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27th, 28th & 29th July 2017

Kuala Lumpur, Malaysia

Committee of the ICOPH - 2017

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MESSAGE FROM THE CO-HOSTING PARTNER ICOPH 2017

On behalf of Taylor's University, it is an honour to welcome delegates to the 3rd International Conference on Public Health (ICOPH) with the theme, "Strengthening the Public Health Infrastructure towards Healthy Communities". A role in public health is vital for increasing life expectancy, however, it is rarely thought of until a crisis catches our attention.

Over the years, health initiatives and management for global communities are increasingly recognised as an important component for the overall wellness of human beings. Public health is constantly evolving in response to the needs of the population around the world. Initiatives like clean air, water policies and vaccinations keep people healthy and safe by preventing injury and disease.

Hospital based treatment may be more apparent to many; community based health initiatives need to be given more emphasis to increase the awareness of the health professionals, and also the public of their valuable role in a healthy population. It is necessary to remove various cultural, social and logistical barriers to enhance knowledge about healthcare needs, closing the gap in health disparities within countries.

At Taylor's University, we emphasise the advancement of knowledge through research and are happy to contribute to its dissemination through scientific conferences. More importantly, research outcomes should lead to action and guide programme development, followed by the delivery of health services. In line with the new strategic plan, we look to increase our capacity and affinity in the area of research and building commercial success, and to be recognised as the leading international university ranked in the top 100 universities in Asia by year 2022.

I sincerely hope the 3rd ICOPH 2017 will facilitate the exchange of research findings, opinions and views on issues related to Public Health among healthcare professionals and academicians from different parts of the world and different health care systems. May the participants today gain valuable experience and put into good use what is learnt.

Prof. Michael Driscoll
Vice Chancellor & President Taylor's University
Malaysia

MESSAGE FROM CONFERENCE CO-CHAIR- ICOPH 2017

It gives me great pleasure to welcome all of you to this 3rd International Conference on Public Health in Kuala Lumpur, Malaysia. This is the 3rd time this conference is being organised by TIIKM and the theme of the conference is 'Strengthening the public health infra-structure towards healthy communities. "First of all let me thank you all for attending this conference and secondly I would like to thank all the local academic partners and all universities and is particular the Ministry of Health Malaysia for providing support for the conference. Globally public health is no longer dominated by infectious diseases instead it is being dominated by chronic diseases such as heart disease, diabetes, cancer, and mental-health conditions, which require continuous treatment although polio and HIV are still with us. At the same time, newly emerging diseases such as Zika and Ebola epidemics are making headlines and these pose challenges to global health security in the future.

Also war, civil unrest, and acts of terrorism can hinder progress in all aspects of global development, including health, education, and gender equality. Extreme weather and rising sea levels, temperatures, and carbon dioxide levels could usher in a wide variety of human health effects. We as public health professionals need to address some of these issues and influence our policy makers to act. It is important to consider how our actions today will be viewed by our future generations' decades from now.

This year we have received about 600 abstracts for the conference and we are happy of the tremendous response we have received. I am sure that you all will deliberate on some of these important issues in the next few days. Finally let me take this opportunity to thank all the plenary speakers and also the members of the organising committee for the excellent preparations and arrangements for this conference and you the participants who have made this conference happen. Hope you all will have good conference for the next few days and also enjoy the beauty of Kuala Lumpur and Malaysia

Thank You

Prof. Dr. Hematram Yadav
Department of Community Medicine
MAHSA University
Kuala Lumpur
Malaysia

MESSAGE FROM CONFERENCE CO-CHAIR- ICOPH 2017

A very warm welcome (*selamat datang*) to all speakers and delegates to Kuala Lumpur, Malaysia and to our Third International Conference on Public Health 2017 (ICOPH 2017), 27-29 July 2017, organized by The International Institute of Knowledge Management (TIIKM). The third conference follows on the highly successful first and second conference in 2015 and 2016, respectively, in Colombo, Sri Lanka. The theme of the first conference was "promoting global health through equitable access to health system" that took cognizance of new advances and research results in the areas of global health and health systems. The theme of the second conference was "bridging the gap between research and policy and creating a global platform to discuss evidence based health policies and interventions in public health." In the third conference, we will address the very important and pertinent issue of "**Strengthening the Public Health Infrastructure towards Healthy Communities**."

The Sustainable Development Goals (SDGs), officially known as "Transforming Our World: the 2030 Agenda for Sustainable Development" is a set of 17 "Global Goals" with 169 targets that was officially sanctioned by the United Nations on 25-27 September 2015 as a successor to the Millennium Development Goals (MDGs). The SDGs build on the principles agreed upon under a United Nation resolution, popularly known as The Future We Want. It is a non-binding document released following the Rio+20 Conference in 2012 in Rio de Janeiro, Brazil.

The 17 global goals are: (1) No Poverty; (2) Zero Hunger; (3) Good Health and Wellbeing; (4) Quality Education; (5) Gender Equality; (6) Clean Water and Sanitation; (7) Affordable and Clean Energy; (8) Decent Work and Economic Growth; (9) Industry, Innovation and Infrastructure; (10) Reduced Inequality; (11) Sustainable Cities and Communities; (12)

Responsible Consumption and Production; (13) Climate Action; (14) Life Below Water; (15) Life on Land; (16) Peace, Justice and Strong Institutions; and (17) Partnerships for the Goals. Indeed, the ICOPH 2017 theme of "Strengthening the Public Health Infrastructure towards Healthy Communities" certainly echoes with most of the 17 SDGs.

Implementation of the SDGs has already started worldwide. It is no easy task, however. In each country, the goals must be translated into national legislation. Poor countries need the support of rich countries, and coordination at the international level is crucial. The SDGs is very ambitious, and there are many obstacles. It would be a great opportunity for ICOPH 2017 to deliberate on some of these obstacles and pave the way ahead.

I would like to take this opportunity to thank all speakers and delegates for making time and effort to attend and actively participate in this international conference. A very sincere thanks to the Organizing Committee and Scientific Committee members for all the help and all sponsors and participating organizations for supporting the conference. I hope that the conference will forge new alliances in research, development and training that will be beneficial to us all.

Sincerely,

Prof. Dr. Rusli Bin Nordin
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ANTHROPOMETRIC STUDY IN DEUTERO-MALAY ETHNIC IN SEARCH OF ACCURATE HEIGHT FORMULAS FOR NUTRITIONAL STATUS ASSESSMENT

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Abstract: Nutritional status can be assessed using a person's height. Sometimes it is difficult to quantify for example in bedrest patient or abnormal stature, so it needs an alternative anthropometric measurement, such as height estimation based on long-bones measurement. Little information is available about the accuracy of these measurements, especially in deutero-malay ethnic. The present study aimed to compare accuracy for estimating height from several long-bones lengths to search an accurate anthropometric formula for nutritional status assessment. This study used an observational analytic method with cross sectional approach. The samples are students of Medical Faculty of University of Jember that meet the inclusion and exclusion criteria. Data were analyzed with Kolmogorov-Smirnov test, Pearson Correlation test and linear regression. The method is by measuring height with microtoise and bones length with medline. The result showed strong and positive ($r > 0.5$) correlation between height and length of long-bones, so linear regression can be done. Among ulna, femur, humerus and radius bones, femur formula showed the highest accuracy both in men (r right = 0.904; left =0.906) and women (r right = 0.911; left = 0.900). We conclude that anthropometric formula from estimation of height by length of femur is the most accurate from all formula, thus the most preferable to be used for height estimation in deutero-malay ethnic when assessing nutritional status.

Keywords: anthropometric formulas, height estimation, nutritional status, deutero-malay

Introduction

Measurement of height is very important both for children, adults, and elderly (elderly). This is important because by knowing a person's height, his or her nutritional status can be assessed. Assessment of nutritional status is often done by calculating the body mass index (BMI). BMI is measured by weight ratio (in kilograms) divided by squared height (in meters) (Goon, et al, 2011). Therefore we need accurate height measurement. The usual measurement of height is by measuring from the top of the head (vertex) to the tip of the heel in an upright position or called the stature (Barbosa, et al, 2012). In some cases where height cannot be directly determined, as in the case of individuals with disabilities, we needs an alternative height measurement to asses nutritional status. Disability is the abnormality of limb shape from birth and due to abnormal growth including spinal deformities. In addition also in individuals who have difficulty to stand because of using a wheelchair, neuromuscular weakness and in individuals with amputation conditions. (Goon et al, 2011).

Based on a survey conducted by WHO, the number of people with disabilities worldwide by age 15 years and over in 2013 is 975 million people, or about 19.4% of the total world population, while for under 15 years reaches 190 million people or about 3.8% of the world's total population. Based on WHO (2013) data, 65% of people with disabilities worldwide come from poor and developing countries. Indonesia is one of developing country with a large number of people with disabilities. Indonesia ranks second in Southeast Asia after

Vietnam as a country with a disability number reaching 3.5 million from the total population of Indonesia (WHO, 2013). The number of people with disabilities in Indonesia reaches 1,652,741 people and 67,5% of them are in productive age (18 - 60 years old). Leg disabilities accounts up to 33.75%, while the other 12% have body deformities (BPS, 2013).

Height has an important role in determining nutritional status and hence we required the need for a good height estimators for individuals with disabilities and other conditions that might cause height cannot be determined directly. Therefore, if the estimation of the height is done by using an unsuitable tool it will have an impact on the calculation of energy needs that are not in accordance with nutritional status. It then encourages the development of research on accurate height measurement alternatives. One of the alternative height measurements can be performed on people living on a percutaneous basis (Madden, et al, 2012). The results show that long bones can be used to formulate a high-estimate formula because long bones have a linear relationship with height (Reinhard, et al, 2013). Linear regression formulations derived from one or more body parts may be used for estimation of height (Krishan and Sharma, 2007, Chikhalkar, et al, 2010, Ahmed, 2013). The use of a linear regression formulation to determine an estimation of height based on a particular body part is an accurate method compared to other methods (Tsokos, 2008).

In Indonesia, the Ministry of Health has not established an official alternative method of measuring height in specific conditions (where height cannot be measured directly). One alternative height measurement using long bones is to use the length of the humerus, radius, ulna and femur. Several studies of the effectiveness of bone length of humerus, radius, ulna and femur as high estimators were performed in various age, ethnic, and gender groups (Ilayperuma, et al, 2010, Thumar, et al, 2011, Prasad et al, 2012, Barbosa et al, 2012, Honandar, 2014) with good correlation results. According to Ozaslan (2006), ulna has a better accuracy than the other long bones of the upper extremities. The British Association for Parenteral and Enteral Nutrition recommends the length of the ulna as an alternative to individual height measurements for the assessment of nutritional status. In addition, as an alternative measurement, we may also use the length of the lower extremity bone such as femur. The estimate formula of height by using the length of the bone of the femur percutaneus has the best accuracy when compared with the long bones of other lower extremities (Itsna, 2015).

The use of long bone length as an estimator of height is limited to specific populations, races and environments. Therefore, further testing is required when it is done with different areas, populations, and races. In addition, differences in a person's height is affected by several factors, one of which is gender. The average male height is greater than the female. Therefore, we need to separate the formula of height estimation between men and women (Schell, et al, 1985, Papaloucas, et al, 2008). Research on height measurement alternatives using humerus, radius, ulna and femur length is still rare in Indonesia especially in deutero-malay ethnic and it is still very rare to distinguish by sex. Therefore, the researcher is interested to develop the estimation formula of height by using humerus, radius, ulna and femoral length of bone in each gender.

Methods

This research used observational analytical method with a cross sectional approach and consecutive sampling technique. This study was conducted at the Faculty of Medicine, University of Jember in November 2016. The study population is 3rd and 4th year students of Faculty of Medicine, University of Jember with the age of more than 21 years old. Slovin formula used to calculate the sample size in this study to obtain representative sample and more definite or close to the existing population (Sugiyono, 2010). Based on a population of 102 persons with an error rate set to 5% or 0.05, then the minimum sample size in this study is 81.2 (rounded to 82). This research involving 88 subjects who fulfilled the inclusion criteria of being able to stand upright, including in the deutero-malay ethnic (Javanese, Sundanese, Madurese, Balinese, Acehnese, Minangkabau, Lampung, Makasar, Bugis, Manado and Minahasa tribes) and willing to sign informed consent, as well as the exclusion criteria of having a history of fractures on the upper and lower extremities.

The method used is measuring height from vertex to heel by using microtoise capacity of 200 cm. Then measure the length of the humerus bone from the major tuberosity to the lateral epicondyle, the radius length of the radius from the radii cap until the Styloideus radii processus, the ulna length from the tip of the elbow (olecranon process) to the middle of the protruding bone at the wrist (styloid process) and the border of the femur is determined by palpation and then measured from the femoral major trochanter to the lateral condyle of the femur using a 150 cm tape measure capacity.

The data obtained were analyzed using IBM SPSS Statistics software version 20.0. The test was Kolmogorov Smirnov normality test. Because the result of normality test p> 0,05 (normal distributed data) then Pearson Correlation test was done. After that, the Linear Regression test was done to determine the approximate formulation of height. This research has got permission of ethical clearance from ethics commission of Medical Faculty of Jember University.

Results and Discussions

Total number of female respondents (65.9%) is more than the number of male respondents (34.1%). It is because of the limitation of the total population that the number between men and women have a large difference. In the results of the study, the average height in men is 167.58 cm, higher than the female height of 156.99 cm (Table 1). This result is relevant with theory that the comparison of male height to woman is 100 : 90. The difference can also be influenced by male activity factor which tend to be more severe than female (Schell, et al, 1985, Papaloucas, et al, 2008). Therefore, looking for height requires a separate formula between men and women. Respondent age range is between 21 and 23 years with mean of 21.23. From the data obtained the average length of humerus and radius is longer on the right side of both the male and female, while ulna and femur slightly longer on the left side (Table 1).

*Table 1 Descriptive data of deutero-malay ethnic samples in this study.**

Skeletal Element	n	Minimum	Maximum	Mean	Std. Deviation
Male Right:					
Humerus	30	26	33.85	29.9	1.5
Radius	30	19.75	27.65	23.09	1.5
Ulna	30	21	30	26.46	1.94
Femur	30	38.01	46.31	42.08	2.11
Male Left:					
Humerus	30	26	33.85	29.85	1.52
Radius	30	19.75	27.65	22.93	1.49
Ulna	30	21	30	26.53	1.94
Femur	30	37.98	46.11	42.09	2.1
Female Right:					
Humerus	58	24	31.25	27.46	1.69
Radius	58	17.9	24.85	21.03	1.43
Ulna	58	21	28.5	25.43	1.75
Femur	58	33.67	44.34	38.96	2.36
Female Left:					
Humerus	58	24	31.25	27.44	1.69
Radius	58	17.9	24.85	20.98	1.43

Ulna	58	20.8	28.5	25.53	1.81
Femur	58	33.54	44.52	38.97	2.36

*All measurements are reported in centimeters

The regression equation is calculated separately for each side and for each limb dimension as body height = a + bx, where "a" is the regression coefficient of the dependent variable ie height and b is the regression coefficient of the independent variable ie the length of the limb (length Humerus bone and radius bone length) and "x" denotes measurements of limb length or bone calculated (Krishan and Sharma, 2007). r square (r^2) or coefficient of determination is to measure the quality or accuracy of the regression equation that gives the proportion or percentage of total variation in the dependent variable (height) described by the independent variable (long bone length) (Anupriya and Kalpana, 2016). Accuracy of the resulting formula is said to be better if r square is approaching 1 (one). The resulting formula from linear regression can be seen in Table 2.

*Table 2 Regression formula for height estimation of deutero-malay ethnic samples in this study and statistic parameters.**

Skeletal Element	n	Regression Formula	r	r^2
Male Right:				
Humerus	30	71.440 + (3.215 x Right Humerus)	0.862	0.743044
Radius	30	96.173 + (3.092 x Right Radius)	0.828	0.685584
Ulna	30	105.156 + 2.321 (Right Ulna)	0.818	0.669124
Femur	30	68.096 + 2.339 (Right Femur)	0.904	0.817216
Male Left:				
Humerus	30	73.272 + (3.159 x Right Humerus)	0.851	0.724201
Radius	30	95.80 + (3.131 x Radius Left)	0.827	0.683929
Ulna	30	105.190 + 2.313 (Left Ulna)	0.822	0.675684
Femur	30	66.974 + 2.365 (Left Femur)	0.906	0.820836
Female Right:				
Humerus	58	93.782 + (2.300 x Right Humerus)	0.868	0.753424
Radius	58	100.737 + (2.673x Right Radius)	0.852	0.725904
Ulna	58	93.239 + 2.643 (Right Ulna)	0.803	0.644809
Femur	58	94.101 + 1.610 (Right Femur)	0.911	0.829921
Female Left:				
Humerus	58	93.847 + (2.300 x Left Humerus)	0.863	0.744769
Radius	58	101.145 + (2.659 x Left Radius)	0.848	0.719104
Ulna	58	95.386 + 2.549 (Left Ulna)	0.803	0.644809
Femur	58	94.046 + 1.611 (Left Femur)	0.9	0.81

*All regression formulas are in centimeters

The correlation test result showed there is a significant relationship so the linear regression analysis to determine the estimation formula of height based on the length of the humerus, radius, ulna and femur can be done. This is consistent with the theory that long bones with height have a linear relationship (Glesser and Trotter, 1958). That makes a certain bone length can be used to formulate a formula for estimating height by linear regression analysis. Accuracy of anthropometric formula of height based on left femur for male and right femur for female bone length have the best accuracy among all formulas of height estimation obtained because the value of r and r square are 0.91 and 0.91 or 0.82 and 0.83. It means that the formulas represent 82 and 83 percent of the samples height variance. This is probably because femur contributes directly to height (Nor, et al, 2013) . In addition, based on Anderson's (1993) study on long bone contribution to growth, femur contributes 36% to growth and height in both sexes, while other bones contribute less than 30%.

The estimated height formula generated in this study was compared with the estimation formula of some previous studies. From the results of these analyzes, it turns out the estimative formula of researchers and estimative formula of UGM's Body Anthropology (Kusuma and Yudianto, 2010) shows the results of measurements close to the actual height of respondents. This happens because the age range of research subjects is almost the same. The study subjects from the Anthropology of the Orthodontology were 25 to 30 years old while in this study were 21 to 23 years old. In addition, subjects in anthropological studies have the same racial race with the subject of this study, which is the mastoloid malayan race. This is also in accordance with the research conducted by Akhlaghi, et al (2012) that height is affected by various factors of age, gender, environment, and race of the subjects.

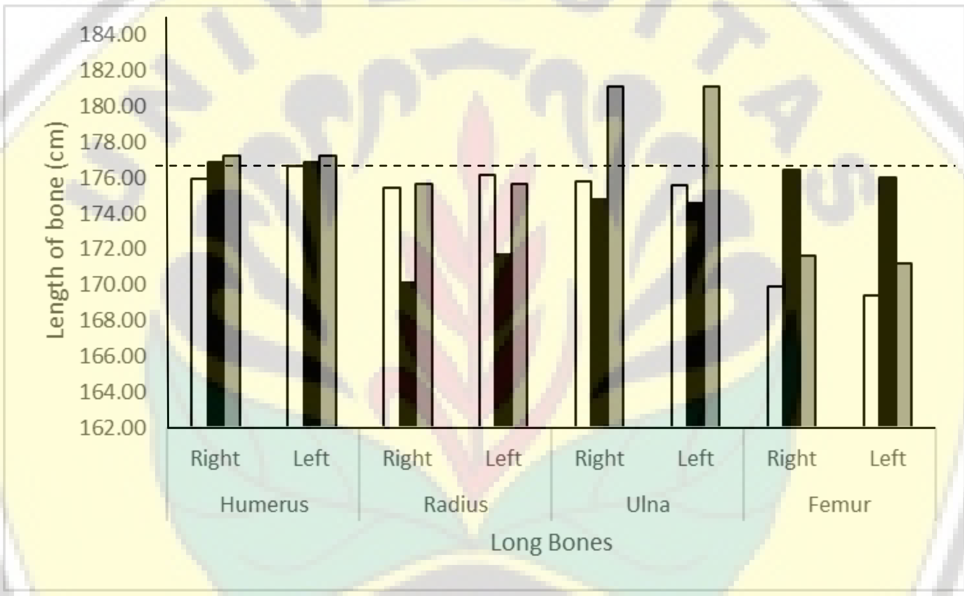

Figure 1 Comparison Between Researchers' Formulas with Some Other Formulas. Measurement based on sample of male height 176.5 cm showed by dash line. White, black and gray bar each represent height estimation using UGM's body anthropology formula, this study formula and Trotter Gleser formula.

From the regression formula obtained then the researcher also tried to test with other existing formulas such as Trotter Gleser's formula (1958). The bone length used in this study is percutaneous, which is still covered in joints, muscles and skin, while the formula to be compared is based on the bone in a dry state, so to insert into the existing formula must first reduce the measurement value of 2.5 cm (Devinson, 2009). Figure 1 showed that the researcher's formula, Trotter Gleser formula, and UGM's Body Anthropology formula have a similarity or close to the actual height of the respondent for humerus length based. This is because the sample of Trotter Gleser's research uses the subject of the mongoloid race and the subject of this study uses a deutero-malay ethnic which is a sub of the mongoloid race so it has a resemblance. As for the formula of UGM's Body Anthropology using research subjects of the Javanese tribe that is part of the deutero-malay ethnic. However, both the formula of Trotter Gleser and UGM's Body Anthropology only conducted research on men, so the formula cannot be set on women.

Formula on other bone length based were slightly different to the actual height, these might be because the differences on calculating dry bone and percutaneous bone and on setting the bone border boundaries measurement on dead and living object (Agnohotri, et al,). In elderly or persons with disabilities, height measurements cannot be measured precisely. In order to know the height of a subject, we need to use formulas based on several parameters such as knee height, arm length and two arm lengths (Cilik, et al, 2010). The formula in this study can be an alternative of a more precise height measurement because it is designed to be used in living object. Therefore, according to the purpose of this research, our formula is more suitable to be used in height estimation than those other formulas compared above.

The formulas obtained in this study must be used carefully since it can only be used in populations of the same character and age. This estimation formula is tested on Javanese, Madurese, Sundanese and Balinese tribes, so it can be used to represent height estimations formulas in Malayan mongoloid races, especially deutero-malay ethnic of the same age range. This is because the height is influenced by several factors i.e. age, sex, race and residential environment (Barbosa, et al, 2012). To know the accuracy of this formula in other population groups, we need to test the validity first in a more varied population.

Although the researcher has tried maximally to control every step in conducting this research, there were still few limitations in this research. The subjects in this research were still limited to medical faculty students who have homogenous physical activity and narrow age range. In addition, the limitation of this study was the determination of bone-measurement borders that were still done manually, therefore for further research needs to be done with more accurate methods such as X-rays to determine and confirm bone measurement borders. It is also suggested to be done with a bigger population with diverse activities and equal number of gender.

Conclusions

Anthropometric approach such as an indirect height measurement help to assess nutritional status in disabled persons, or where direct method is not possible to be done. Based on the result of data analysis, height estimation formulas based on femur length are the best height estimation formulas and feasible to be applied in deutero-malay ethnic. When comparing with other formulas (UGM's Body Anthropology and Trotter Glesser), according to the purpose of this research, our formula especially the femur length based is the most suitable to be used in height estimation than those other formulas. However, to overcome the limitation of this study, it is suggested to conduct future research with larger number of samples, wider age range and proportioned number of samples between men and women. It is also suggested to add an X-rays examination as a measurement validity confirmation.

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References

Anderson, M., Green, W.T., Messner, M.B, 1963, Growth and Prediction of growth in the Lower Extremities. *The Journal of Bone and Joint Surgery*, 45-A:1–14.

Agnohotri, A.K., Kachhwaha, S., Jowaheer, V. dan Singh, A.P., 2009, Estimating stature from percutaneous length of tibia and ulna in indo-mauritian population. *Forensic Sci. Int*. 187:109-110.

Ahmed, A.A., 2013, Estimation of Stature from The Upper Limb Measurements of Sudanese Adults. *Forensic Sci Int.*, 228:178-179.

Akhlaghi M, Hajibeygi M, Zamani N, Moradi B., 2012, Estimation of stature from upper limb anthropometry in Iranian population, *Journal of Forensic and Legal Medicine, 19(5):280-4.*

Anupriya, A. and Kalpana, R., 2016, Estimating the Height of an Individual from the Length of Ulna in Tamil Nandu Population and its Clinical Significance. *International Journal of Scientic Study*, 4:254-257

Badan Pusat Statistik, 2013, Survei Sosial Ekonomi Nasional (Susenas) Tahun 2013 (Jakarta, Indonesia: Badan Pusat Statistik).

Barbosa, V.M., Stratton, R.J., Lafuentel, L., dan Elia, M., 2012, Ulna length to predict height in English and Portuguese patient populations. *European Journal of Clinical Nutrition*, 66:209–215.

Chikhalkar, Mangaonkar, Nanandkar, Peddawad., 2010, Estimation of Stature from Measurement of Long Bones, Hand and Foot Dimensions. *J Indian Acad Forensic Med*, 32 (4):329–33.

Cilik, W., Kuswandhani, T., Aryana, S., Astika, N., Yanson., Widana, K. 2010. Hubungan Antara Sudut Kelengkungan Thorak Dan Selisih tinggi Badan Ukur Dan Tinggi badan Hitung Berdasarkan Tinggi Lutut Pada Pasien Usia lanjut Di Poliklinik Geriatri Rumah sakit Sanglah Denpasar. *Jurnal Penyakit dalam*, 2(1).

Devinson, R., J., 2009, *Penentuan Tinggi Badan Berdasarkan Lengan Bawah* .Tesis (Medan, Indonesia: Fakultas Kedokteran Universitas Sumatera Utara).

Goon, D.T., Torolia, A.L., Musa, D.I., Akusu, S., 2011, The relationship between arm span and stature in nigerian adults. *Kinesiology*, 43(1), 38-43.

Honandar, B., 2014, *Hubungan Tinggi Badan dan Panjang Ulna pada Etnis Sangihe Dewasa di Madidir Ure*. Tidak Diterbitkan. Skripsi. (Manado, Indonesia: Universitas Sam Ratulangi).

Ilayperuma I, Nanayakkara G, Palahepitiya N., 2015, Assessment of Stature from the Percutaneous Measurement of Ulna in Healthy Volunteers. *Int. J. Morphol*, 2(3):154-157.

Itsna, U.H., 2015, *Estimasi Tinggi Badan Berdasarkan Panjang Demispan dan Panjang Femur pada Mahasiswa Fakultas Kedokteran UNS Surakarta*. Tidak Diterbitkan. Skripsi. (Surakarta, Indonesia: Universitas Sebelas Maret).

Krishan, K. and Sharma, A., 2007, Estimation of Stature from Dimensions of Hands and Feet in a North Indian Population. *J Forensic Leg Med*. 14:327–332

Kusuma, S.E, and Yudianto,A. Identifikasi medikolegal. Dalam: Hoediyanto dan Apuranto,H. Ilmu Kedokteran Forensik Dan Medikolegal. Edisi 7.Surabaya: Departemen Ilmu Kedokteran Forensik Dan Medikolegal Fakultas Kedokteran Universitas Airlangga. 2010; p. 311-336.

Madden, A. M., Tsikoura, Stott, D. J., 2012, The Estimation of Body Height from Ulna Length in Healthy Adults from Different Ethnic Groups. *J Hum Nutr Diet*, 25, 121–128.

Nor, F.M., Abdullah, N., Mustapa, A. M., Qi Wen L, Faisal, N. A., Ahmad, 2013, Estimation of stature by using lower limb dimensions in the Malaysian population. *Journal of Forensic and Legal Medicine*, 20(8):947-952

Ozaslan, A., Koc, S., Tugcu, H. 2006. Estimation of stature from upper extremity. *Journal of Military Medicine*. 171(4):288-91.

Papaloucas, M., Papaloucas, C., Tripolitsioti, A.,and Stergioulas, A., 2008.,The Assymetry in Length between Right and Left Humerus in Humans. *Journal of Applied Sciences*, 11(21):2509-12.

Prasad, A., Bhagwat, B., Porwal, S., Joshi, S., 2015, Estimation of Human Stature from length of Ulna in Marathwada Region of Maharashtra. *Indian Journal of Forensic and Community Medicine*, 2(3):154-157.

Reinhard, D., Verhoff, M. A., Schütz, F. H., 2013, Forensic Medicine: Fundamentals and Perspectives (Berlin, Germany: Springer Science & Business Media).

Schell, L.M., F.E. Johnston, D.R. Smith and A.M. Paolone, 1985, Directional asymmetry of body dimensions among white adolescents. *American Journal of physical anthropology*, 67: 317-322

Sugiyono, D., 2010, *Metode penelitian kuantitatif kualitatif dan R&D* (Bandung, Indonesia: Penerbit Alfabeta).

Trotter, M. and Gleser GC., 1958, A re-evaluation of Estimation of Stature Based on Measurements of Stature Taken During Life and of Long Bones After Death. *Am J PhysAnthropol*, 16:79-123

Tsokos, M. 2008. *Forensic Pathology Reviews 5* (Berlin, Germany: Springer Science & Business Media).

Thummar, B., Patel, Z.K., Patel, S., Rathod, 2011, Measurements of Ulnar Length for Estimation of Stature in Gujarat. *Forensic Sci. Int.*, 2(2):36–40.

WHO. 2013. *Disability in the South-East Asia Region 2013* (New Delhi, India: WHO-SEARO).

WHO. 2013. *World Report on Disability* (Geneva, Switzerland: World Health Organization. York: Delmar Publisher Inc.)

Appendix

*Table 1 Descriptive data of deutero-malay ethnic samples in this study.**

Skeletal Element	n	Minimum	Maximum	Mean	Std. Deviation
Male Right:					
Humerus	30	26	33.85	29.9	1.5
Radius	30	19.75	27.65	23.09	1.5
Ulna	30	21	30	26.46	1.94
Femur	30	38.01	46.31	42.08	2.11
Male Left:					
Humerus	30	26	33.85	29.85	1.52
Radius	30	19.75	27.65	22.93	1.49
Ulna	30	21	30	26.53	1.94
Femur	30	37.98	46.11	42.09	2.1
Female Right:					
Humerus	58	24	31.25	27.46	1.69
Radius	58	17.9	24.85	21.03	1.43
Ulna	58	21	28.5	25.43	1.75
Femur	58	33.67	44.34	38.96	2.36
Female Left:					
Humerus	58	24	31.25	27.44	1.69
Radius	58	17.9	24.85	20.98	1.43
Ulna	58	20.8	28.5	25.53	1.81
Femur	58	33.54	44.52	38.97	2.36

*All measurements are reported in centimeters

*Table 2 Regression formula for height estimation of deutero-malay ethnic samples in this study and statistic parameters.**

Skeletal Element	n	Regression Formula	r	r^2
Male Right:				
Humerus	30	71.440 + (3.215 x Right Humerus)	0.862	0.743044
Radius	30	96.173 + (3.092 x Right Radius)	0.828	0.685584
Ulna	30	105.156 + 2.321 (Right Ulna)	0.818	0.669124
Femur	30	68.096 + 2.339 (Right Femur)	0.904	0.817216
Male Left:				
Humerus	30	73.272 + (3.159 x Right Humerus)	0.851	0.724201
Radius	30	95.80 + (3.131 x Radius Left)	0.827	0.683929
Ulna	30	105.190 + 2.313 (Left Ulna)	0.822	0.675684
Femur	30	66.974 + 2.365 (Left Femur)	0.906	0.820836
Female Right:				
Humerus	58	93.782 + (2.300 x Right Humerus)	0.868	0.753424
Radius	58	100.737 + (2.673x Right Radius)	0.852	0.725904

Ulna	58	93.239 + 2.643 (Right Ulna)	0.803	0.644809
Femur	58	94.101 + 1.610 (Right Femur)	0.911	0.829921
Female Left:				
Humerus	58	93.847 + (2.300 x Left Humerus)	0.863	0.744769
Radius	58	101.145 + (2.659 x Left Radius)	0.848	0.719104
Ulna	58	95.386 + 2.549 (Left Ulna)	0.803	0.644809
Femur	58	94.046 + 1.611 (Left Femur)	0.9	0.81

*All regression formulas are in centimeters

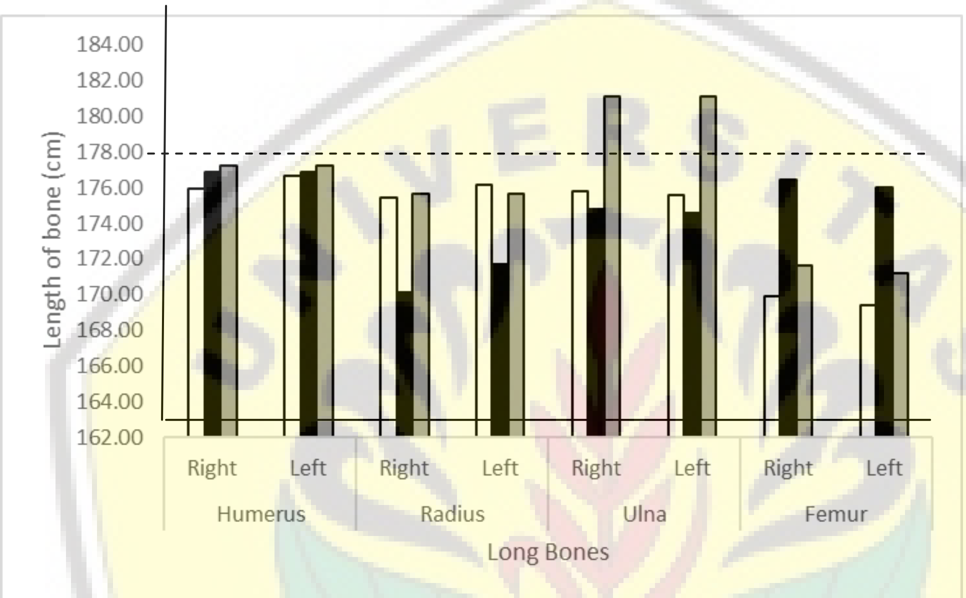

Figure 1 : Comparison between researchers' formulas and some other formulas. Measurement based on sample of male height 176.5 cm showed by dash line. White, black and gray bar each represent height estimation using UGM's body anthropology formula, this study formula and Trotter-Gleser formula