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Systolic blood pressure of Nigerian children with sickle cell disease

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Abstract: *Background*: Blood pressure readings of adult Nigerians with sickle cell disease (SCD) are reported to be lower than that of the general population but similar studies in children are unavailable.
Objectives: To determine the systolic blood pressure (SBP) of children with SCD and compare it with that of healthy controls. Also, to correlate the SBP of children with SCD with age, gender, height and weight.
Methods: Children with SCD were recruited from the Paediatric Haematology Clinic of the Lagos University Teaching Hospital. Data collected included bio-demographic details, social classification, height and weight measurements and present clinical status. SBP was measured using a Doppler (VASCUTRACK 120®) and a mercury sphygmomanometer. Similar data were obtained from age and sex matched apparently healthy children.
Results: One hundred and twenty three children with SCD and 62 apparently healthy controls were studied; 62% were females. The mean age of the children with SCD was 8.93±3.91years (range 1-17 years) and was similar to the controls. SBP was similar in both groups of children (90.9±12.7 versus 92.2±15.2 mmHg; p=0.53) and increased with age. In 91 (74%) children with SCD the SBP was below the 50th centile for the general population. Multiple linear regressions involving sex, age, height and weight found no independent factor to be a significant predictor of the SBP in children with SCD.
Conclusion: The SBP of children with SCD is similar to that of age and sex-matched controls. The sex, age, weight and height did not significantly predict SBP in multiple linear regression.

Introduction

Blood pressure (BP) in childhood is a predictor of adult BP with evidence that childhood hypertension can track into adulthood.[1] More importantly, hypertension in childhood is usually secondary and may be prevented or amenable to cure. Despite these, BP checks are not performed routinely in children.

Hypertension is known to be more prevalent among people of the black race, who also frequently carry the sickle cell gene.[2] Sickle cell disease (SCD) is associated with high morbidity from recurrent episodes of vaso-occlusive and anaemic crises. Mortality most times occurs during acute crises and may be secondary to various organ failures including the kidneys. Kidney disorders are often associated with hypertension. Adult Nigerians with sickle cell disease have however been shown to have low BP when compared with individuals with normal haemoglobin genotype.[3] The exact reason for this phenomenon is uncertain with various suggested hypotheses including anthropometry.[4,5]

Similar studies in Nigerian children are as yet unavailable thus prompting us to determine the systolic blood pressure (SBP) of children with SCD. Also, we aimed to determine the linear relationship between SBP and gender, age, height and weight.

Patients and Methods

Children with documentary evidence of SCD were recruited from the weekly Paediatric Haematology Clinic of Lagos University Teaching Hospital (LUTH). Only children with SCD in steady state were enrolled; excluded were children with fever or ongoing vaso-occlusive crisis, those needing hospitalization or

discharged from hospital admission in the past two weeks. Age and sex matched controls were recruited from the nursery, primary and secondary schools of the University of Lagos. For children under the nursery school age, controls were enrolled from the Well Baby Clinic of LUTH. Any child found on physical examination to have one or more of the following were also excluded: frontal bossing, gnathopathy, jaundice, marked pallor and hepatosplenomegaly. The study participants were enrolled on a consecutive basis. Ethical clearance for the study was obtained from the Health Research and Ethics Committee of LUTH. Permission was obtained from the authorities of the schools. The parent/guardian of each children provided written informed consent. The study lasted 6 months.

Data Collection

Data collected from every child included relevant biodemographic data, weight and height. Height was measured using a wall-mounted stadiometer with the child standing barefoot, legs together and looking straight ahead. For subjects under two years length was measured using an infantometer. Subjects were weighed barefoot, wearing only light clothing or underwear, using a Seca® scale. The social status of each child was derived using the classification proposed by Olusanya *et al*[6] which utilizes the mother's education and the father's occupation. After being seated for about five minutes, two SBP readings were taken at about 10 minutes interval for each child. A Doppler (VASCUTRACK 120 by Seward) and a mercury sphygmomanometer (Welch Allyn, Skaneateles Falls, NY) were used for this purpose. While in the sitting position, a cuff with an inflatable bladder width of at least 40% of the child's mid upper arm circumference that covered at least 80% of the upper arm length was applied around the right arm.[7] Measurements were done in the sitting position. After cuff placement, transmission gel was placed on the probe of the Doppler which was used to locate the point of loudest blood flow of the radial artery. With the probe of the Doppler secured over this point, the sphygmomanometer cuff was inflated until the blood flow was no longer heard and then deflated slowly until the initial burst of sound was heard from the audio-amplified Doppler probe; the mercury level of the sphygmomanometer at the point of the initial burst of sound when deflating the cuff was taken as the SBP. This point corresponds with the first korotkoff sound heard when using a stethoscope. The average of the two readings was taken as the SBP of the child.

Data Management

All data were entered into a proforma, crosschecked for errors, and analyzed using the SPSS statistical package version 17.0. Continuous variables were reported as means and standard deviation and analyzed by student's t test. Categorical variables were analyzed using chi-square or Fischer's exact tests where applicable. The SBP of each child with SCD was compared with that of the general population as published by the National High Blood Pressure Education Program.[7] Linear associations between SBP and weight and height were quantified using Pearson's correlation. Sex and other independent factors found on bivariate analysis to have significant correlation with SBP were simultaneously entered into an equation to predict the mean SBP. A P value less than 0.05 was considered statistically significant.

Results

One hundred and eighty five children aged one year to 17 years were enrolled for the study; 123 were children with SCD. The mean (SD) age of the children with sickle cell disease was 8.93±3.91years and was similar to the mean age of the 62 apparently healthy controls. Of the children with SCD, 6 (4.9%) had haemoglobin SC (HbSC). In each group females make up 62% of the population. The children with SCD were significantly shorter (126.7cm versus 134.2cm) and weighed less (25.1kg versus 31.6kg) than age and sex-matched controls (Table 1).

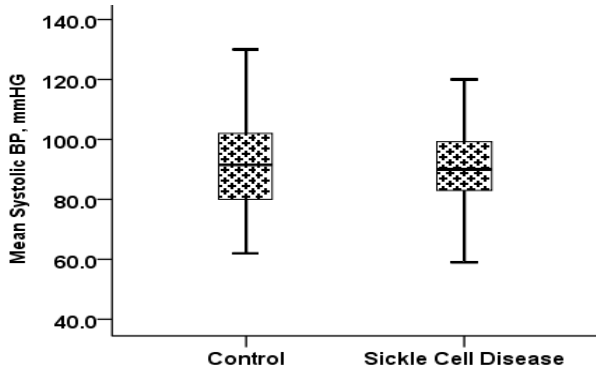
Table 1: Demographics of patients included in study

Variables	Cases, n	Controls, n	p value
Age years),			
1-5	25	13	1.00
6-10	58	29	
11-17	40	20	
Sex			
Male	59	30	0.957
Female	64	32	
Social class			0.10
Upper	15	15	
Middle	72	33	
Lower	36	14	
Mean weight (SD) kg	25.1 (8.9)*	31.6 (12.8)*	0.00
Mean height (SD) cm	126.7 (19.4)*	134.2 (21.2)*	0.02

*Standard deviation

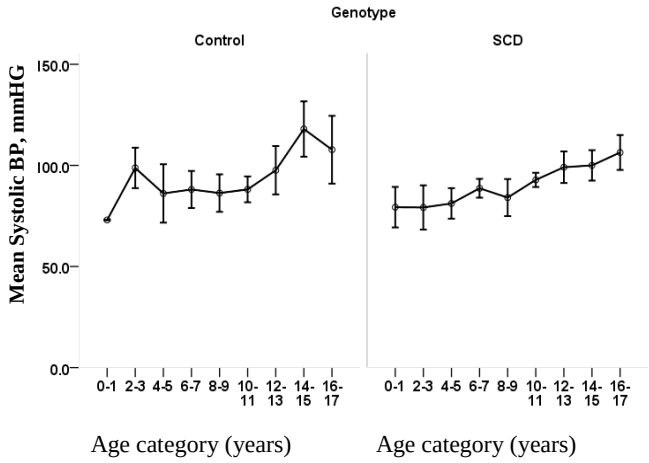
The mean SBP in the group of children with SCD was 90.9±12.7mmHG and was similar to that of the healthy controls (92.2±15.2mmHG) (Figure 1). The SBP was below the 50th, between the 50-95th and ≥95th centile for age, sex and height in 91 (74%), 29 (23.6%) and 3 (2.4%) children with SCD respectively. There was a gradual increase in the SBP with increasing age in both children with SCD and healthy controls (Figure 2).

Fig 1: Box Plot comparing the systolic blood of children with sickle cell disease and healthy controls



t= -0.63, df=183, P=0.53

Fig 2: Line graph showing the systolic BP in healthy control and children with sickle cell disease at different ages



Bivariate correlations in the sickle cell population revealed significant positive linear relationship between SBP and age, weight and height (Table 2). In a multiple linear regression model involving the above mentioned factors, the model only accounted for 33% of the SBP and no variable was a significant predictor of SBP (Table 3).

Table 2: Univariate correlation between mean systolic BP and age, weight and height in children with sickle cell disease

Independent Factors	Correlation Coefficient	P value
Age	0.56	0.00
Weight	0.57	0.00
Height	0.57	0.00

Table 3: Multiple linear regression model of mean SBP simultaneously accounting for sex, age, weight and height in children with SCD

Independent variables	Unstandardized coefficient	Standardized coefficient	P value
Sex	1.25	0.050	0.51
Age	0.74	0.23	0.25
Height	0.03	0.05	0.84
Weight	0.47	0.33	0.11

R^2=0.33, P value=0.00

Discussion

The majority of the children with SCD in the present study had SBP below the 50th centile for the general population. Lower BP has been documented in children and adults with SCD.[4 8 9] The reasons for lower BP in SCD population are unclear but have been partly attributed to the phenomenon of increased renal tubular sodium and water excretion thus promoting lower arterial pressures.[4 5] Other reports however attribute the lower BP to a lower weight and increased vasodilation in adults and children with SCD.[3 10 11] With increasing age especially after adolescence, kidney function may deteriorate relatively faster in persons with SCD resulting in hypertension. Indeed two of the three children with elevated BP in the present study were in their adolescence. However the SBP documented in our study represents the mean of two SBP readings taken 10 minutes apart and thus may be transient or due to white coat effect.[12] The relatively lower BP in the population with SCD implies that BP values that are considered normal or mild hypertension in healthy individuals may represent significant risk factor for morbidity and mortality in the population with SCD.[4]

In the present study, although the value of SBP in children with SCD was lower than that of the controls, this was not significant. This result is in contrast with some reports where participants with SCD had lower SBP compared to their AA counterparts.[4 9 11] These studies were however conducted predominantly in adolescent and adult populations. A study involving children with SCD documented similar results as ours. Adams- Campbell *et al* [13] found that SBP did not differ between the groups of children with sickle cell anaemia, sickle cell trait and normal haemoglobin despite significantly lower diastolic BP (DBP) among the children with SCD. This was irrespective of the significant difference in weight between the two groups in both studies. The results of our study and that of Adam-Campbell suggest that lower body weight may not be the only reason for lower BP in children with SCD. A recently published study[14] involving Nigerian adults found comparable SBP between the group with SCD and the controls despite lower DBP in the adults with SCD, and together with the report of

Adam-Campbell[13] may imply differential effects of SCD on SBP and DBP. The lower DBP in the group with SCD despite similar SBP may be also due to the common absence of the fifth korotkoff sound in the persons with hyperdynamic states like SCD.[15]

In both the children with SCD and the controls, SBP increased with increasing age. This increase with age may also reflect increases in weight and height which have also been reported to correlate positively with BP in the general population.[7] As expected, height and weight bore significant positive linear relationship with SBP on bivariate analysis. However, none of these factors remained a significant predictor of SBP in multiple linear regressions, suggesting the effects of some unexplored factors on the SBP. Indeed the model of age, sex, height and weight could only predict about a third of the change in SBP. This observation is in contrast to the finding of Homi *et al* which showed that the difference in BP between adolescents with SCD and normal control was due to differences in body weight.[10]

A limitation of our study was the inability to perform haemoglobin electrophoresis in the participants used as controls. The reluctance of parents and school authorities to permit bloodletting in an apparently healthy child weighed against performing haemoglobin electrophoresis in the controls. This introduces the small probability that some of our controls may have sickle cell disease, although, the two to three percentage prevalence of SCD in the general population and our rigorous exclusion criteria make this a remote possibility. Another limitation was measuring only SBP. However DBP is more prone to errors than the SBP because the fourth and fifth korotkoff sounds are not always present in children, [16 17] especially in children with hyperdynamic states like anaemia.[15]

Conclusion

There is no significant difference in the SBP of children with SCD compared to age and sex matched controls. Age, sex, height and weight were not significant predictors of SBP on multiple linear regressions.

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