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Assessment of Cormic Index and Other Anthropometric Parameters of Young Adults with Sickle Cell Anaemia in Ile-Ife, Nigeria

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Abstract: This study assessed the effect of Haemoglobin SS (Hb SS) on cormic index and some other body anthropometric indices among students of Obafemi Awolowo University, Ile-Ife, Nigeria. A total of 100 young adults (18 – 40 years) participated in the study. They were classified into two groups; 50 cases (participants with Hb SS) and 50 control (participants with Hb AA) which were purposively selected after haemglobin typing using electrophoresis method. The cases and controls were age-and sex-matched. The weight, sitting and standing height were measured by using Seca stadiometer-model 216 following standard protocol. Cormic index (CI%) was calculated using sitting height x 100/ standing height while the body mass index (BMI) and body surface area were calculated using Keys and Monsteller formulae respectively. The data were analyzed using descriptive and inferential statistics and alpha value was set at $p < 0.05$. The mean values of weight in kg [54.39 ± 5.54 vs 60.48 ± 8.65 (t= -4.195, $p < 0.001$], body mass index in kg/m^2 [19.58 ± 2.08 vs 21.48 ± 2.91 (t = 6.068; $p < 0.001$)], cormic index in % [44.71 ± 6.05 vs 50.03 ± 1.33 (t = -3.760; $p < 0.001$)], subischial leg length in cm [92.22 ± 10.76 vs 83.84 ± 4.41 ($p < 0.001$; t = 5.092)] and body surface area in m^2 [1.59 ± 0.09 vs 1.68 ± 0.14 ($p < 0.001$, t = -3.798)] of cases were significantly different from those of controls respectively. In conclusion, this study showed that Hb SS is associated with lower weight, sitting height, body mass index, body surface area and cormic index but higher subischial leg length when compared with Hb AA.

Keywords: Cormic Index, Subischial Leg Length, Body Mass Index, Sickle Cell Anaemia, Young Adults

1. Introduction

Sickle cell anaemia (SCA) is a public health challenge that affects the people of African origin. SCA is a group of genetic disorders of haemoglobin in which glutamine is substituted for valine at position six of the beta-haemoglobin chain [1]. It is the most common human genetic disorder and found in people of African descent. It has also been observed among people of other ethnic groups [2, 3]. People with SCA have being reported to have a characteristic outlook called sickle cell habitus characterized by frontal bossing, gnathopathy, finger clubbing, long extrimities, spider fingers and lack of lip seal [4]. The lack of lip seal exposes the anterior teeth and a prognathic maxilla which results from rapid proliferation of maxilla as a result of increased rate of erythropoiesis that occurs among people with SCA [5]. Prognathic maxilla is evidenced by maxillary prominence, malocclusion and mandibular retrusion which was described as the main jaw abnormality seen among black North Americans with SCA [5]. Shnorhokian et al in a study of black American children with SCA also reported that there was a larger angle of convexity – a measure of protrusion of the maxillary part of the face – to the total profile in sickle cell patients than in controls and incisors were also seen to be more

retruded due to increased lip pressure [6]. Many of these physical changes were due to the chronic hypoxaemia associated with severe anaemia. During infancy, severe haemolysis causes marrow hyperplasia of the skull and facial bones, resulting in frontal bossing, prognathism, or malocclusion [7]. Cormic Index is the expression of sitting height in relation to full height [8]. The Cormic Index measures the ratio of trunk length to stature which is known to decline throughout childhood because leg length increases faster than trunk length during prepubertal growth [9]. The Cormic Index can be used to correct for variability in body shape when BMI is used to compare the nutritional status in or between different populations. Impaired growth was also said to be associated with specific nutrient deficiencies owing to low dietary intake and enteric pathology resulting in decreased absorption and increased loss from the gut or increased utilisation by the body. The precise roles of extrinsic factors related to inadequate food intake or intrinsic factors associated with disease activity and higher energy expenditure are unclear. Inadequate dietary intake can result from anorexia and reduced food consumption during acute disease complications and hospitalisation, and these may remain low for weeks following discharge [10, 11].

Chronic nutritional deficiencies resulting from inadequate food intake because of poor appetite especially during the vaso-occlusive crisis also contributes to reduction in body anthropometry in SCA. Increased resting energy expenditure and underlying chronic anaemia were reported in patients with SCA and contributing factors may include increased protein turnover, enhanced erythropoietic activity, cardiac work overload and chronic low-grade inflammation [12-14]. Growth impairment in SCA also relates to endocrine dysfunction and micronutrient deficiency and this has been reviewed recently [15]. In view of these multiple effects, growth monitoring is an important tool for assessing the health and nutrition of these children as growth status can be a sign of disease activity and severity and its monitoring a useful marker of efficacy of medical and/or nutritional interventions [16]. However, adults that have suffered vertebral infarction and collapse may be shorter than normal [17]. Report on Cormic Index among young adults with sickle cell anaemia is rare. The aim of this study was to assess the effects of sickle cell anaemia on cormic index and some other anthropometric parameters among young adult Nigerians.

2. Methodology

2.1. Study Population

This was a comparative descriptive study involving two groups of young adults: group A were young adults with SCA (confirmed by haemoglobin electrophoresis) aged between 18 – 40 years in steady state. Steady state was defined as a period without any acute event such as pain, fever, infection or severe anaemia, and no blood transfusion in the four weeks preceding recruitment [18]. Group were age and sex-matched apparently healthy young adults with haemoglobin AA (also confirmed by haemoglobin electrophoresis) without acute illness in the previous two weeks [19]. The haematocrit of all the participants were checked.

2.2. Anthropometry

Bare footed standing heights were measured to the nearest centimetre, each participant stood erect with back touching the stadiometer and arms held laterally by sides while the two feet closely apposed using Seca stadiometer-model 216. The weight of each participant was measured to the nearest kilogram using bathroom scale. Sitting height (SH) was measured after sitting on a standard laboratory stool of a known height placed against the stadiometer. Each of the subjects was made to sit upright with their head at eye-ear plane. The sitting height was then obtained by subtracting the known height of the stool from the reading on the stadiometer at the apex of the vertex. Subischial leg length was calculated as the difference between the standing height and sitting height. The body mass index was calculated from height in metres and weight in kg using the formula; BMI (kg/m^2) = weight / $height^2$ [20]. The body surface area (BSA) was calculated from the weight (kg) and height (cm) using Mosteller formula; BSA= [(weight in kg × height in cm) / 3600] 1/2 [21]. Cormic index (CI) was calculated using the formula; CI (%) = Sitting height × 100/ Standing height.

2.3. Statistical Analysis

The data was analyzed with the aid of SPSS IBM version 20.0 software. Descriptive statistics and cross tabulations were used to present the data. Comparison of means of two groups (Hb SS and Hb AA) was done using Student T-test and relationship between categorical variables was determined by Chi square respectively. A p-value of < 0.05 was taken as statistically significant.

3. Results

A total of one hundred young adults within the age range of 18 – 36 years participated in this study. The mean haematocrit (%) of group A (24.86 ± 4.13) was significantly lower ($t= -17.473$, $p < 0.001$) than group B (38.20 ± 3.54). The mean ± SD of body weight in kg, height in cm, cormic index in percentage, body mass index in kg/m^2 and body surface area m^2 of participants with Hb SS (n=50) were significantly lower while subischial leg length in cm was significantly higher than Hb AA (n=50) as shown in table 1.

When the mean ± SD of body weight in kg, height in cm, sitting height in cm, cormic index in percentage, body mass index in kg/m^2, subischial leg length in cm and body surface area m^2 the male participants with Hb SS and Hb AA were compared, the weight, sitting height, cormic index, BMI and BSA were significantly lower while the subischial leg length were significantly higher among participants with Hb SS as shown in table 2.

The mean ± SD of body weight in kg, sitting height in cm, cormic index in percentage, body mass index in kg/m^2 and body surface area m^2 were significantly lower but subischial leg length in cm significantly higher among female

participants with Hb SS when compared with female Hb AA female participants as shown in table 3.

Correlation between age and anthropometric parameters showed a positive significant correlation with subischial leg length but negative significant correlation with cormic index among Hb SS participants table 4. Correlation between haematocrit and anthropometric parameters showed a positive significant correlation with weight, height and body surface area among Hb SS participants while height and sitting height were positively correlated among Hb AA participants as shown in table 5.

Table 1. *Effects of Sickle Cell Anaemia on Anthropometric Parameters.*

Anthropometric Parameters	Mean ± SD		t	p-value
	Group A (n=50)	Group B (n=50)		
Age (years)	22.10 ± 3.45	22.10 ± 3.45	0.000	1.000
Body weight (kg)	54.39 ± 5.54	60.48 ± 8.65	-4.195	<0.001*
Height (cm)	166.76 ± 5.26	167.76 ± 7.22	-0.791	0.431
Sitting height (cm)	74.54 ± 10.21	83.92 ± 4.08	-6.034	<0.001*
Cormic index (%)	44.71 ± 6.05	50.03 ± 1.33	-6.068	<0.001*
Body mass index (kg/m^2)	19.58 ± 2.08	21.48 ± 2.91	-3.760	<0.001*
Subischial leg length (cm)	92.22 ± 10.76	83.84 ± 4.41	5.092	<0.001*
Body surface area (m^2)	1.59 ± 0.09	1.68 ± 0.14	-3.798	<0.001*

*Significant p-value < 0.05
Group A – Hb SS, Group B – Hb AA

Table 2. *Effect of Sickle Cell Anaemia on Anthropometric Parameters among Male Participants.*

Anthropometric Parameters	Mean ± SD		t	p-value
	Group A (n=25)	Group B (n=25)		
Age (years)	21.28 ± 3.10	21.28 ± 3.10	0.000	1.000
Body weight (kg)	54.04 ± 5.25	60.62 ± 7.162	-3.710	0.001*
Height (cm)	169.84 ± 5.44	172.04 ± 6.26	-1.327	0.191
Sitting height (cm)	73.32 ± 11.39	86.00 ± 4.09	-5.240	<0.001*
Cormic index (%)	43.15 ± 6.42	49.99 ± 1.48	-5.188	<0.001*
Body mass index (kg/m^2)	18.77 ± 1.80	20.42 ± 1.52	-3.511	0.001*
Subischial leg length (cm)	96.52 ± 11.10	86.04 ± 3.98	4.444	<0.001*
Body surface area (m^2)	1.60 ± 0.09	1.70 ± 0.13	-3.362	0.002*

*Significant p-value < 0.05
Group A – Hb SS, Group B – Hb AA

Table 3. *Effect of Sickle Cell Anaemia on Anthropometric Parameters among Female Participants.*

Anthropometric Parameters	Mean ± SD		t	p-value
	Group A (n=25)	Group B (n=25)		
Age (years)	22.92 ± 3.65	22.92 ± 3.65	0.000	1.000
Body weight (kg)	54.74 ± 5.89	60.33 ± 10.06	-2.398	0.020*
Height (cm)	163.68 ± 2.67	163.48 ± 5.41	0.166	0.869
Sitting height (cm)	75.76 ± 8.94	81.84 ± 2.87	-3.238	0.002*
Cormic index (%)	46.28 ± 5.33	50.07 ± 1.18	-3.473	0.001*
Body mass index (kg/m^2)	20.40 ± 2.06	22.54 ± 3.55	-2.617	0.012*
Subischial leg length (cm)	87.92 ± 8.66	81.64 ± 3.72	3.332	0.002*
Body surface area (m^2)	1.57 ± 0.91	1.65 ± 0.15	-2.118	0.039*

*Significant p-value < 0.05
Group A – Hb SS, Group B – Hb AA

Table 4. *Correlation between Age and Anthropometric Parameters.*

Anthropometry	Group A		Group B	
	r	p-value	r	p-value
Weight	-0.066	0.648	-0.038	0.794
Height	0.223	0.120	0.032	0.825
Sitting height	-0.238	0.096	0.027	0.854
Cormic Index	-0.288	0.042*	-0.001	0.997
BMI	-0.195	0.174	-0.052	0.718
SLL	0.335	0.018*	0.028	0.848
BSA	0.017	0.908	-0.015	0.918

*Significant p-value < 0.05
Group A – Hb SS, Group B – Hb AA, BMI- body mass index, SLL – subischial leg length, BSA – body surface area

Table 5. *Correlation between Haematocrit and Anthropometric Parameters.*

Anthropometry	Group A		Group B	
	r	p-value	r	p-value
Weight	0.376	0.007*	0.033	0.819
Height	0.518	<0.001*	0.450	0.001*
Sitting height	0.133	0.358	0.512	<0.001*
Cormic Index	0.010	0.947	0.207	0.149
BMI	0.060	0.680	-0.245	0.086
SLL	0.127	0.379	0.264	0.064
BSA	0.488	<0.001*	0.155	0.283

*Significant p-value < 0.05
Group A – Hb SS, Group B – Hb AA, BMI- body mass index, SLL – subischial leg length, BSA – body surface area

4. Discussion

The mean haematocrit of 24.86% gotten from this study among participants with SCA was similar to 24.44%, reported by Akinbami *et al* in 2012 among SCA individuals within the same age range [22]. The mean haematocrit of participants with SCA was significantly lower when compared with the participants with Hb AA. The low haematocrit in sickle cell anaemia was related to the degree of chronic haemolysis that constantly occurr in individuals with SCA. This was as a result of blunted response to erythropoietin secretion i.e. the rate of secretion is not proportional to the degree of anaemia [23]. The weight, body surface area and body mass index were significantly lower among participants with SCA when compared with Hb AA. This was also the pattern of earlier reported studies among young adult Nigerians [24, 25]. The same pattern was also observed when male and females with SCA participants were compared with the Hb AA counterparts. These findings have been attributed to chronic anaemia, inadequacy of nutrients that result from inadequate diet, poor absorption or defective metabolic utilization and chronic nutritional deficiencies from inadequate food intake because of poor appetite especially during the vasoocclusive crisis [25, 26].

The sitting height and cormic index of individuals with Hb SS (74.54 ± 10.21cm) were significantly lower when compared with the Hb AA (83.92 ± 4.08cm). However, subischial leg length was significantly higher in group A than group B (table 1). These patterns were observed in both male and female participants (tables 2 & 3). This could not be compared with any other study because no known study has compared the cormic index of individuals Hb SS within this age group with Hb AA to the best of my knowledge. Similar study done by Akodu *et al* in 2014 among paediatric age group (8 months – 15 years) showed no significant difference in cormic index of 54.1 ± 5.1% among Hb SS and 54.9 ± 4.5% among Hb AA participants [8]. The reason could be due to the fact that the effect of sickle cell anaemia on growth might not have manifested at the early stage of life [8]. The reason for the low mean cormic index and sitting height among participants with Hb SS gotten from this study could be due to the negative effect of sickle cell anaemia on spinal growth which is more obvious in this age group. The low sitting height among the SCA individuals may also be due to the effects of vertebral infarction and collapse which they usually suffered during VOC [17]. Age is negatively and significantly correlated with cormic index among participants with Hb SS but not significantly correlated in Hb AA participants while subischial leg length showed a positive significant correlation with age among Hb SS participants. This may be due to the fact that the limb growth might have stopped among the controls at this age while it may still be active in sickle cell anaemic individuals because of extramedullary haematopoiesis that may cause delay in fusion of growth plate of long bones. The significant negative correlation in age and cormic index was supported by study of Akodu and colleagues in 2014 who reported the cormic index of 54.1% among the paediatric group with sickle cell anaemia compared to 44.71% gotten from this study [8]. The findings of this study can be of great importance in anthropology and forensic medicine specialities.

5. Conclusion

In conclusion, this study showed that Hb SS causes lower cormic index, weight, sitting height, BMI, BSA but higher subischial leg length. It further showed that SCA has no significant effect on standing height.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Ethics and Research Committee of the Obafemi Awolowo University, Ile-Ife, Nigeria. The participants were all informed about the research and written consents were obtained before participating.

Consent for Publication

Obtained

Availability of Data Materials

Data is available with the authors and will be made

available on request.

Competing Interests

All the authors do not have any possible conflicts of interest.

Authors' Contribution

MAA, OO and RAB contributed to the design of this research study, MAA, OO and SAO conducted the research, MAA, SAO, RAB and OO analysed the data and wrote the manuscript. All authors critically reviewed and edited the final manuscript. All authors read and approved the final manuscript.

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