Bajopas Volume 10 Number 2 December, 2017
http://dx.doi.org/10.4314/bajopas.v10i2.31

Bayero Journal of Pure and Applied Sciences, 10(2): 184 - 189
Received: October, 2017
Accepted: December, 2017
ISSN 2006 – 6996

AGE SPECIFIC SEX DIFFERENCES IN BMI AND SKIN FOLD THICKNESS AMONG CHILDREN OF KAZAURE EMIRATE, NIGERIA

*** Gudaji, A.,[1] Adamu, L.H.,[1] Taura, M.G.,[1] Danborno, B.,[2] * Asuku, A.Y.,[1] *Datti, S.,[1] *Mika'il, U. I.[1]**

[1]Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Bayero University Kano
[2]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Ahmadu Bello University Zaria
*Corresponding author: agudaji.ana@buk.edu.ng; gudajikzr@yahoo.com +2347036892418

ABSTRACT
An important phenomenon occurring in human population is the variation in their physical morphology. The physical dimensions of human body are influenced by geographical, racial, age and gender factors. Physical anthropometry provides the technique by which human body dimensions can be evaluated and measured. The aim of the study was to determine age specific sex differences in height, weight, BMI and skin fold thickness among children aged 5- 12 years from Kazaure emirate, Jigawa State, Nigeria. The objective of the study was to investigate sexual dimorphism in the measured variables. A total of 1212 primary school pupils aged 5-12 years (659 males and 553 females) were involved. All the anthropometric variables were taken using standard protocols. An independent t-test was used to determine gender differences using SPSS version 20.0and P ≤ 0.05 considered a level of significance. The results showed a significant gender difference in height and weight at age of 8 years (P = 0.009) and (P< 0.001), respectively. For bicep skin fold thickness (BSF), the gender difference was observed at 7 to 12years of age with (P< 0.001). Similar pattern in triceps (TSF) and suprailiac (SISF), showed significant difference at age six (P< 0.001) and (P =0.01), respectively. All ages showed differences in subscapular skin fold thickness (SSF)(P< 0.001). In the SSF, female had higher mean value while for height and weight the reverse trend was the case. In conclusion, the gender differences in SSF may be linked with higher adipose tissue in female than in the male counterparts in childhood.
Key words: Anthropometry, BMI, Skin fold thickness, age, sex, Nigeria

INTRODUCTION

Anthropometry (measurement of height, weight, body circumferences and skinfold thicknesses etc) is widely used in surveys as an indicator of nutritional and health status (Khalid *et al.*,1997; Al-Sendi *et al.*, 2003).Obesity is associated with sympathetic activation and is the leading risk factor for development of hypertension (Rahmouni *et al.*, 2005). The use of body mass index (BMI) for the prediction of risk factor clustering among children and adolescents has significant clinical utility (Katzmarzyk *et al.*, 2004). In a large cross sectional study of adolescents, BMI has been shown to be a better index of body fatness compared to waist-hip ratio (Neovius *et al.*, 2004).

An important phenomenon occurring in human population is the variation in their physical morphology. The physical dimensions of human body are influenced by ecological, geographical, racial, age and gender factors (Golalipour *et al*, 2001; 2003). Physical anthropometry which probably began due to interest in racial classification provides the technique by which human body dimensions can be evaluated and measured (Chamella, 1997; Heidari *et al*, 2006).

In developing countries like Nigeria, the characteristic pattern of poverty, poor maternal education, high rates of morbidity, and inadequate nutritional intake of both the mother and child combine to produce a pattern of growth characterized by an increased risk of low birth weight, poor growth velocities, and a growth status that gradually falls away from the norms of children in developed countries (Cameron, 1991).

Growth is not only accompanied by an increase in size, but also by changes in body proportions and form. The changes are especially marked during puberty and sexual dimorphism is heightened (Kromeyer and Jaeger, 2000). Changes in segment lengths and breadths are useful to understand differential growth and variation in human size and proportions (Kromeyer and Jaeger, 2000).

Growth in early childhood is a health indicator that has been tied more directly to diet and nutritional status (Martorell and Habicht, 1986). Similarly, in other areas of the developing world, the effects of broad socio-economic changes on growth have not been equally distributed throughout a population (Leatherman *et al.*, 1995).

Child growth in particular, is considered to be one of the most sensitive indicators of child health and nutritional status and thus is open to a variety of interpretations (Tracer *et al.*, 1998; Mueller *et al.*, 2001). Growth measurements are expressed in terms of height-for-age, the mean height at a particular age.

Height-for-age is considered to be an indicator of long-term nutritional status because an individual's present height is the result of many years' growth (WHO Working Group, 1986). Although, there is a report that, weight-for-height is frequently considered to be a better indicator of current nutritional status than is height-for-age since weight can be quickly gained or lost (Waterlow *et al.*, 1977; WHO Working Group, 1986; Victoria, 1992).

MATERIALS AND METHODS

Study Area

Kazaure is located in the Northern part of Kano State among the 27 local governments of Jigawa State. It lies between longitude 12^0 30;' to 12^0 45' and latitude 8^0 15' to 8^0 30 North and East respectively. It covers a land area of about 1780 kilometers square. It is bordered to the north by Daura (Katsina State), West by Ingawa (Katsina State), East by Babura (Jigawa State) and to the South by Dambatta (Kano state) (Olofin, 1987; Ayodele, 2000).

The area belongs to the Sudan Savanna Vegetation. Rainfall begins between May and June and ends around September and October. The main annual rainfall is about 600mm with the highest input during the months of July and August. The major occupation of the people is agriculture and their staple foods are millet, guinea corn, maize, wheat and rice (Olofin, 1987).

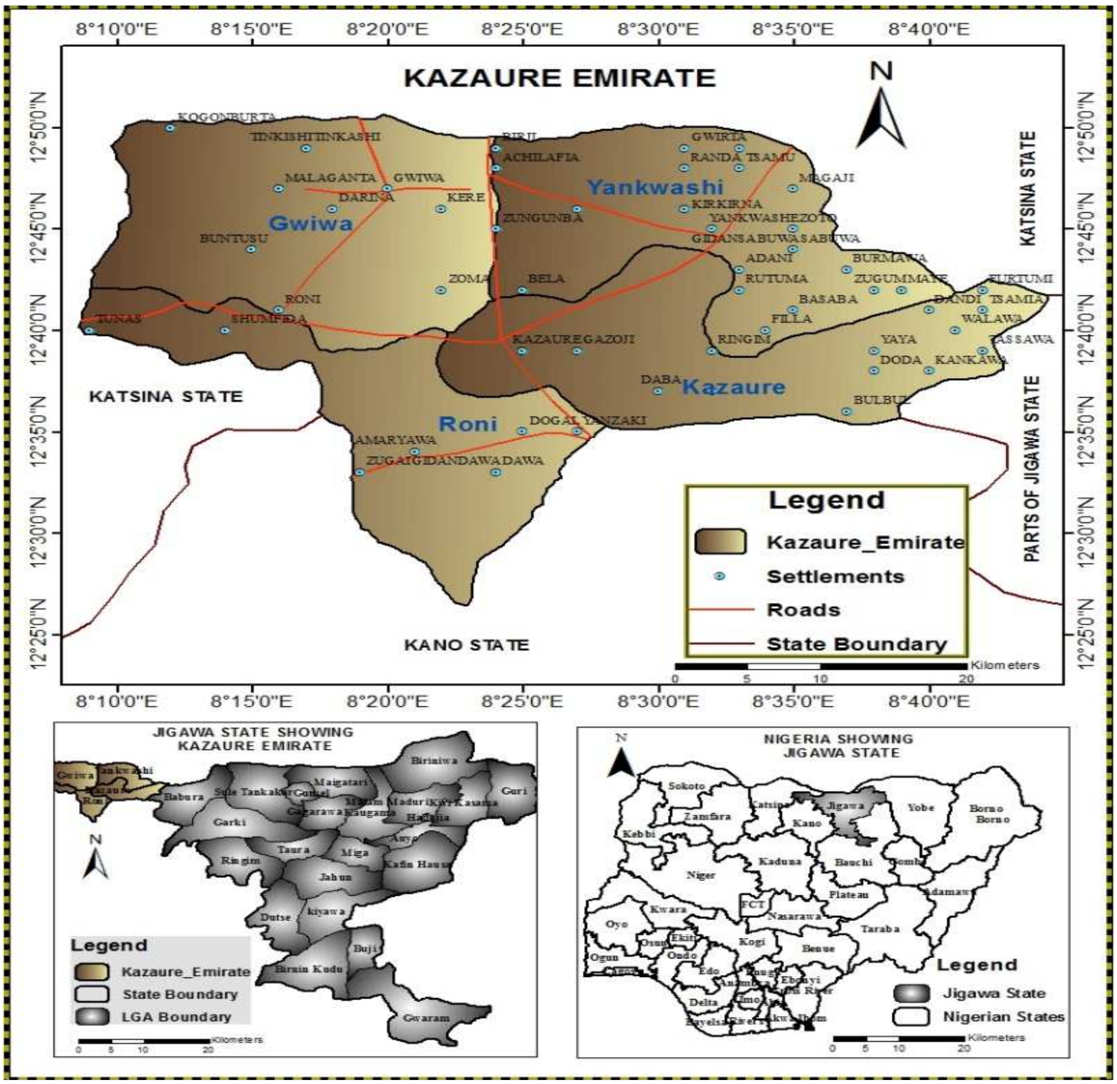

Figure1: Map of Jigawa Showing Kazaure emirate

Study population

It was a cross-sectional survey comprising 1,212 primary school pupils randomly selected from public schools from Kazaure local government education authority, Roni local government education authority, Gwiwa local government education authority and 'Yankwashi local government education authority respectively. Informed consent was given by each participant's guardian and ethical approval was obtained from Ahmadu Bello University Ethical Committee and Jigawa State Ministry of Health Ethical Committee respectively, before the commencement of the study.

Anthropometric Measurements

All subjects within the selected age group underwent a series of anthropometric measurements of height, weight, skinfold thickness of biceps, triceps, sub scapular and suprailiac, respectively, using standard equipment or their substitute where necessary.

An anthropometer (Holtain Ltd., Crymych, Dyfed, UK) was used to measure height, digital weighting scale (Model DS-410, Seiko, Tokyo, Japan) was used for the measurement of weight, a non-elastic measuring tape (Seca 201 Ergonomic Circumference measuring Tape, Amazon, UK)was used for the measurement of mid upper arm, hip, waist and calf circumferences respectively. A Harpenden skin fold caliper (Harpenden Skin Fold Caliper, Amazon, UK)was used for the measurement of biceps, triceps, subscapular, and supra iliac skinfold thicknesses to the nearest 0.1mm. All measurements were made according to the methods of (Lohman *et al.*, 1988; Fidanza, 1991).

Body mass index (BMI) was calculated using the formula weight (Kg)/height squared (m^2) (Monyeki *et al.*, 2000).

i. Height/ Stature (HT): The subjects stood up perfectly upright with arms relaxed by the side, and ankles and knees placed together. The subjects were encouraged to stand as upright as possible and bare footed before measurements were taken. The anthropometer was positioned behind the subjects and the measurement taken to the nearest 0.1cm.
ii. Body weight: This was taken with subjects wearing light clothes and barefooted to the nearest 0.5kg.
iii. Biceps skinfold: This was taken on the left side using the Harpenden caliper. The measurement was done at the midpoint of the upper non-dominant arm anteriorly and recorded to the nearest 0.1mm.
iv. Triceps skinfold: This was measured using the Harpenden skin fold caliper at the midpoint of the upper non-dominant arm posteriorly and recorded to the nearest 0.1mm.
v. Subscapular skinfold: This was measured using the Harpenden skin fold caliper around the inferior angle of the scapula and recorded to the nearest 0.1mm.
vi. Suprailiac skinfold: This was measured using the Harpenden skin fold caliper around the posterior aspect of the crest of the ilium using the Harpenden skin fold caliper and recorded to the nearest 0.1mm.

Selection Criteria

Inclusion criteria

The subjects were primary school pupils from three schools each from Kazaure local government education authority; Roni local government education authority; Gwiwa local government education authority and 'Yankwashi local government education authority respectively, all from Kazaure emirate within the age range of 5-12 years as obtained from their respective Head Teachers. They were physically fit without any deformity. Informed consent was obtained from their guardians. It was voluntary and so pupil had the right to quit at any time/stage.

Exclusion criteria

Any subject outside the stated primary schools, age range of 5-12 years and with any physical deformity.

Statistical Analysis

Data were expressed as mean and standard deviation. An independent *t*-test was used to determine gender differences. Statistical package for social science (SPSS) version 20.0 was used.P $\leq$ 0.05 was considered significant.

RESULTS

Table 1 shows the height of pupils from Kazaure emirate aged 5-12 years with males having greater height than the females at all ages with statistically significant difference at age 8 (P=0.009). Similarly, Table 2 shows the weight of pupils from Kazaure emirate aged 5-12 years with males having greater weight than the females at all ages with statistically significant difference at age 8 (P≤0.001). Furthermore, Table 3 shows the body mass index (BMI) of pupils from Kazaure emirate aged 5-12 years with males having greater BMI than the females at all ages with no statistically significant difference. Table 4 shows the biceps skinfold thickness of pupils from Kazaure emirate aged 5-12 years with females having greater skinfold thickness than the males with statistically significant difference at ages 7-12 years (P<0.001), respectively. Similarly, Table 5 shows the triceps skinfold thickness of pupils from Kazaure emirate aged 5-12 years with females having greater skinfold thickness than the males with statistically significant difference at ages 6-12 years (P<0.001), respectively. Moreover, Table 6 shows the subscapular skinfold thickness of pupils from Kazaure emirate aged 5-12 years with females having greater skinfold thickness than the males with statistically significant difference at ages 5-12 years (P=0.01) at age 6, and (P<0.001) at the remaining ages, respectively. Similarly, Table 7 shows the suprailiac skinfold thickness of pupils from Kazaure emirate aged 5-12 years with females having greater skinfold thickness than the males with statistically significant difference at ages 6-12 years (P=0.01) at age 6, and (P<0.001) at the remaining ages, respectively.

Table 1: Mean and Standard deviation of height of Kazaure emirate children according to age and sex

Age (yrs)	N	Male Mean±SD	n	Female Mean±SD	p-value
5	55	1.07±0.06	57	1.06±0.05	0.81
6	68	1.16±0.05	56	1.15±0.06	0.66
7	54	1.20±0.06	56	1.19±0.04	0.39
8	55	1.25±0.08	55	1.22±0.05	0.009
9	76	1.27±0.05	73	1.26±0.07	0.65
10	94	1.31±0.06	84	1.30±0.05	0.50
11	105	1.35±0.06	79	1.34±0.06	0.41
12	152	1.43±0.07	93	1.41±0.06	0.11

Table 2: Mean and Standard deviation of weight of Kazaure emirate children according to age and sex

Age (yrs)	n	Male Mean±SD	n	Female Mean±SD	p-value
5	55	16.80±1.72	57	16.53±2.00	0.44
6	68	19.87±2.36	56	19.61±2.39	0.54
7	54	21.30±2.90	56	20.96±2.08	0.49
8	55	23.22±2.96	55	21.40±2.43	<0.001
9	76	23.23±2.15	73	23.21±3.16	0.64
10	94	25.72±3.21	84	25.16±2.89	0.22
11	105	28.01±3.31	79	27.57±3.74	0.40
12	152	32.22±4.53	93	31.56±4.20	0.26

Table 3: Mean and Standard deviation of BMI of Kazaure emirate children according to age and sex

Age (yrs)	N	Male Mean±SD	n	Female Mean±SD	p-value
5	55	14.68±0.93	57	14.47±1.01	0.26
6	68	14.82±1.08	56	14.74±1.05	0.68
7	54	14.77±1.17	56	14.75±1.09	0.92
8	55	14.83±1.59	55	14.37±1.00	0.07
9	76	14.65±1.83	73	14.63±1.09	0.38
10	94	15.05±1.09	84	14.88±1.31	0.35
11	105	15.30±1.02	79	15.21±1.26	0.56
12	152	15.82±1.32	93	15.80±1.46	0.99

Table 4: Mean and Standard deviation of biceps skinfold thickness of Kazaure emirate children according to age and sex.

Age (yrs)	n	Male Mean±SD	n	Female Mean±SD	p-value
5	55	3.84±0.80	57	4.08±0.93	0.15
6	68	3.55±0.83	56	3.75±0.74	0.16
7	54	3.26±0.60	56	3.73±0.84	<0.001
8	55	3.11±0.55	55	3.53±0.64	<0.001
9	76	3.02±0.54	73	3.57±0.61	<0.001
10	94	3.03±0.49	84	3.72±0.78	<0.001
11	105	3.01 ± 0.50	79	3.66 ± 0.71	<0.001
12	152	3.12±0.60	93	3.75±0.88	<0.001

Table 5: Mean and Standard deviation of triceps skinfold thickness of Kazaure emirate children according to age and sex.

Age (yrs)	n	Male Mean±SD	n	Female Mean±SD	p-value
5	55	6.54±1.69	57	7.11±1.64	0.08
6	68	6.08±1.37	56	6.97±1.45	<0.001
7	54	5.66±1.22	56	6.91±1.71	<0.001
8	55	5.32±1.18	55	6.57±1.27	<0.001
9	76	5.19±1.18	73	6.75±1.35	<0.001
10	94	5.47±1.31	84	7.19±1.76	<0.001
11	105	5.42±1.31	79	7.15±1.78	<0.001
12	152	5.71±1.62	93	7.64±1.72	<0.001

Table 6: Mean and Standard deviation of subscapular skinfold thickness of Kazaure emirate children according to age and sex.

Age (yrs)	n	Male Mean±SD	n	Female Mean±SD	p-value
5	55	4.76±0.85	57	5.49±1.23	<0.001
6	68	4.92±0.91	56	5.34±0.87	0.01
7	54	4.66±0.61	56	5.43±1.00	<0.001
8	55	4.72±0.69	55	5.26±0.93	<0.001
9	76	4.49±0.64	73	5.53±0.90	<0.001
10	94	4.71±0.66	84	5.86±1.25	<0.001
11	105	4.80±0.73	79	6.16±1.21	<0.001
12	152	5.18±0.86	93	6.55±1.42	<0.001

Table 7: Mean and Standard deviation of suprailiac skinfold thickness of Kazaure emirate children according to age and sex.

Age (yrs)	n	Male Mean±SD	n	Female Mean±SD	p-value
5	55	7.42±1.78	57	8.02±2.08	0.10
6	68	7.12±1.75	56	8.01±2.16	0.01
7	54	6.69±1.41	56	8.32±2.26	<0.001
8	55	6.90±1.77	55	8.15±1.91	<0.001
9	76	6.64±1.60	73	8.62±2.39	<0.001
10	94	6.92±1.63	84	8.82±2.56	<0.001
11	105	6.87±1.63	79	9.25±2.30	<0.001
12	152	7.25±1.95	93	9.66±2.56	<0.001

DISCUSSION

In this study, it was observed that males had better growth in terms of height and weight and subsequently in BMI than the females despite the fact that they were of the same age, the same environment, the same tribe and race. However, growth depends on so many factors in which genetic factor is among which possibly was the reason for this sexual dimorphism. Similarly, this may possibly be due to physical activities the males were exposed to than the females who on the other handwere exposed to sedentary life. However, females had higher subcutaneous fatness than the males which may be connected to their sedentary life in which the rate of deposition is greater than the rate of withdrawal and therefore less energy expenditure. Moreover, females have fat deposit in many places than males such as in the buttocks, breast, abdomen, n the anterior and lateral aspects of the thighs while in males were shoulder, upper arm and nape of the neck (Leeson*et al*., 1988). This agrees with the earlier reports by Malina *et al*. (1988), Santos and Coimbra, (1991) and Pucciarelli*et al*. (1993) that females have higher subcutaneous fatness (panniculusadiposus) than males due to their sedentary life nature and less involvement in strenuous physical exercise and less expenditure of energy.

CONCLUSION

It was observed that males had higher height, weight and BMI than the females despite living in the same environment and having the same age. This variation may possibly be attributed to genetic difference between males and females. Above all, no two individuals are ever alike in their measurablecharacters, since the measurable characters tend to undergo changes in varying degrees from birth to death, in health and in diseases and being members of different genetic influence, frequently may present interesting differences in bodily form andproportions.

Conflict of interest: none declared.

REFERENCES

Al-Sendi, A.M., Shetty, P. and Musaiger, A.O. (2003).Anthropometric and body composition indicators of Bahraini adolescents.*Annals of Human Biology*;30 (4):367 – 379.

Ayodele, A. (2000). Kazaure emirate: Historical and social perspectives. *More blessing printers, 42 Wariroad S/Gari Kano.*1-22.

Cameron N. (1991). Human growth, Nutrition, and health status in sub-Saharan Africa. *Physical Anthropology*; 34:211-250.

Chamella, M. (1997).Biological Anthropology. Translated to Persian (Farsi) by Nadri, A. *First Edition, Gostar Publisher.*Tehran.:75.

Fidanza, F. (1991).Anthropometric methodology. In Nutritional Assessment: a manual for population studies, edited by F. Fidanza (London: Chapman and Hall), pp. 1-43.

Golalipour, M. J., Vakilli, M. A. and Ahamadpour, M. (2001).Height and Weight of Newborns in relation with mother age, race and parity.*Journal Qazvin University of Medical Sciences;* 16: 58 – 64*.*

Golalipour, M. J., Haidari, K., Jahanshahi, M. and Farahani, R. M. (2003).The shapes of Head and Face in normal male newborns in South – East of Capsian Sea (Iran - Gogan).*Journal Anatomical Society of India;* 52(1): 28 – 31.

Heidari, Z., Sagheb, H. M. and Mugahi, M. N. (2006).Morphological evaluation of Head and Face in 18 – 25 years old women in South East of Iran.*Journal of Medical Science; 6(3):* 400 – 404.

Katzmarzyk, P.T., Srinivasan, S.R., Chen, W., Malina, R.M., Bouchard, C. and Berenson, G.S. (2004).Body mass index, waist circumference and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. *Pediatrics*; 114: e198–e205.

Khalid, M.E.M., Mahmoud, M.S.W., Ahmed, M.E.K., Adzaku, F.K. (1997). Fat indices in high and low altitude populations in Southern Saudi Arabia. *Annals of Saudi Medicine*; 17: 312-315.

Kromeyer – Hauschild, K and Jaeger, U. (2000). Growth studies in Jena, Germany: changes in sitting height, biacromial and bicristal breadth in the past Decenniums. *American Journal of Human Biology*;12:646-654.

Leatherman, T.L., Carey, J.W. and Thomas, R.B. (1995).Socio-economic change and patterns of growth in the Andes. *American Journal of Physical Anthropology*; 97:307-321.

Lohman, T.G., Roche, A.F. and Martorell, R. (Editors).(1988). *Anthropometric Standardization Reference Manual*. Champaign, Illinois*:* Human Kinetics Books.

Malina, R.M.; Bouchard, C. and Beunen, G. (1988). Human growth: selected aspects of current research on well-nourished children. *Annual Review of Anthropology*; 17:187-219.

Martorell, R. and Habicht, J.P. (1986).Growth in early childhood in developing countries. In Falkner. F and Tanner J.M (eds): Human Growth. Vol. 3.Methodology.Ecological, Genetic, and Nutritional Effects on Growth. 2nded. New York: Plenum, Pp. 241-262.

Monyeki, K.D., Cameron, N. and Getz, B. (2000). Growth and nutritional status of rural South African children 3-10 years old: The Ellisras growth study. *American Journal of Human Biology*; 12:42-49.

Mueller, I., Vounatson, P., Allen, B.J. and Smith, T. (2001). Spatial patterns of child growth in Papua New Guinea and their relation to environment, diet, socio-economic status and subsistence activities. *Annals of Human Biology*; 28:263-280.

Neovius, M., Linne, Y. and Rossner, S. (2004). BMI, waist circumference and waist hip ratio as diagnostic tests for fatness in adolescents. *International Journal Obesity*; 10:1038.

Olofin, A. E. (1987). Some aspect of physical geography of the Kano region and related human responses: department lecture note. *Series no.* 1.

Pucciarelli, H., Carnese, F., Pinotti, L., Guimarey, L. and Goicoechea, A. (1993).Sexual dimorphism in school children of the villa lapineighbourhood (Quilmes, Buenos Aires, Argentina).*American Journal of Physical Anthropology*; 92; 165-172.

Rahmouni, K., Correia, M.L.G., Haynes, W.G. and Mark, A.L. (2005). Obesity associated hypertension. *Hypertension*; 45: 9–14.

Santos, R. and Coimbra, C. (1991) Socioeconomic transition of the Aripuana Park Brazilian Amazon. *Human Biology*; 63:795 – 819.

Tracer, D.P., Sturt, R.J., Sturt, A.and Braithwaite, L.M. (1998). Two decade trends in birth weight and early childhood growth in Papua New Guinea. *American Journal of Human Biology*; 10:483-493.

Victoria, C.G (1992). The association between wasting and stunting: An international perspective. *Journal of Nutrition*; 122:1105-1110.

Waterlow, J.C, Buzina, R. and Keller, W. (1977). The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. *Bulletin of World Health organization*; 55:489-498.

WHO Working Group (1986). Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of World Health Organization*; 64:929-941.