# **Correlation between Head Circumference, Weight and Height of Urhobo Children and Adolescents in Abraka, Delta State, Nigeria**

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**ABSTRACT**

**Background**: Anthropometric measurements are important in forensic investigations and in assessing the nutritional status of many paediatric patients. The present study was designed to evaluate the correlation between head circumference (HC), height and weight among Urhobo children and adolescents in Abraka, Delta State.

**Materials and Methods**: This descriptive cross-sectional study used 1179 children from primary and secondary schools (629 males and 550 females) aged between 5-17 years. The subjects were selected using the proportional stratified sampling technique. Height was measured in centimetres with a stadiometer, and weight was measured in kilogramme using a weighing scale. An inelastic measuring tape was used to measure the head circumference in centimetres and these were compared based on gender using independent t-test. Statistical significance was set at p < 0.05.

**Results**: The weight and head circumferences were significantly larger in males than in females (p=0.001). The height of subjects in both 5-11 years and 12-17 years’ age-groups lacked significant sexual differences (p>0.05). There was a strong positive correlation between weight and height in both genders and age-groups as well as HC and weight in males of both age-groups and females aged 5-11 years. This correlation was also observed between the HC and height of males aged 12-17 years and females aged 5-11 years (0.5≤r<1. P<0.05).

**Conclusion**: The significant positive association between the variables and the sexual dimorphism in the weight and HC may be used in clinical assessment and forensic investigations involving the specified age-groups of the studied population.

**Keywords**: Head Circumference, Weight, Height, correlation

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INTRODUCTION

A series of standardized measurement techniques known as anthropometry are used to express the dimensions of the human body and skeleton in numerical terms. Anthropometry is frequently considered to be a traditional and possibly the most essential tool in biological anthropology [1]. However, its application in the medical sciences has grown, particularly in forensic medicine. Personal identification of unidentified human remains is the end objective of anthropometry in forensic medicine. One of forensic anthropology’s four crucial components, along with determining age, sex, and race, is evaluating stature. In cases when the identity of the victims in question, it aids in decreasing the pool of potential victims in an investigation [2].

The anthropometric characteristic of head circumference is included in the physical examination of children. It measures the circumference of a child's head around its largest area. The head circumference is measured because it is a simple technique to determine whether a child is developing normally or tending towards a growth associated problem [3]. Growth assessment is a common practice in child health care, and health professionals accept regular growth monitoring as a standard component of community child health services throughout the world. In clinical level, by implementing these activities, one can discover and timely intervene whenever growth faltering occurs. The international recommended standard of determining malnutrition at population level is to take anthropometric measurements [4]. Growth problems in children include a variety of conditions such as obesity, underweight, dwarfism, gigantism, and systemic delay of growth and pubertal development. Growth may also be affected by systemic and endocrine diseases [5].

Human body height has a proportional biological link with other body components such as weight and body mass index (BMI), except in specific pathological situations or due to certain ecological circumstances [6]. In both anthropological research and the identification procedures utilized by medico-legal professionals, a person's height, which is the total length of their body's bones and appendages, is crucial [7].

Body weight is the measurement of how much an individual weighs without having any additional items on the person. Weight under-estimation could lead to suboptimal drug dosing, whereas weight overestimation may increase the premeditated dosage of stringent weight-based drugs or measures with a narrow range of safety subsequently resulting in possible lethal side effects. Therefore, inaccurate estimation of weight in a critical state is inherently harmful[8, 9].Factors affecting the growth of a child include growth hormones, nutrition, heredity and genetics, socioeconomic factors, season and climate, ethnicity and physical factors [10].This study was therefore designed to evaluate the correlation between head circumference, height and weight of Urhobo children in Abraka, Delta State.

MATERIALS AND METHODS

This descriptive study of the cross-sectional design comprised of children and adolescents (aged 5-17 years) from the Urhobo ethnic group in Abraka, Delta State. The study population was from primary and secondary schools with subjects aged 5-11 years and 12-17 years respectively. The ethnicity was confirmed from the children’s biodata files in the schools. The sample size was 1179 based on the proportional stratified sampling technique. The subjects were included in the study if their parents were natives of Urhobo ethnic group. Subjects with history of chronic diseases such as sickle cell anaemia and growth abnormalities such as stunting and gigantism were excluded from the study. Permission for the study was obtained from the respective school managements. Furthermore, informed consent was obtained from the parents or legal representatives prior to measurements. Ethical approval was sought from the Research and Ethical Committee of the Faculty of Basic Medical Sciences, Delta State University, Abraka (REC/FBMS/DELSU/21/121).

The head circumference was measured using an inelastic measuring tape around the largest area of the head. This is about 4.5 centimetres above the eyebrows and ears and around the back of the head [11]. The standing height of the subject was measured using a stadiometer in centimetres. This was measured from the crown of the head to the sole, with the subject in an erect position. The digital weighing scale was used in taking the weight in kilograms, with the subject in light clothing and free of heavy accessories and foot wears.

Data obtained were analyzed using the IBM Statistical Package for Social Science (SPSS version 23) manufactured in Chicago, USA. Descriptive statistics were used to summarize the data while Pearson’s correlation was used to determine the relationship between head circumference, height and weight. Independent t-test was used to determine gender differences in the parameters that were assessed. All p-values less than 0.05 were considered statistically significant.

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RESULTS

One thousand one hundred and seventy-nine (1,179) individuals participated in the study. Out of this study sample, 52.98% were males and 47.02% were females. Figure 1 shows the distribution of the study subjects based on gender while the gender distribution based on 2 years’ age-groups is shown in Figure 2.

**Figure 1:** Distribution of the study subjects based on gender

**Figure2:** The gender distribution of subjects based on 2 years’ age-groups

The mean weight in the5-11years’ age-group was greater in females (26.65±8.42 kg) than in males (26.15±7.50 kg), but the difference was not statistically significant (p=0.514). In the 12-17 years’ age-group,females (44.66±10.80 kg) had a significantly higher mean weight than their male counterparts (42.63±11.38 kg)(p=0.021) (Table 1).

**Table 1:** Comparison of body weight between male and female subjects

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| **Age (Years)** | **Gender** | **N** | **Range** | **Mean Body Weight (kg)** | **Std. Deviation** | **t** | **Df** | **P-Value** |
| 5-11 | M | 243 | 14.80-63.40 | 26.15 | 7.50 | -0.66 | 457 | 0.514 |
| F | 216 | 14.20-63.40 | 26.65 | 8.42 |
| 12-17 | M | 386 | 22.20-82.60 | 42.63 | 11.38 | -2.42 | 691.37 | 0.021\* |
| F | 320 | 25.20-79.00 | 44.66 | 10.80 |

t = value of t-test Df = degree of freedom M = Males, F = Females\*statistical significance

The females in the 5-11 years’ age-group were taller (131.69±13.21 cm) than the males (131.05±12.87 cm) while the males in the 12-17 years’ age-group were taller (157.24±12.95 cm) than the females (156.21±9.74 cm). However, in both age-groups, the gender differences in height were not statistically significant (p>0.05) (Table 2).

**Table 2:** Comparison of body height between male and female subjects.

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| **Age (Years)** | **Gender** | **N** | **Range** | **Mean Body Height (cm)** | **Std. Deviation** | **t** | **Df** | **P-Value** |
| 5-11 | M | 243 | 100-168 | 131.05 | 12.87 | -0.52 | 457.00 | 0.602 |
| F | 216 | 103-165 | 131.69 | 13.21 |
| 12-17 | M | 386 | 116-196 | 157.24 | 12.95 | 1.12 | 697.73 | 0.227 |
| F | 320 | 115-188 | 156.21 | 9.74 |

t = value of t-test Df = degree of freedom M = Males, F = Females

The males in both 5-11 years’ and 12-17 years’ age groups had significantly larger head circumference (52.02±1.79 cm, 54.09±1.81 cm) than their female counter parts (51.40±1.51 cm, 53.62±1.66 cm) (p<0.05) (Table 3).

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**Table 3:** Comparison of HC between male and female subjects

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| **Age** | **Sex** | **N** | **Range** | **Mean HC (cm)** | **SD** | **t** | **Df** | **P-Value** |
| 5-11 | M | 243 | 48.00-59.00 | 52.02 | 1.79 | 3.97 | 457 | 0.001\* |
| F | 216 | 48.00-55.00 | 51.40 | 1.51 |
| 12-17 | M | 386 | 50.00-59.00 | 54.09 | 1.81 | 3.54 | 704 | 0.001\* |
| F | 320 | 49.00-59.00 | 53.62 | 1.66 |

t = value of t-test Df = degree of freedom M = Males, F = Females, \* statistical significance.

There was a significant strong positive correlation between; head circumference and weight in males of both age-groups and females aged 5-11 years as well as head circumference and height in 5-11 years old females and 12-17 years old males. In both age-groups, the height and weight showed a significant positive correlation in both males and females (0.5≤r<1. P<0.05) (Tables 4 and 5).

**Table 4:** Table showing correlation between variables in males

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| **Age-group** |  | |  | | **Height** | | **Weight** | | **HC** | |
| 5-11 years | Height | | r | | 1 | | 0.823 | | 0.436 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | Weight | | r | | 0.823 | | 1 | | 0.528 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | HC | | r | | 0.436 | | 0.528 | | 1 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
| 12-17 years | | Height | | r | | 1 | | 0.826 | | 0.513 | |
|  | |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | | Weight | | r | | 0.826 | | 1 | | 0.576 | |
|  | |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | | HC | | r | | 0.513 | | 0.576 | | 1 | |
|  | |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |

r= Pearson’s correlation p= p-value, \*statistical significance

**Table 5:** Table showing correlation between variables in females.

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| **Age-groups (Years)** | |  | |  | **Height** | **Weight** | | **HC** | |
| 5-11 | | Height | | r | 1 | 0.852 | | 0.522 | |
|  | |  | | p | 0.001\* | 0.001\* | | 0.001\* | |
|  | | Weight | | r | 0.852 | 1 | | 0.524 | |
|  | |  | | p | 0.001\* | 0.001\* | | 0.001\* | |
|  | | HC | | r | 0.522 | 0.524 | | 1 | |
|  | |  | | p | 0.001\* | 0.001\* | | 0.001\* | |
| 12-17 | Height | | r | | 1 | | 0.540 | | 0.391 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | Weight | | r | | 0.540 | | 1 | | 0.491 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |
|  | HC | | r | | 0.391 | | 0.491 | | 1 | |
|  |  | | p | | 0.001\* | | 0.001\* | | 0.001\* | |

r= Pearson’s correlation p= p-value\* statistical significance

DISCUSSION

In this study, significant gender difference in weight was only observed in the 12-17 years old subjects, with the female subjects weighing more than the males. This could be explained based on similar growth reported in males and females before adolescence, followed by a major growth spurt in early adolescence. Testosterone production in males causes more increase in bone density and muscle mass compared to females and this is associated with heavier males than females in some populations [12]. Females however have been reported to weigh more than males at younger age since they attain puberty earlier hence, their accelerated growth begins earlier and males catch up later [13]. Similar reports of significant gender differences in weight of children have been documented by Al-sendi *et al.*[14] Gultekin *et al.,*[15] and Kavak [16]. Likewise, Akinpelu *et al.*[17] studied the reference growth values for adolescents aged 12-18 years in a Nigerian community and reported that girls where slightly heavier than boys till the age of 15 years, while the boys took the lead at 16 and 17 years. On the contrary, our findings differed from Nto*et al.*[18] who found out that boys aged 5-18 years weighed more than their female counterparts in Ebonyi State, Southeast Nigeria.

We report no significant gender differences in height among subjects of both age-groups studied. In the 5-11 years’ age-group, this finding may attributed to the fact that male and female children develop at a close interval each year until the first growth spurt which occurs in early adolescence [12]. The reason for the observed similar height in both males and females aged 12 to 17 years is unclear because it is well-known that late fusion of ossification centres in males allows more time for growth in length of bones [19]. The observed phenomenon herein may be attributed to variations in factors including genetics, diet, environment, social and cultural factors [4]. Consistent with our findings, previous Nigerian studies also reported no significant gender differences in the height of children and adolescents in south western Nigeria [20, 21]. On the contrary, some Nigerian studies documented contrasting findings. For instance, Akinpelu *et al.* [16] evaluated adolescents aged 12-18 years and reported higher heights among girls than boys until 15 years of age while Eyong *et al.* [22] reported that from age 14 to 18 years, boys in Calabar, a south-south Nigerian city, were taller than girls. These discrepancies may be as a result of varying sample sizes, study settings, methodological approaches, and population variations based on genetics, tribe and diet.

Congruent with the findings of Mathews *et al.,*[23] we observed significantly larger HC in males than females in both age-groups and his could be ascribed to larger posterior cranial fossae in males. Similarly, Galjaard *et al.*[24] conducted a study on sex differences in foetal growth and immediate birth outcomes in a low-risk Caucasian population and reported a significantly larger HC in male than female foetuses. In contrast, a study among teenage Indians by Jayesh *et al.*[25] revealed larger head circumference in females than in males.

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We observed a strong positive association between HC and weight in both sexes of the 5-11 years’ age-group and males of 12-17 years’ age-group. Among the Dutch, the HC was reported to show a strong correlation with weight and height [26]. Similarly, at birth, Adiele and Elem in 2013[27] observed a significant relationship between birth weight and HC in Nigeria. In contrast to these findings, Christiane *et al.*[28] reported that the relationship between HC and weight was not significant at all ages assessed in their study. The positive correlation between HC and height among 5-11 years’ males and 12-17 years’ females was weak although statistically significant. Therefore, they should cautiously be used in estimating each other within our studied population. On the other hand, the HC and height of females and males in the 5-11 years’ and 12-17 years’ age-groups respectively may be utilized in estimating each other due to the significantly strong association between these variables. Similarly, previous Nigerian studies carried out in Cross-river, Lagos, Delta and Benin documented a positive correlation between HC and Height [29, 30]. However, Jervas *et al.* [31] reported no significant association between these variables among the Igbos of Nigeria. Studies by Agnihotri *et al.* [7], Shah *et al.,* [32], Marko *et al.* [33], Singh *et al.* [34] and Mansur *et al.* [35] in Indo-Mauritian and Indian populations showed a strong significant positive association between HC and height.

Our study observed a strong positive association between height and weight in both males and females of both age-groups. This was congruent with Islam *et al*. [36] who documented that the increasing height of an individual is accompanied by their increase in weight. These findings were parallel with Daniel *et al.* [37] and William *et al.* [38] but contrasting with Mohammad *et al.* [39] who observed a weak association between weight and height. The relationship between weight and height may be utilized in estimation of weight to help in calculating drug dosages in patients whose weight is unknown.

CONCLUSION

The significant positive association between the variables and the sexual dimorphism in the weight and HC may be used in clinical assessment and forensic investigations involving the specified age-groups of the studied population.

CONFLICT OF IBADAN

Nil

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