International Journal of Healthcare and Medical Sciences
ISSN(e): 2414-2999, ISSN(p): 2415-5233
Vol. 3, No. 9, pp: 55-61, 2017
URL: http://arpgweb.com/?ic=journal&journal=13&info=aims

Estimation of Stature of the Annang Ethnic Group of Nigeria Using Knee Height

Udoh U. G. Department of Anatomy, Faculty of Basic Medical Sciences, University of Uyo, Nigeria

Peter A. I.* Department of Anatomy, Faculty of Basic Medical Sciences, University of Uyo, Nigeria

Thomas D. F. Department of Anatomy, Faculty of Basic Medical Sciences, University of Uyo, Nigeria

Johnson E. I. Department of Anatomy, Faculty of Basic Medical Sciences, University of Uyo, Nigeria

Abstract: This study was to determine the mean stature, mean knee height and the correlation between stature and knee height among adults of the Annang ethnic group of Nigeria. It was also aimed to find a regression equation to predict stature from knee height in adults of the Annang ethnic group of Nigeria. A total of 400 people (216 males and 184 females) between the ages of 18 and 50 participated in this anthropometric study. These participants were randomly selected from the eight local government areas of Akwa Ibom state which make up the Annang ethnic group. Verbal consent was obtained from each individual. Stature and knee height were measured using standard anthropometric techniques. Pearson's coefficients of correlation and regression equations were calculated using Minitab statistical package for stature and knee height. The mean and standard deviation for stature in this study was 165.29±9.98 and 160.36±9.09 for male and female respectively and that for knee height was 53.600±3.343 and 51.441±3.493 for male and female respectively. The knee height showed a significant linear correlation(r) with stature. ($r=0.576$ and $r=0.400$, ($p<0.05$) for males and females respectively. The following equations were derived to predict the stature (S). In males S= 73.1 + 1.72 knee height (cm), in females S= 107 + 1.04 knee height (cm).). The results from this study showed that the male had significantly higher figures in all parameters than their female counterpart, thus indicating the existence of sexual dimorphism in these parameters among the Annang ethnic group of Nigeria. The result from this study is comparable to studies done in other ethnic groups and may be relevant in further anthropometric or forensic studies as it concerns the Annang ethnic group.

Keywords: Stature; Knee height; Sexual dimorphism; Annang.

1. Introduction

Stature is the maximum distance measured from the point where the heel touches the floor to the highest point of the head while the person is in erect position [1]. It is an easily measured and widely used anthropometric parameter used as a feature of human identification. It is also wide clinical applications, especially as an indicator of nutritional status [2] and in the calculation of Body mass index (BMI), Basal metabolic rate(BMR), and Creatinine Height index and for interpretation of lung function tests [3]. It is proven that a person's growth in height ceases at the chronological age of 19years and after the age of 30 years onwards age related regressions take place [4]. The measurement of stature is either not possible or not accurate in situations where patients cannot assume the posture necessary for the accurate measurement [3]. Thus patients with some lower extremity disability, or with musculo-skeletal conditions for which maintaining an erect posture is difficult or not possible, the sick immobile patient and the critically ill may not benefit from the many clinical indexes calculated using height. When it is not possible to accurately measure height, other anthropometric parameters can be used to estimate it. Knee height is one such anthropometric variable proven by many studies and used commonly [4].

Knee height is defined as the length measured parallel to the long axis of the tibia from the heel of the foot to anterior surface of the thigh while ankle and knee are bent at a 90^0 angle [1]. It has an additional advantage as it could be measured while patient is seated or even lying down [5].

Estimation of stature from extremities and their parts play an important role in identifying the dead body in forensic examination [6]. Because of early maturation and ossification of bones of the lower extremities, it is fairly

*Corresponding Author

accurate, even in the adolescence to predict stature from the long bones of the lower limb. [7]. It has been universally concluded that the linear regression equation provides the best estimates for stature estimation from bone length [8]. It has been shown that the reliability of prediction of height from knee height measurements was as high as that from long bones [9]. Knee height has been used as a surrogate to predict height in various ethnic groups and most of the times showed a positive correlation with height.

A study to determine the differences in stature of Hausa and Ibo adults in Nigeria and its correlation with arm span, knee height and foot length showed statistically significant differences between the two tribes for all parameters measured and for both sexes. In this study, the knee height showed the least correlation. The results conformed to special references for gender and ethnicity on stature for both tribes [10].

Height is used to determine many important clinical measurements, but height may be difficult or impossible to measure accurately in some patients [11]. When the accurate measurement for stature is unobtainable, other surrogates are used to predict stature. Knee height has proven to be a reliable predictor of stature in such circumstances. Inter and intra population variations may be observed in relation to anthropometry due to factors such as genetic makeup, age, gender and ethnicity [3].

The Annang is a cultural semi-Bantu speaking ethnic group that lives in Southeastern Nigeria. The Annang people are located in southeastern Nigeria and southwestern Cameroon which was a part of the present-day Akwa Ibom State and Cross River State [12]. The Annang territory lies between latitude 4.25 and 7 north and longitude 7.15 and 9.30 East and the landscape is generally flat and low-lying with no point rising to 300 feet above sea level. [12].

Though many ethnic groups have been studied in relation to the estimation of stature, non have reported findings among the Annang ethnic group of Nigeria. Thus the aim of this study was to fill the gap in knowledge as concerning this ethnic group in Nigeria.

2. Materials and Method

2.1. Study Popualtion

The study was carried out between May 2016 to August 2016 on four hundred 400 Annang adults (216 males, 184 females) between the age range of 18 to 50. Male and female subjects were selected at random from Abak, Ikot Ekpene, Essien Udim, University of Uyo, Ika, Akwa Ibom state polytechnic Ikot Osurua, Etim Ekpo, Oruk Anam, Ukanafun, Obot Akara local government areas. The slovens formula was used to calculate the minimum sample size of subject in this research.

$$n = N/1+N\,(e)^2$$

n=Sample size, N=Population size (Annang-1,101,160 (Federal Republic of Nigeria official gazette, 2006), e=Significant level (0.05). Sample size for Annang $n=1,101,160/\ 1+\ 1,101,160\ (0.05)^2$

Minimum sample size for Annang = 399.7 approximately 400 subjects were used.

2.2. Measurement of Stature

The subjects were made to stand in upright 2 position with both hands on the sides facing a plain surface (mostly wall). The ruler was placed on top of the subjects (the persons) vertex to indicate the upper margin and this point was marked on the wall using a marker pen, then the height of each individual was measured using a steel meter rule. The distance between the vertex and the floor was taken as the height recorded in centimeters (cm).

2.3. Measurement of Knee Height

The subjects were made to sit on a low leveled chair, while the ankle and knee are bent at a 90^0 angle. A ruler was then placed on the surface of the thigh and knee height was measured from the heel of the foot to the anterior surface of the thigh using a steel meter rule and the distance recorded in centimeters (cm).

2.4. Knee Height Stature Ratio Calculation

The knee height stature ratio was calculated by using the length of the knee height divided by stature, multiplied by one hundred i.e 100 x length of knee height / stature (height).

All linear measurements were in centimeters for each parameter. The data on the measured parameters were analyzed using the Z-test to determine the sex differences and ($p<0.05$) was taken as being statistically significant. The actual ranges for the male and female sexes were found out.

Pearson's coefficients of correlation and regression equations were calculated using Minitab statistical package between stature and knee height. A regression analysis was carried out to predict the stature (height) of the males and females from their knee height.

2.5. Inclusion Criteria

The following were the inclusion criteria for this study;

1. Only subjects who gave verbal consent were selected.
2. The subjects were selected from the eight LGAs that make up the Annang ethnic group.
3. The subjects were indigenes of Annang ethnic group and had dual parentage; their parents and grandparents where from Annang ethnic group.

4. The subjects included male and female of ages 18-50 years.

2.6. Exclusion Criteria

The following were the exclusion criteria for this study;

1. Individuals with recognized deformities of the lower extremities.
2. Individuals with any other musculo-skeletal deformity eg Kyphoscoliosis
3. Subjects with just one parentage of the Annang ethnic group were excluded
4. Subjects below (18) years and above 50 years were excluded from the study.

2.7. Precautions

The following precautions were taken during the measurement:

1. Measurements were taken on bare foot.
2. Each participant's measurements were taken twice to obtain accurate results.
3. Verbal consent was obtained before any measurements was taken after had been explained to the participant.

3. Results and Analysis

The result of the mean and standard deviation of stature, knee height, knee height stature ratio of the Annang ethnic group are shown in table 1-3. The mean and standard deviation of height of the males and females were 165.29±9.98cm and 160.66±9.09cm respectively. It was observed that the Annang males had a significantly higher height than the Annang females ($p<0.05$). The mean and standard deviation of knee height of the males and females were 53.600±3.343cm and 51.441±3.493cm respectively. It was observed that the males of the Annang ethnic group had a significantly larger knee height than their female counterpart ($p<0.05$). The mean and standard deviation of knee height Stature Ratio was 32.477±1.869cm and 32.071±2.223cm for males and females respectively, but it was observed that the difference between these values had less statistical significance. It was observed that for all the parameters, the males had a significantly higher values than that of the females ($p<0.05$). It was also observed that the knee height was significantly lower than the height of the Annang people. Table 3: Shows a comparison of the mean knee height of present study and previous studies. It was observed that, there were ethnic differences in these parameters. Table 4: Shows the Linear Regression Equation for estimation of Stature (Height) from knee height. Figure 1 and 2 Shows the Pearson correlation between the stature and knee height of the Annang ethnic group. R=0.576 and 0.400 for male and female respectively. It was observed that, there was a positive correlation between their stature and knee.

Table-1. Showing mean values of measured parameters for the Annang ethnic group.

Parameters	Sample Size	Males	Females
	(N)	(N=216)	(N=184)
Stature (cm)	400	165.29±9.98	160.36±9.09*
Knee height (cm)	400	53.600±3.343	51.441±3.493*
Knee height Stature Ratio	400	32.477±1.869	32.071±2.223

P<0.05

Table-2. Showing mean values of measured minimum and maximum parameters for the Annang ethnic group.

Parameters	Total Count	Mean	SD	Minimum	Maximum
Female Height(Cm	184	160.66	9.09	141.15	193.10
Female knee height	184	51.441	3.493	28.650	58.950
Female KNEE HEIGHT: SR	184	32.071	2.223	19.087	37.578
Male Height(Cm)	216	165.29	9.98	160.05	208.30
Male knee height	216	53.600	3.343	43.100	64.450
Male KNEE HEIGHT: SR	216	32.477	1.869	26.325	39.624

SD.: Standard Deviation
SR.: Stature Ratio

Table-3. Showing a comparison of mean knee height values of present study and previous studies.

Researchers(year)	Ethnic group	Males(cm)	Females(cm)
Fawehinmi and Paul [13]	Igbo	53.30±3.30	51.75±2.78
	Hausa	58.03±2.37	55.25±2.37
Binoy Kuiti and Kaushik Bose [14]	Bengalees	50.49±2.54	45.20±2.33
Stellenbosh university	SouthAfricans Adult group	53.05± 0.7	49.44± 2.57
	Older group	52.70± 3.04	49.39±2.86
Li, *et al.* [15]	Chinese	48.4 ± 1.9	45.7 ± 1.9
Aline Siqueira Fogal, *et al.* [16]			
Shahar and Pooy [17]	Brazil	51.6 ±2.7	47.3±2.5
	Malaysia	49.8 ± 2.5	49.8 ± 2.5
In Cheol Hwang, *et al.* [18]	Adult group		
	Elderly group	46.1 ± 2.3	49.2 ± 2.2
	korea	50.5±2.5	47.4±2.0(PRM)
			46.0±2.1(POM)
Present study	Annang	53.600±3.343	51.441±3.493

PRM: premenopausal
POM: postmenopausal

Figure-1. Pearson correlation of Stature(cm) and knee height(cm) for the Annang males. R= 0.576

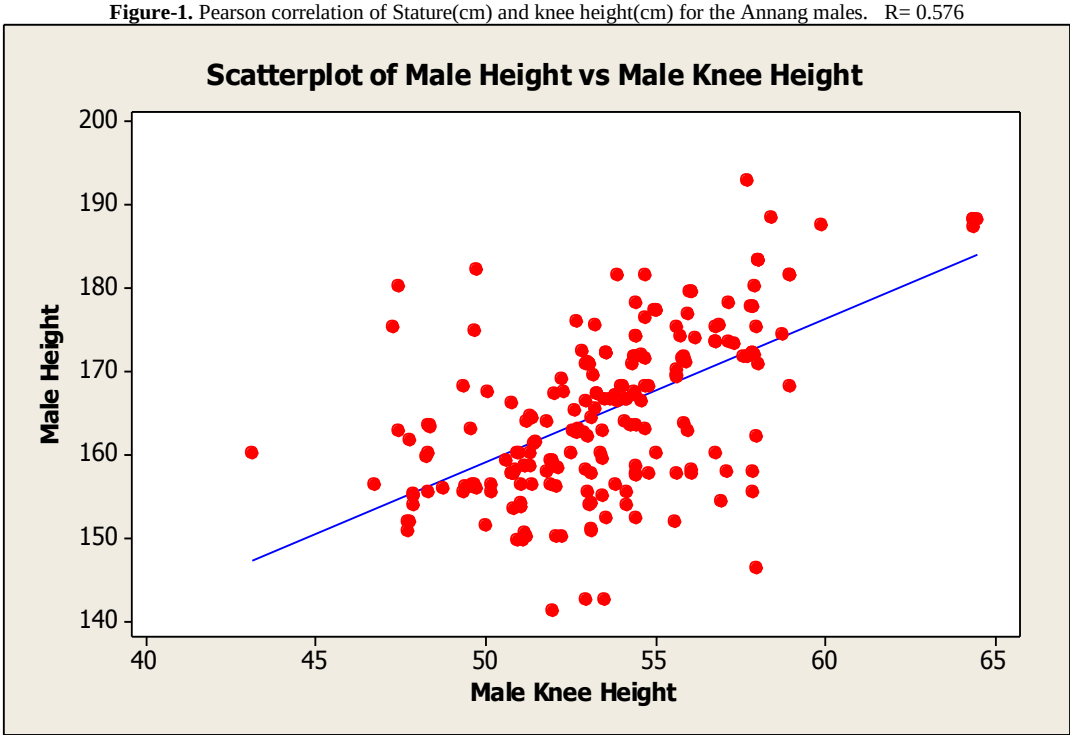

Figure-2. Pearson correlation of Stature (cm) and knee height(cm) for the Annang females. R= 0.400

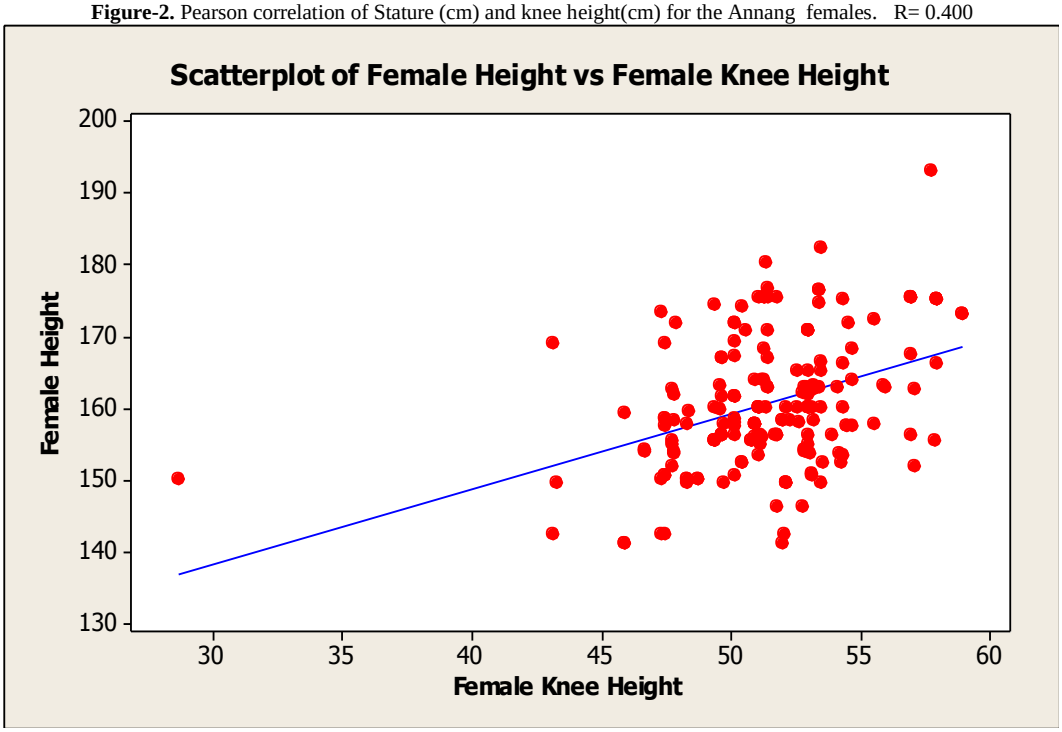

Table-4. Showing Linear Regression Equation for Stature (Height) from knee height

Variable	Regression Equation
Annang Males knee height(cm)	Annang Males Height (Stature) = 73.1 + 1.72 Annang Male knee height(cm)
Annang Females knee height(cm)	Annang Females Height (Stature) = 107 + 1.04 Annang Female knee height(cm)

4. Discussion

When the accurate measurement for stature is not possible, it is computed using other surrogates. Knee height is one of the most widely used. This study analyses the correlation coefficients of stature and knee height of the Annang ethnic group of Nigeria among adults of 18 -50 years. Regression equations are hence developed to predict stature. In the present study it was observed that the males had higher anthropometric measurements than that of females. Similar observations are made in many studies [15, 19, 20]. These differences may be due to gender associated genetic factors, hormonal factors and lifestyle factors [15, 19, 20]. Mean stature for population of adults varies from minimum values for the Efe pymies of Africa at 144.9cm for men and 136.1cm for women [21] to the maximum values for the dutch of Europe at 184.0cm for men and 170.6cm for women [22].

In this study, the mean stature of Annang adults is significantly higher than the pigmies of Africa, but lower than that of the Dutch people of Europe. This may be as a result of genetical, environmental and nutritional differences. It has been reported that the most important nutrient for one to reach his or her maximum height potential is protein in childhood and also food rich in calcium, vitamin A and D are essential for a child's growth [23].This however explains the reason for tall height among the Dutch whose meals are known to be rich in protein. This phenomenon may also explain the relatively short stature of the Annang people because their major food is carbohydrate from cassava and maize [24].

The required sample size to develop prediction equations depends on the number of independent variables and their relation with the dependent variable [25]. In this study, the sample sizes are population-based and large enough to estimate accurately the height in Annang adults. The equations reported herein were obtained from large representative samples from the selected villages, thereby allowing for the possibility of their application to the Annang ethnic group of Nigeria.

In this present study, knee height showed a positive linear relationship with height in males and in females. This corresponds with the study of Varun, *et al.* [3] which showed a positive correlation of knee height with height to be r= 0.740 and 0.668 for male and female respectively among Peradeniya medical students. Fatmah [19] also obtained a similar result on his study on Indonesian Javanese elderly people with a correlation coefficient of knee height to stature of (r = 0.698) and (r = 0.679) for male and female respectively. Li, *et al.* [15] obtained a similar result on his study among chinese elderly people, the correlation coefficient was 0.633 for male and 0.665 for female at ($P <$ 0.001).

Binoy and Kaushik's work on the older Bengalees of Purba Medinipur, West Bengal, India to predict height from knee height showed a similar result with the Pearson's correlation coefficient (r) being 0.724 (p<0.001) for men and 0.534 (p<0.001) for women also showed a strong positive correlation.

Correlations as shown in the present study makes it clear that the knee height can be used as the predictor of stature, but it should be borne in mind that ethnic specific equations should be derived for a specific ethnicity [26].

Fawenhinmi and Paul's work on the Igbos and Hausas where Igbos had a mean and standard deviation of the knee height to be 53.30±3.30 and 51.75±2.78 for male and female respectively and for the Hausa's was 58.03±2.37and 55.25±2.37 for male and female respectively was similar to the mean and standard deviation for knee height in this present study. Many of these studies had better correlation between these parameters than our study, but this may be accounted for by ethnic, geographical, demographic and environmental differences inherent in the study populations.

5. Conclusion

The objective of this research was to determine the stature and knee height of the Annang ethnic group and to derive a regression equation that could be used to predict stature using knee height among adult Annang individuals. This study was imperative because there was no previous studies to predict stature using knee height among the Annang ethnic group. Results obtained from this study showed that knee height has a positive correlation with stature among the Annang adults. The result from this study is comparable to studies done in other ethnic groups and may be relevant in further anthropometric or forensic studies as it concerns the Annang ethnic group.

References

[1] Lohman, T. G., Roche, A. F., and Mattorell, R., 1988. *Segment Length, anthropometric standardization reference manual*. Human Kinetics Publishers Inc, Illinois.

[2] Lakshmi, P., Kavyashree, A. N., Bindurani, M. K., and Asha, K. K., 2015. "Arm span as a predictor of stature among Indian population." *Research journal of pharmaceutical, biological and chemical sciences*, vol. 6, p. 802.

[3] Varun, R., Jayasinghearachchi, T., and Priyalini, R., 2012. "Arm span and knee height as predictors of stature among peradeniya medical students." *Sri Lankan Journal of Anaesthesiology*, vol. 19, pp. 76-80.

[4] Mohanty, S. P., Suresh, B., and Sreekumaran, N., 2001. "The use of arm span as a predictor of height, a study of South Indian women." *Journal of Orthopaedic Surgery*, vol. 9, pp. 19-23.

[5] Chumlea, W. C., Roche, A. F., and Stienbaugh, M. I., 1985. "Estimating stature from knee height for persons 60-90 years of age." *Journal of American Geriatric Society*, vol. 33, pp. 116-120.

[6] Krishan, K., 2007. "Anthropometry in forensic medicine and forensic science-forensic anthropometry. Internet scientific publications." *The Internet Journal of Forensic Science*, pp. 206-211.

[7] llayperuma, I., Nanayakkara, B. G., and Palahepltiya, K. N., 2008. "A model for reconstruction of personal stature based on the measurement of foot length." *Galle Medical Journal*, vol. 13, pp. 7-15.

[8] Parekh Utsav, Reekee Patel, and Pratik Patel, 2014. "A study of relation of stature with foot length in natives of gujarat state." *NHL Journal of Medical Sciences*, vol. 3, pp. 5-11.

[9] Kulthanan, T., Techakampuch, and Bed, N. D., 2004. "A study of foot prints in athletes and non -athletic people." *J. med association Thai*, vol. 87, pp. 788-793.

[10] Paul, C. W. and Fawehinmi, H. B., 2008. "Comparison of anthropometric characteristics (height, armspan, knee height and foot length) between ibo and hausa adults." *Journal of Biomedical Sciences in Africa*, vol. 6, pp. 57-59.

[11] Brown, J. K., Whittemore, K. T., and Knapp, T. R., 2000. "Is Arm Span an Accurate Measure of Height in Young and Middle-Age Adults?" *Clinical Nursing Research*, vol. 9, pp. 84-94.

[12] Enang, K., 1979. "Some key religious concepts of the annang. In Africana Marburgensia: Cross River Religion, Hackett, R. I. J. (edition) Sonderhe." vol. 12, pp. 21–34.

[13] Fawehinmi, H. B. and Paul, C. W., 2008. "Comparison of anthropometric characteristics (heigh, armspan, knee height and foot length, between Ibo and Hausa adults)." *Biomedical. Africana*, vol. 6, pp. 1-10.

[14] Binoy Kuiti and Kaushik Bose, 2016. "Predictive equations for height estimation using knee height of older Bengalees of Purba Medinipur, West Bengal, India." *Anthropological review*, vol. 79, pp. 47-57.

[15] Li, E. T. S., Tang, E. K. Y., Wong, C. Y. M., Lui, S. S. H., Chan, V. Y. N., and Dai, D. L. K., 2000. "Predicting stature from knee height in Chinese elderly subjects." *Asia Pacific Journal of Clinical Nutrition*, vol. 9, pp. 252-255.

[16] Aline Siqueira Fogal, Sylvia do Carmo Castro Franceschini, Silvia Eloiza Priore, Rosângela Minardi, M., Cotta, and Andréia Queiroz Ribeiro, 2015. "Stature estimation using the knee height measurement amongst Brazilian elderly." *Nutr. Hosp*, vol. 31, pp. 829-834.

[17] Shahar, S. and Pooy, N. S., 2003. "Predictive equations for estimation of stature in Malaysian elderly people." *Asia Pacific Journal of Clinical Nutrition*, vol. 12, pp. 80-84.

[18] In Cheol Hwang, Kyoung Kon Kim, Hee Cheol Kang, and Dae Ryong Kang, 2009. "Validity of stature-predicted equations using knee height for elderly and mobility impaired persons in koreans." *Epidemiology and Health*, Available: https://doi.org/10.4178/epih/e2009004

[19] Fatmah, M., 2009. "Predictive equations for estimation of stature from knee height, armmspan and sitting height in Indonesian Javanese elderly people." *International Journal of Medicine and Medical Sciences,* vol. 1, pp. 456-461.

[20] Chumlea, W. C., Guo, S., and Wholihan, K., 1998. "Stature prediction equations for elderly non- Hispanic white, non-Hispanic black and Mexican-American persons developed from NHANES III data." *Journal of American Dietary association,* vol. 98, pp. 137-142.

[21] Dietz, W. H., Marino, B., Peacock, N. R., and Bailey, R. C., 1989. "Nutritional status of Efe pygmies and Lese horticulturalists." *American Journal of Physical Anthropology,* vol. 78, pp. 509–518.

[22] Fredriks, A. M., Van, B. S., Burgmeijer, R. J., Meulmeester, J. F., Beuker, R. J., Brugman, E., Roede, M. J., Verloove-Vanhorick, S. P., and Wit, J. M., 2000. "Continuing positive secular growth change in The Netherlands 1955–1997." *Pediatric Research,* vol. 47, pp. 316–323.

[23] Chao, Q. L., 2006. "How much of human height is genetic and how much is due to nutrition?" *Scientific American,*

[24] Ebewo, P., 2005. *Ika Folklore: Oral traditions of the Ika people of Nigeria*. JANyeko Publishing Center, p. 86.

[25] Guo, S., Wu, X., Vellas, B., Guigoz, Y., and Chumlea, C., 1994. "Prediction of stature in the french age and nutrition." vol. 5, pp. 169–173.

[26] Nunez, V. M. M., Rodriguez, M. A. S., and Sandoval, A. C., 2002. "Equations for predicting height for elderly mexican americans are not applicable for elderly mexicans." *American Journal of Human Biology,* vol. 14, pp. 351-355.