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Correlation Between Body Height And Length Of Foot Among Undergraduate Students

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ABSTRACT

Estimation of stature is a major step in developing a biological profile for human identification and provides a valuable indicator for an unknown individual in a general population. Forensic anthropology had discovered an interesting fact that the human foot bears a biological correlation with age, sex, height and race of a person. This study was designed to determine the correlation between body height and length of foot among undergraduate students, between the ages of 18 – 24 years old of SEGi University Kota Damansara based on gender and race. Participants for this study were 210 students (107 males and 103 females). The ethical approval to perform our research was obtained from the ethical committee of SEGi University, Kota Damansara. The participants were randomly selected to participate in our cross-sectional study. Student's body height and length of foot were measured. All data was tabulated systematically and a statistical analysis using the Statistical Package for the Social Science software v22 (SPSS) was performed. The average mean body height and length of foot for males (171.59 cm, 28.83 cm) were greater than that for females (158.35 cm, 23.32 cm). A statistically significant correlation was obtained between body height and length of foot for overall participants (N=210, p-value < 0.001 and r value=0.7252), male participants (N=107, p-value < 0.001 and r value=0.5875) and female participants (N=103, p-value < 0.001 and r value=0.4689). In conclusion, the significant correlation observed in this study can be used as a basic guideline for forensic anthropology to help in establishing a person's identity.

Keywords: Body height, Length of foot

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INTRODUCTION

Estimation of stature is a major step in developing a biological profile for human identification and provides a valuable indicator for an unknown individual in a general population. Forensic anthropology had discovered an interesting fact that the human foot bears a biological correlation with age, sex, height and race of a person [1] and this fact became a valuable tool in personal and medico-legal identification, especially to estimate the height of a person whose body is no longer intact after a crime scene, a mass disaster like a transportation vehicle crash, a bomb explosion, fire and flood [2-4].

In general, male bones are larger and heavier than females, and this fact is also true regarding foot size between males and females [3]. A significant close relationship was found between the length of the foot (rather than its width) with the body height, suggesting the reliability of height estimation of a person obtained from his/her foot length [5].

Some studies had been used in stature estimation with proven accuracy. It is recognized as the single most universally applicable, inexpensive and non-invasive technique used by anthropologists worldwide to estimate body stature for many years [6].

The lower extremity measurements have higher correlation with the body height than the upper extremity measurements [7]. Nor et al. (2013) had studied and analyzed the relationship between stature and lower limb dimensions in the Malaysian population and reported the presence of significant correlation between lower limb dimensions and stature [8]. Few studies had been reported on height estimation in relation to the foot length and these studies were performed only on Malaysian Chinese population [9-10].

Therefore, we conducted a study to determine the correlation between body height and length of foot among undergraduate students in SEGi University, Kota Damansara based on gender and race, between ages 18 to 24 years old. The obtained results would be useful as a basic guideline for forensic anthropology to help in establishing a person's identity.

MATERIALS AND METHODS

Two parameters were used in our research: Body height and length of foot. The ethical approval to perform our research was obtained from the ethical committee of SEGi University, Kota Damansara. Our target participants were the undergraduate medical students of SEGi University, Kota Damansara with a total of 210 students 18-24 years-old (107 males and 103 females). We briefly explained to them the purpose of our research and the methods obtaining the necessary data. Finally, we obtained the measurements from the participants for our study in the Physiology Lab at the Faculty of Medicine of SEGi University, Kota Damansara.

Measuring body height

A stadiometer was used to measure the body height of each participant. The participants were requested to remove their shoes and hair ornament, and to step on the stadiometer. Each participant was asked to stand straight against the wall with both heels of feet placed together and touching the ground with the back of the head, back, buttocks, calves and heels could be touching the wall; eyes looking straight and the arms hanging freely with palms facing the thighs by the sides of the trunk. The measurement was taken from the tip of head to the heel. Then the body height was read from the scale in the stadiometer by lowering the horizontal bar until it touched the top of the head. Body height was recorded to the nearest 0.1cm [11].

Measuring length of foot

The participants were asked to stand erect on a graduated (scaled) plastic board and the length of their foot was measured from the proximal point (outline of the heel) to the distal point (point of maximum curvature on the outline of the great toe or 2nd toe) in centimeters by using a metallic ruler [3].

Data analysis

After the data was obtained from all 210 participants, a statistical analysis of the data collected was performed using the statistical package for the social sciences software version 22.0 [12].

RESULTS

Data interpretation for mean body height based on gender and race

Out of the 210 participants, 107 were males and 103 were females. Figure 1 shows the data interpretation for mean body height based on gender and race. For males, Indians had the highest mean body height followed by Others, Chinese and Malays respectively. For females, Others had the highest mean body height followed by Chinese, Malays and Indians respectively. The average mean body height for males (171.59 cm) was greater than that for females (158.35 cm).

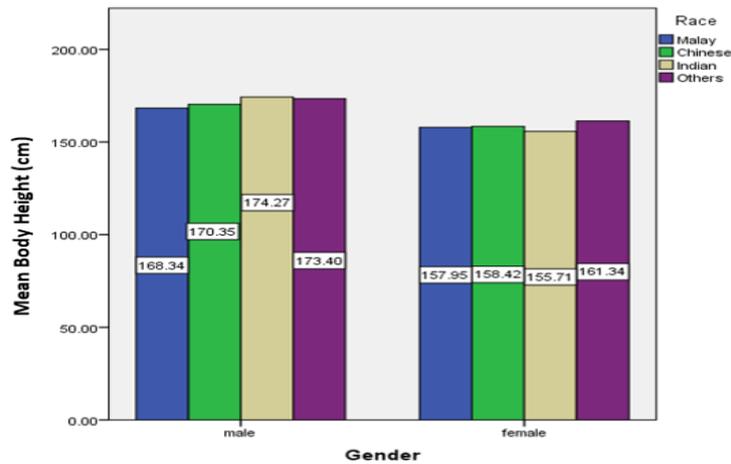


Figure 1: Showing Data interpretation for mean body height based on gender and race

Data interpretation for mean length of foot based on gender and race

Figure 2 shows the data interpretation for mean length of foot based on gender and race. For males, Others had the highest mean length of foot followed by Indians, Chinese and Malays respectively. For females, Others had the highest mean length of foot followed by Malays, Chinese and Indians respectively. The average mean length of foot for males (28.83 cm) was greater than that for females (23.32 cm).

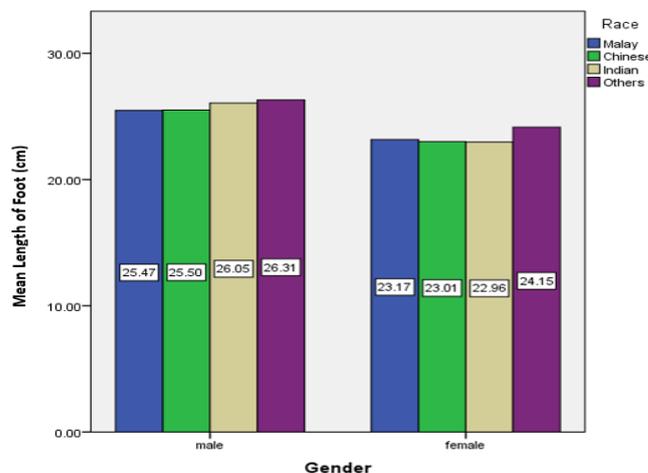


Figure 2: Showing data interpretation for mean length of foot based on gender and race

Data interpretation of correlation between body height and length of foot based on gender and race for overall participants

The scatter plots in Figure 3 shows that there was a statistically significant correlation between body height and the length of foot among the overall participants (N=210, p-value < 0.001 and r value=0.7252).

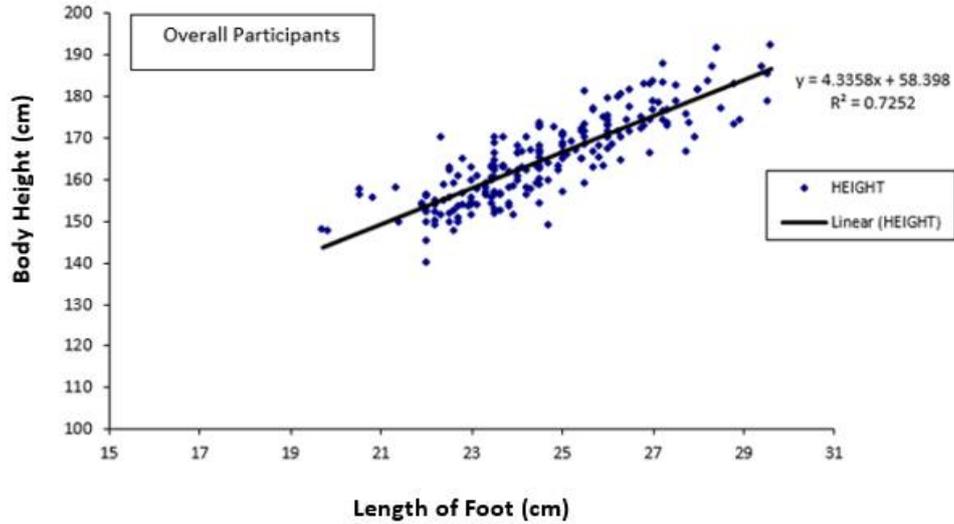


Figure 3: Showing data interpretation of correlation between body height and length of foot based on gender and race for overall participants

Data interpretation of correlation between body height and length of foot based on gender and race for male participants

The scatter plots in Figure 4 shows that there was a statistically significant correlation between body height and the length of foot among the male participants (N=107, p-value < 0.001 and r value=0.5875).

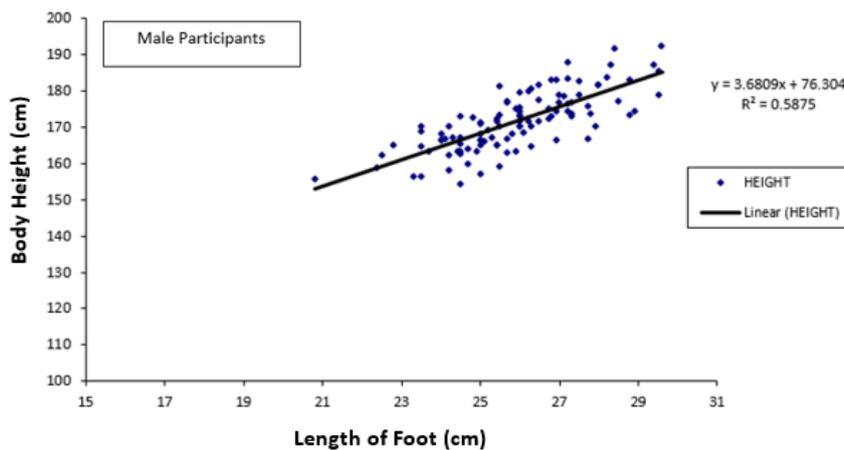


Figure 4: Showing data interpretation of correlation between body height and length of foot based on gender and race for male participants

Data interpretation of correlation between body height and length of foot based on gender and race for female participants

The scatter plots in Figure 5 shows that there was a statistically significant correlation between body height and the length of foot among the female participants (N=103, p-value < 0.001 and r value=0.4689).

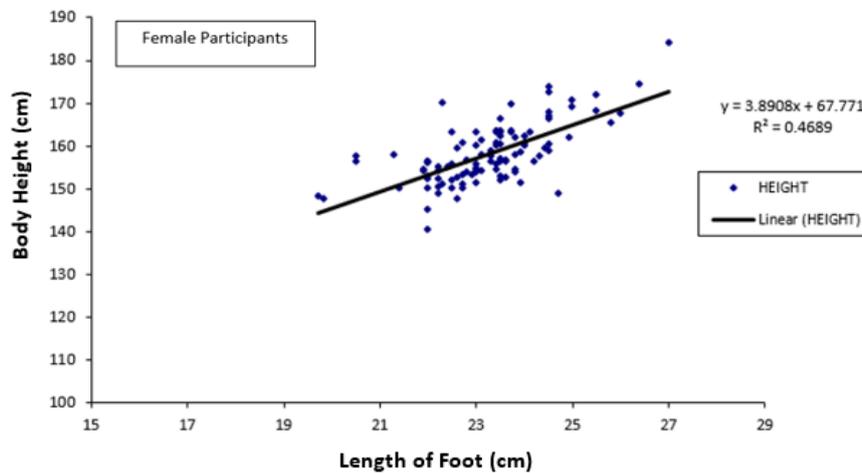


Figure 5: Showing data interpretation of correlation between body height and length of foot based on gender and race for female participants

DISCUSSION

Our results showed that, for males, Indians had the highest mean body height followed by Others, Chinese and Malays respectively. For females, Others had the highest mean body height followed by Chinese, Malays and Indians respectively. Our findings also showed that, for males, Others had the highest mean length of foot followed by Indians, Chinese and Malays respectively. For females, Others had the highest mean length of foot followed by Malays, Chinese and Indians respectively. Few studies had been reported on height estimation in relation to the foot length and these studies were performed only on Malaysian Chinese population [9-10]. The results obtained from our research also showed that the average mean body height and length of foot for males were greater than that for females. Similar to our findings were reported by other researchers [3,13,14].

In our research, a statistically significant correlation was obtained between body height and length of foot for overall participants (N=210, p-value < 0.001 and r value=0.7252), male participants (N=107, p-value < 0.001 and r value=0.5875) and female participants (N=103, p-value < 0.001 and r value=0.4689). Findings similar to ours were reported by other scientists [3,7,8,15].

CONCLUSION

In conclusion, the average mean body height and length of foot for males were greater than that for females. Statistically significant correlation was obtained between body height and length of foot for overall participants, male participants and female participants. Hence, the significant correlation observed in this study can be used as a basic guideline for forensic anthropology to help in establishing a person’s identity.

COMPETING INTERESTS

The authors declare they have no competing interests.

AUTHOR CONTRIBUTIONS

Conceived and designed the experiments: KTZ NSS SRD HTD. Performed the experiments: GCJ ATD ARHKA FFB. Analyzed the data: GCJ ATD ARHKA FFB HTD SAM. Wrote the paper: KTZ NSS SRD HTD. Revised the paper: KTZ NSS SRD HTD ATK GCJ ATD ARHKA FFB KAJ RM NHL SYAK JZ RSYW SAM. All authors read and approved the final manuscript to be published.

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REFERENCES

- [1] Rao NG, Kotian MS (1990). Foot print ratio (FPR) - A clue for establishing sex identity. *J. Ind. Acad Forensic Med*, 12:51-56.
- [2] Raju GM, Vijayanath V, Anitha MR (2012). Estimation of Stature from Shoe Print Length While Walking In Females. *J Indian Acad Forensic Med*, 34:4:288-291.
- [3] Pradeep KP, Abhilasha D (2012). Study of correlation between human height and foot length in residents of Mumbai, *Int J Biol Med Res*, 3(3):2232-2235.
- [4] Kanwal K, Iram K, Kuldeep P (2018). A study on the correlation between foot length and height of an individual and to derive regression formulae to estimate the height from foot length of an individual. *Int J Res Med Sci*, 6(2):528-532.
- [5] Mohanty BB, Agrawal D, Mishra K, Samanthsinghar P, Chinara PK (2012). Estimation of height of an individual from foot length: A Study on population of Odisha. *Int J Rev Life*, 2(2):69-74.
- [6] BidmosMA (2007) "Estimation of stature using fragmentary femora in indigenous South Africans," *Int. J. Legal Med*, 122:293-299.
- [7] Zeybek G, Ergur I, Demiroglu Z (2008). Stature and gender estimation using foot measurements. *Forensic Sci Int.*, 181(1-3):54.e1-5. doi: 10.1016.
- [8] Nor FM, Abdullah N, Mustapa AM, Wen LQ, Faisal NA, Ahmadnazari DAA (2013). Stature Estimation Based on Lower Limb Dimensions in the Malaysian Population. *International Journal of Medical and Health Sciences*, 7(7):346-350.
- [9] Salina H, Che RM, Mohamad AI (2012). Regression analysis for stature estimation from foot anthropometry in Malaysian Chinese. *Australian Journal of Forensic Sciences*, 44:4:333-341.
- [10] NatarajaTM, Ang YL, Saufee AS, Nikfakhruddin NH (2014). Estimation of stature from footprint and foot outline measurements in Malaysian Chinese. *Australian Journal of Forensic Sciences*, 46:2:136-159.
- [11] Doustjalali SR, Kumar RG, Sharma R, Nurfatiha M, Nur-Firzanah R, Muhamad-Syukri MK, Napatr WA, Nurul-Syahirah TKZ, Al-Jashamy K, Irfan M, El-Sersi M, Khin TZ, Nyan HL, Wai-Ma L, Vinothini A, AbdulKadir SY, Mohamad R, Wong AC, Yusuf A, Rebecca-Wong SY, Kumarasamy V, Nadankutty J, Nazrila SSF, Hlaing TD, Myo NH, Nazmul MHM, Ahmad TK, Htet H, Saw AY, Munira B, Christinal PWT, Sami ARA, Fidel F, Muftah AE, Mirhasheminasab SA, Marzalina M, Sabet NS (2016). Correlation Between Body Mass Index (BMI) And Waist To Hip Ratio (WHR) Among Undergraduate Students. *Pakistan Journal of Nutrition*, 15(7):618-624.
- [12] IBM Corp (2012). IBM SPSS Statistic Windows, Version 22.0. Armonk, NY: IBM Corp.
- [13] Arun KA, Brijesh P, Kreshna G, Smriti A, Nilima J (2007). Estimation of stature by foot length. *Journal of forensic and legal medicine*, 14:5:279-283.
- [14] Kanchan T, Menezes RG, Moudgil R, Kaur R, Kotian MS, Garg RK (2008). Stature estimation from foot dimensions. *Forensic Sci Int.*, 179(2-3):241.e1-5. doi: 10.1016.
- [15] Ingrid HER (1968). Prediction of Height from Foot Length: Use of Measurement in Field Surveys. *Arch. Dis. Childh.*, 43:310-312.