.362  | \( TB = 149.16 + 10.48(D1LKp) \) | 5.50 |
|        | D2P      | 0.475  | \( TB = 127.13 + 6.83(D2P) \) | 5.19 |
|        | D2LKr    | 0.288  | \( TB = 153.08 + 9.62(D2LKr) \) | 5.64 |
|        | D2LKp    | 0.270  | \( TB = 152.95 + 8.79(D2LKp) \) | 5.68 |
|        | D3P      | 0.402  | \( TB = 139.64 + 4.31(D3P) \) | 5.40 |
|        | D3TBs    | 0.453  | \( TB = 151.24 + 6.66(D3TBs) \) | 5.26 |
|        | D3LKp    | 0.348  | \( TB = 149.05 + 11.19(D3LKp) \) | 5.53 |
|        | D3TKp    | 0.280  | \( TB = 150.72 + 10.57(D3TKp) \) | 5.66 |
|        | D4P      | 0.430  | \( TB = 131.42 + 6.11(D4P) \) | 5.32 |
|        | D4TBs    | 0.369  | \( TB = 152.81 + 6.74(D4TBs) \) | 5.48 |
|        | D4LKr    | 0.315  | \( TB = 153.29 + 10.75(D4LKr) \) | 5.60 |
|        | D4LKp    | 0.344  | \( TB = 149.71 + 11.49(D4LKp) \) | 5.54 |
|        | D4TKp    | 0.284  | \( TB = 150.19 + 11.52(D4TKp) \) | 5.65 |
|        | D5P      | 0.440  | \( TB = 136.96 + 6.29(D5P) \) | 5.29 |
|        | D5TBs    | 0.395  | \( TB = 151.50 + 8.21(D5TBs) \) | 5.42 |
|        | Right    |        |                   |      |
|        | D1P      | 0.518  | \( TB = 129.99 + 7.89(D1P) \) | 5.05 |
|        | D1TBs    | 0.376  | \( TB = 144.02 + 10.35(D1TBs) \) | 5.46 |
|        | D1LKp    | 0.297  | \( TB = 150.74 + 9.15(D1LKp) \) | 5.63 |
|        | D2P      | 0.539  | \( TB = 119.48 + 8.16(D2P) \) | 4.96 |
|        | D2TBs    | 0.315  | \( TB = 147.96 + 8.11(D2TBs) \) | 5.60 |
|        | D2LKr    | 0.273  | \( TB = 151.51 + 10.49(D2LKr) \) | 5.67 |
|        | D3P      | 0.583  | \( TB = 118.92 + 7.59(D3P) \) | 4.79 |
|        | D3TBs    | 0.405  | \( TB = 151.57 + 6.20(D3TBs) \) | 5.39 |
|        | D3LKp    | 0.299  | \( TB = 150.17 + 10.20(D3LKp) \) | 5.63 |
|        | D4P      | 0.475  | \( TB = 120.48 + 7.94(D4P) \) | 5.19 |
|        | D4TBs    | 0.293  | \( TB = 156.73 + 4.57(D4TBs) \) | 5.64 |
|        | D4LKr    | 0.293  | \( TB = 149.13 + 11.56(D4LKr) \) | 5.64 |
|        | D4LKp    | 0.329  | \( TB = 146.94 + 4.03(D5P) \) | 5.57 |
|        | D5P      | 0.295  | \( TB = 156.19 + 5.41(D5TBs) \) | 5.63 |
|        | D5TBs    | 0.265  | \( TB = 153.69 + 10.68(D5LKr) \) | 5.68 |
|        | D5TKp    | 0.283  | \( TB = 151.98 + 11.51(D5TKp) \) | 5.65 |
| Female | Left     |        |                   |      |
|        | D2P      | 0.365  | \( TB = 126.31 + 5.92(D2P) \) | 5.03 |
|        | D3P      | 0.394  | \( TB = 128.34 + 5.03(D3P) \) | 4.96 |
|        | D3TKp    | 0.317  | \( TB = 145.07 + 9.03(D3TKp) \) | 5.12 |
|        | D4P      | 0.380  | \( TB = 127.67 + 5.64(D4P) \) | 4.99 |
|        | D4LBs    | 0.398  | \( TB = 148.20 + 6.93(D4LBs) \) | 4.95 |
|        | D5P      | 0.288  | \( TB = 142.42 + 3.46(D5P) \) | 5.17 |
|        | Right    |        |                   |      |
|        | D1TBs    | 0.367  | \( TB = 144.60 + 6.64(D1TBs) \) | 5.02 |
|        | D2TBs    | 0.352  | \( TB = 145.59 + 5.81(D2TBs) \) | 5.05 |
|        | D3LKr    | 0.318  | \( TB = 147.25 + 7.91(D3LKr) \) | 5.12 |
|        | D3TKp    | 0.317  | \( TB = 144.52 + 9.01(D3TKp) \) | 5.12 |
|        | D4P      | 0.494  | \( TB = 131.89 + 4.81(D4P) \) | 4.69 |
|        | D5P      | 0.471  | \( TB = 141.21 + 3.63(D5P) \) | 4.76 |
|        | D5TKp    | 0.285  | \( TB = 147.89 + 8.45(D5TKp) \) | 5.17 |
Hafizah, TL. et al. Correlation between Dimension of...

D1: Proximal thumb phalanx
D2: Proximal phalanx of the index finger
D3: Proximal phalanx of middle finger
D4: Proximal phalanx of ring finger
D5: Proximal phalanx of little finger
P: Proximal phalanx bone length
LBs: Base width of proximal phalanx
TBs: Thick base of proximal phalanx
LKr: Width of corpus proximal phalanx
LKp: The width of the proximal phalanx head
TKp: The thick of proximal phalanx head
r: Coefficient of correlation
SEE: Standard Error of Estimate

Table 6 Comparison of Height Measures with Researcher’s Formula, Jasuja OP-Singh G, and Habib SR-Kamal NN

| Gender | Finger | Peneliti | Jasuja OP-Singh G | Habib SR-Kamal NN | The Real Height |
|--------|--------|----------|-------------------|-------------------|----------------|
|        |        | Left     | Right             | Left              | Right          |                |
| Male   | D2P    | 169,50   | 171,46            | 204,93 –         | 206,33 –       | 199,14 – 220,12 – |
|        |        | 214,59   | 215,99            | 213,44 –         | 233,86 –       |                |
|        | D3P    | 168,00   | 167,90            | 177,33 –         | 177,11 –       | 230,86 – 237,57 – |
|        |        | 188,13   | 187,91            | 243,96 –         | 251,15 –       |                |
|        | D4P    | 169,00   | 169,47            | 180,13 –         | 180,17 –       | 234,36 – 231,42 – |
|        |        | 190,91   | 190,95            | 247,36 –         | 244,66 –       |                |
|        | D5P    | 167,40   | 166,93            | 183,84 –         | 184,37 –       | 193,49 – 202,00 – |
|        |        | 185,33   | 194,86            | 206,95 –         | 215,74 –       |                |
| Female | D2P    | 154,13   | -                 | 161,47 –         | 161,75 –       | 167,86 – 183,87 – |
|        |        | 171,94   | 172,21            | 178,54 –         | 194,05 –       |                |
|        | D3P    | 154,50   | -                 | 156,65 –         | 156,65 –       | 189,08 – 196,61 – |
|        |        | 167,17   | 167,17            | 199,36 –         | 206,35 –       |                |
|        | D4P    | 154,74   | 157,38            | 160,24 –         | 161,30 –       | 177,82 – 189,81 – |
|        |        | 170,68   | 171,74            | 188,04 –         | 200,01 –       |                |
|        | D5P    | 154,88   | 151,37            | 156,30 –         | 155,53 –       | 170,37 – 163,22 – |
|        |        | 166,82   | 166,05            | 180,33 –         | 173,06 –       |                |

D2P: Height of Proximal phalanx of the index finger
D3P: Height of Proximal phalanx of middle finger
D4P: Height of Proximal phalanx of ring finger
D5P: Height of Proximal phalanx of little finger

This research height formula can be a new formula in determining height based on the length of the proximal phalanx of the fingers in men and women, especially in Indonesia. The importance of this researcher’s regression formula is because it was examined on a sample that is still complete and allows for victims of accidents, mutilations, and natural disasters whose bodies are still intact and have not become bones. The number of height regression formulas found in this study can be applied to the condition of the discovery of bodies where only the proximal phalanx of the fingers is not intact and can only be measured one dimension of the proximal phalanx bone only.

CONCLUSION

Based on the results and discussion above, it can be concluded that there is a significant relationship between several dimensions of the size of the proximal phalanx of the fingers with height based on sex and a height regression formula can be searched based on the dimensions of the proximal phalanx bone size of the fingers in males and females. It is necessary to conduct a research estimating the height at the age under 18 years so that it can be used
in the population of children and adolescents.

It is also necessary to do research on correction factors for the population in Indonesia on soft tissue, muscles, skin, cartilage, and joints in the proximal phalanx of the fingers so that an estimate of height is more accurate based on the dimensions of the size of the proximal phalanx of the fingers.

REFERENCES
1. Hidayat T, Susanti R. Analisis antropologi forensik pada kasus penemuan rangka dalam koper. Prosiding Pertemuan Ilmiah Tahunan Perhimpunan Dokter Forensik Indonesia; 2017 15-16 Juli; Pekanbaru, Indonesia.
2. Ismail TS, Syahrul S, Mirza RM. Perkiraan tinggi badan berdasarkan panjang jari tengah tangan. JKM. 2018;1(2):67-72.
3. Chikhalkar BG, Mangaonkar AA, Nanandkar SD, Peddawad RG. Estimation of stature from measurements of long bones, hand, and foot dimensions. J Indian Acad Forensic Med. 2009;32(4):329-31.
4. Budiyanto A, Widiatmaka W, Sudiono S, Mun'im TW, Sidhi, Hertian S, et al. Ilmu kedokteran forensik. Jakarta. Kedokteran Forensik Fakultas Kedokteran Universitas Indonesia; 1997.
5. Patel SM, Shah, Patel SV. Estimation of height from measurements of foot length in Gujarat Region. J Anat Soc India. 2007;56(1):25-7.
6. Jasuja OP, Singh G. Estimation of stature from hand and phalanx length. J Indian Acad Forensic Med. 2004;26(3):100-6.
7. Albanese J, Tuck A, Gomes J, Cardoso HFV. An alternative approach for estimating stature from long bones that is not population- or group-specific. Forensic Sci Int. 2016;259:59-68.
8. Iscan MY, Steyn M. The human skeleton in forensic medicine. USA: Charles C Thomas Ltd; 2013
9. Chauhan A, Tyagi N, Shukla SK. Utilization of index finger’s length in stature establishment and sex determination of the population of Rajasthan Region of India. J Forensic Sci Crim Inves. 2018;10(4):1-4.
10. Putri CP. Hubungan tinggi badan dengan panjang lengan atas pada etnis minangkabau [skripsi]. Padang: Universitas Andalas; 2018.
11. Habib SR, Kamal NN. Stature estimation from hand and phalanges lengths of Egyptians. J Forensic Leg Med. 2010;17(3):156-60.
12. Sen J, Kanchan T, Ghosh A, Mondal N, Krishan K. Estimation of stature from lengths of index and ring fingers in a North-Eastern Indian population. J Forensic Leg Med. 2014;22:10-5.
13. Schmitt A, Cunha E, Pinheiro J. Forensic anthropology and medicine. New Jersey: Humana Press; 2007.
14. Shintaku K, Furuya Y. Estimation of stature based on the proximal phalanxal length of Japanese women’s hands. JUEOH. 1990;12(2):215-9.
15. Rhiu I, Kim W. Estimation of stature from finger and phalange lengths in a Korean adolescent. Journal of Physiological Anthropology. 2019;38(1):1-8.
16. Jendriella. Perkiraan tinggi badan berdasarkan panjang tulang tungkai atas (femur) [skripsi]. Pekanbaru: Universitas Riau; 2011.
17. Mahakkanukrauh P, Khanpetch P, Prasitwattaneree S, Case DT. Determination of sex from the proximal hand phalanges in a Thai population. Forensic Sci Int. 2013;226(1-3):208-15.
18. Agrawal J, Raichandani L, Kataria SK, Raichandani S. Estimation of stature from hand length in living subjects of Gujarat Region. Natl J Integr Res Med. 2013;4(4):9650-6.
19. White TD, Folkens PA. Bone biology and variation. In: Maragioglio N, Sonnack K, eds. The human bone manual. USA: Elsevier Academic Press; 2005. p. 31.

20. Ilayperuma I, Nanayakkara G, Palahepitiya N. Prediction of personal stature based on the hand length. Gall Med J. 2009;14(1):15-8.

21. Aggarwal K, Chauhan A, Shukla SK. Determination of stature and gender perception from the length of middle finger of North Indian population in age group of 20 – 30 years. International Journal of Recent Scientific Research. 2018;9(3):25477-80.
