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Perceived stress and social support as correlates of sickle cell anaemia severity in a low-resource setting

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Abstract

Background The role of biological factors such as foetal haemoglobin in modifying the severity of Sickle Cell Anaemia (SCA) has been extensively investigated. However, the phenotypic variability of SCA cannot be explained by genetic factors alone. Hence, the need to determine other correlates of SCA severity such as perceived stress and social support.

Methods This was a hospital-based cross-sectional study involving 60 participants aged 8–17 years selected using simple random sampling technique. Standard rating scales (i.e., SCA scoring system, perceived stress scale, and child and adolescent social support scale) were used to assess the severity of SCA, perceived stress and social support, respectively. Foetal haemoglobin (HbF) was estimated using high performance liquid chromatography. The psychosocial predictors of sickle cell severity were analyzed using multivariate linear regression.

Results There was a negative moderate significant correlation between SCA severity and domains of social support: parents' ($\rho = -0.30, p = 0.03$) and classmates' ($\rho = -0.50, p < 0.001$). Of all the variables studied, only classmates' perceived social support emerged as the significant predictor of SCA severity when other confounders such as HbF were controlled for ($\beta = -0.37, t = 2.41, p = 0.02$).

Conclusion The findings of this study support the available literature on the mediating effect of social support on SCA severity. These findings buttress the need for clinicians to consider psychosocial methods (e.g., family and classmates' support) in improving disease outcomes.

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Introduction

Sickle Cell Anaemia (SCA) has significant public health implications due to its high morbidity and mortality [1]. In addition, it poses great psychological stress and financial burden on the caregivers of affected children [2, 3]. Worldwide, more than 300,000 children are born with SCA annually [4, 5]. Sub-Saharan Africa contributes over 75% of the global burden with an under five mortality rate up to 16% in some countries [5]. In Nigeria, about 150,000 babies are born with the disease annually, with a prevalence of about 2% [5].

A significant challenge to the effective management of patients with SCA is its substantial clinical heterogeneity ranging from near complete asymptomatic illness to severe debilitating illness [6–9]. This clinical heterogeneity has been linked to several factors broadly classified into genetic and environmental factors [7–9]. Foetal haemoglobin (HbF) is one of the most extensively studied genetic correlates of sickle cell severity [8]. Environmental factors including psychosocial variables have, however, also been implicated as determinants of severity among children with SCA [8–11].

With the advent of the biopsychosocial model as popularized by Engel, emphasis is now on psychological and social mediators of health and disease [12]. This biopsychosocial approach supports the integration of biological, psychological and social factors in the assessment, prevention and treatment of diseases and thus offers a more holistic approach to a patient [13, 14]. This is in contrast with the biomedical model which explains illness in terms of single-factor biological malfunction with little attention to behavioral and social processes [14]. Psychological stress and psychosocial support are known to modulate chronic illnesses generally, and SCA specifically [13, 15, 16]. Some studies have found a significant association between perceived stress and indices of disease severity such as increased number of vaso-occlusive crises, reduced activity, increased utilization of health-care services and school absenteeism [17–21].

Better quality of life, psychological well-being, and a milder severity of SCA have been linked to satisfactory perceived social support [15, 16, 22]. There is a distinction between available social resources (structural) and the individuals' subjective perception or assessment of received support (functional) [23]. Both forms of social support have been reported to be protective against distress and adverse outcome [23]. More so, perceived and tangible social supports have been reported to mediate disease severity and improve quality of life [15, 16, 22].

The strict biomedical perspective of diseases has been viewed by critics as narrow and reductionist in approach [14]. The importance of psychological and socio-cultural factors is now well recognized in the general medical practice. Globally, there is paucity of data on the

psychological and socio-cultural factors that influence SCA despite the extensive research on the effect of biological and other clinical variables [9, 24–27]. In the light of the above issues, the main objective of this study was: to determine the relationship between psychosocial variables (e.g., perceived stress and perceived social support) and SCA severity.

Materials and methods

Study design and setting

This was a cross sectional study carried out at the Paediatric Sickle Cell Clinic of a Nigerian tertiary institution. The Sickle Cell clinic has a population of about 300 children, of which about 160 are aged 8 to 17 years. The hospital has laboratory services for haematology, microbiology, and clinical chemistry investigations.

Ethical considerations

Ethical approval was obtained from the Health Research and Ethics Committee of the institution, with reference number UNTH/NREC/2021/06/226. International ethical norms and standards were strictly adhered to; written informed consent was obtained from parents/guardians of the participants. Assent was obtained from all the participants. The participants were also informed that if in the process of the research, any previously undiagnosed clinical condition was found, the managing team would be appropriately informed. Information gathered in the course of the research was stored in an encrypted computer accessible only to the researcher.

Sample size estimation

With a trait prevalence of 25%, or one in every four persons, an estimated 4–6 million people in Nigeria are believed to have sickle cell disease [28]. However, in the study setting, about 160 children with SCA aged eight to 17 years were seen annually. In computing the required sample size for the study, we used the findings of Diwe et al. [29] on the prevalence of SCA in the South Eastern region of Nigeria of 5%. Based on their finding, we computed the required sample size by using these figures to substitute in the Cochran formula for a single proportion ($n = \frac{z^2(p)(q)}{e^2}$) [30] and arrived at 60, which was judged to have sufficient power to answer the research question.

Sample selection

The list of SCA patients aged 8–17 years registered with the Sickle Cell Clinic of the institution was obtained from the records department. A computer-generated table of random numbers was used to select prospective participants (i.e., simple random sampling technique). The randomly selected patients were communicated prior to their scheduled routine follow up date. Those who

missed this date were followed up and a subsequent visit was scheduled. Replacements were made if the selected person did not meet the study criteria or refuses to consent or give assent to participate.

Participants were included if they were diagnosed with SCA using alkaline-acid haemoglobin electrophoresis and aged eight (8) to seventeen (17). Those with chronic co-morbidities such as asthma, diabetes, malignancy, renal disease, heart disease and intellectual disabilities such as autism, cerebral palsy, hearing loss, speech problems that may interfere with the patient's understanding and answering of interview questions were excluded.

Data collection procedure

Obtaining consent/assent

Recruitment was done as the randomly selected patients present to the sickle cell clinic of the study setting. Details of the study protocol were explained to prospective participant/caregiver pair in clear terms when they presented to the SCA clinic. The voluntariness of participation was emphasized, and patients/caregivers were assured that refusal to participate will not affect their medical care. Caregivers who were willing to participate gave consent either in writing or by thumb printing. Verbal assent was obtained from children of the consenting caregivers.

Questionnaire administration

After consent was obtained, a thorough history, physical and mental state examination was done to exclude ineligible participants. Thereafter, those who met the study eligibility criteria were recruited. The researcher obtained socio-demographic and clinical data using the proforma and in some cases the medical records. Each participant was given the perceived stress and perceived social support scales to assess their stress level and social support, respectively. Severity of SCA was assessed using the SCA scoring system. Participants' socio-economic class was categorized according to the criteria described by Oyedeji [31].

The perceived stress scale (PSS)

The PSS is one of the most widely used psychological instrument for measuring the perception of stress and is a robust predictor of health and disease [32]. It is a self-reported, 10-item questionnaire scored using a 5-point Likert scale. Scores range from 0 to 40 with higher scores indicative of higher stress [32, 33]. The PSS has strong psychometric properties, possessing good reliability and construct validity among multicultural populations [34, 35]. Although the PSS is designed for use in subjects with at least a junior high school education, the National Institutes of Health Toolbox for the Assessment of Neurological and Behavioral Function initiative recommends using

the 10-item version for children aged 12–17 years (self-report) and parents of children aged 8–12 years (proxy-report) [36]. The scale has been used in adolescent sickle cell patients and has also been used in Nigerian populations [37–40].

The child and adolescent social support scale (CASSS)

The CASSS is a well-validated and reliable tool used to assess the perceived social support of children and adolescents [41]. The CASSS is a 60-item multidimensional scale measuring perceived social support from five sources: parents, teachers, classmates, close friends and people in the school [41]. Each item is a statement of the four types of support (emotional, informational, appraisal and instrumental). The revised version (CASSS 2000) has only one version suitable for children aged 8 to 18 years. The children are asked to rate how often they perceive the support and how important it is to them that they perceive the support. Frequency ratings are on a 6-point Likert scale (ranging from 1 = Never to 6 = Always). Importance ratings are on a 3-point scale (ranging from 1 = not important to 3 = very important). Subscale scores are calculated by summing the frequency ratings of the 12 items on each subscale (Parent, Teacher, Classmate, Close Friend and School). Higher scores indicate higher perception of support. The CASSS has been well studied with strong psychometric properties and has been used in children with sickle cell anaemia [7, 22].

Assessment of sickle cell anaemia severity

A comprehensive scoring system of SCA severity based on clinic-laboratory variables was developed by Adegoke and Kuti [9]. It assesses a total of 15 parameters to reflect each patient's present state, their state during the previous 12 months, and lifetime complications [9]. Items are scored according to the frequency of occurrence and severity, with scores ranging from 1 to 5. Acute life-threatening events and neurological complications are assigned higher scores; for instance, cerebrovascular disease (CVD) is assigned a score of 5, and pneumococcal meningitis and acute chest syndrome (ACS) are assigned scores of 3. Avascular necrosis (AVN) is assigned a lower score because it does not immediately lead to acute life-threatening events. The total score is calculated for each child (range from 0 to 34), with higher scores indicating more severe disease. The scoring system was chosen for the following reasons: first, it is simple and has been robustly used in our environment. Secondly, factors from other chronic illnesses including kidney, cardiac, and lung disease were excluded from this scoring system, which if present in the index study could confound the experience of perceived stress.

Blood collection and analysis

Venous blood samples were collected from all participants. This was used for HbF estimation and complete blood count (haemoglobin concentration/packed cell volume and white blood cell count). The materials (disposable gloves, tourniquet, sample bottles, sterile needles and syringes, plaster, 70% alcohol cotton swabs and dry cotton wool balls) required for the procedure were assembled in a tray. The test to be performed was discussed with participant/caregiver pair and verbal consent was obtained. The participants' full names and hospital numbers were written on the investigation forms and Ethylenediaminetetraacetic acid (EDTA) bottles. The participants were placed comfortably in a sitting position and reassured. The venipuncture site was identified, and a clean tourniquet was applied 4–5 finger widths above this site. The investigator observed basic aseptic procedures. Appropriately sized needle was used with a syringe to collect five (5) milliliters of blood. The tourniquet was untied and firm pressure applied at venipuncture site with the dry cotton wool balls and the used needles were discarded into a sharp container. Three milliliters of blood were transferred to the first EDTA bottle for HbF assay while the remaining two milliliters were transferred to the second EDTA bottle for full blood count. The sample bottles were gently rocked to ensure mixing with the EDTA. The patient's information on the bottles and the forms were cross-checked and the blood stored vertically at room temperature on a specimen rack dedicated for the study at the side laboratory till the end of the clinic day (maximum of eight hours). Thereafter, all samples collected for the day were dispatched to the Haematology laboratory of the Teaching Hospital. Foetal haemoglobin was assayed with an automated high performance liquid chromatography machine at the same laboratory using the following steps [42]: **Sample Preparation (Step 1):** The blood sample was properly mixed and a fraction (i.e., about 100 μ l) was transferred to the sample cup. **Haemolysis (Step 2):** A haemolyzing agent, 0.1% saponin was added to the sample to facilitate the release of haemoglobin from the red cells. **Sample Injection (Step 3):** The haemolyzed samples were loaded into the high-performance liquid chromatography (HPLC) machine's autosampler. **Chromatographic Separation (Step 4):** The HPLC machine separates the different haemoglobin fractions based on their ionic interactions with the stationary phase. **Detection and Quantitation (Step 5):** The separated hemoglobin fractions are detected by their absorbance at 415 nm, and the HbF percentage was calculated based on the peak areas.

Data analysis

Analysis of the results was done using the International Business Machine Statistical Package for the Social

Sciences (IBM-SPSS, version 20, Armonk, NY: IBM Corp) [43]. Questionnaires were scrutinized for incorrectly filled information and then cleaned. The normality of distribution of data was done using Kolmogorov-Smirnov test. Spearman's correlation was used to determine the direction, magnitude and significance of the relationship between the total severity scores and the total scores of perceived stress scale, perceived social support and subscale scores. Multivariate linear regression analysis was used to determine the psychosocial predictors of SCA severity while controlling for potential confounding variable such as age, social class, gender, and HbF. A test was considered significant if p was less than 0.05. All test were two-tailed at 95% confidence interval.

Results

Participants were mostly early adolescents with mean age of 14 years, predominantly males (51.7%) with mild disease severity (Table 1). There was a negative moderate significant correlation between SCA severity scores and parents' ($\rho_s = -0.30, p = 0.03$) and classmates' social support ($\rho_s = -0.50, p < 0.001$) as shown in Table 2. Psychosocial variables as predictors of SCA severity is shown in Table 3. Classmates' social support emerged as the predictor of SCA severity after controlling for socio-demographic variables of age, social class, sex and biological variable (i.e., HbF).

Discussion

The study aimed to determine the relationship between psychosocial variables and the severity of sickle cell disease among children and adolescents in a Nigerian Tertiary Hospital.

The main highlights of the findings of this study are: (1) Parental and classmates' perceived social support was significantly associated with SCA severity; (2) perceived stress scores had a weak relationship with SCA severity; and (3) that classmates' perceived social support emerged as the significant predictor of SCA severity after adjusting for age, social class and HbF.

The finding of the positive effect of parental and classmates' perceived social support on the SCA severity is consistent with previous reports with other chronic diseases [15, 22, 44, 45]. The buffering role of social support in patients with chronic diseases such as SCA has been demonstrated in several studies [15, 22, 46, 47]. Researchers have also reported that children and adults with higher levels of social support have better health-related quality of life and less disease severity [15, 22, 46]. Classmates' social support was the only significant predictor of disease severity obtained in the index study when other confounding variables were controlled for. This finding suggests that peer support is moderately correlated to disease severity. This beneficial effect of classmates'

Table 1 Socio-demographic and clinical characteristics of the participants *N* = 60

Variables	Frequency (%)	Mean (SD)
Mean Age (years)		14.00 (2.48), Range: 9.00–17.00 years
Gender		
Male	31(51.7)	
Female	29(48.3)	
Total	60(100.0)	
Educational Status		
Primary	13 (21.7)	
Secondary	46 (76.7)	
Tertiary	1 (1.7)	
Total	60(100.0)	
Social Class		
Class 1	11(18.3)	
Class 2	15(25.0)	
Class 3	10(16.7)	
Class 4	24(40.0)	
Class 5	0(0.0)	
Total	60(100.0)	
SCA severity*		
Mild	35 (58.3)	
Moderate	25 (41.7)	
Severe	0 (0.0)	
Total	60 (100.0)	
Foetal Haemoglobin (%)		6.90 (5.50)**
Packed Cell Volume (%)		23.37 (4.13)
Complete White Blood Cell Count (cells/mm ³)		11635.50 (4360.00)**
Platelet count (cells/mm ³)		306000.00 (2100.50)**

NB: SD=Standard Deviation, *=severity scores (mild < 8, moderate 8–17, severe > 17)⁹, ** Median (interquartile range), Upper Class (Class I and II), Middle Class (Class III) and Lower Class (Class IV and V) [31]. Primary education in the index study (aged 8–11 years), secondary (aged 12–17 years), and tertiary (aged 17 years and above)

Table 2 Relationship between social support, perceived stress and severity of sickle cell anaemia

Variables	Sickle Cell Severity Score, Rho _s (p-value)
Social Support-Parents' Sub-scale	-0.30 (0.03)
Social Support - Teachers' Sub-scale	-0.23 (0.06)
Social Support - Classmates' Sub-scale	-0.50 (< 0.001)
Social Support - Total Score	-0.40 (0.002)
PSS score	0.06 (0.67)

Rho = Spearman's Correlation Coefficient, PSS = Perceived Social Support

social support in mitigating adverse disease outcome is congruent with reports by Von Weiss et al. [45] and Varni et al. [46] among children with rheumatic disease and newly diagnosed cancer, respectively. This beneficial effect of classmates' social support is understandable considering that a majority of the index study population

Table 3 Multivariate linear regression analysis of the independent predictors of SCA severity

Dependent Variable	Independent predictors	Standard β coefficient	t-test	p-value
Sickle Cell Severity Score	Foetal haemoglobin	-0.17	-1.15	0.26
	Classmates' domain of social support	-0.37	-2.41	0.02
	Parents' domain of social support	-0.04	-0.24	0.81
	Teachers' domain of social support	-0.003	-0.02	0.99
	Perceived stress Score	-0.10	-0.69	0.50
	Age	-0.01	-0.11	0.91
	Gender	-0.11	-0.86	0.40
	Social class	-0.004	-0.03	0.98
	Platelet count	0.12	0.97	0.34

Coefficient of multiple determination (R^2) = 0.125

were adolescents. Consistent with a developmental point of view, various facets of adolescent life are more influenced by peer factors/opinions than family factors [47, 48]. Furthermore, classmates (peers) provide empathy and emotional support that enables adaptive coping skills and cushion the disease trajectory. The implication is that there is need to explore evidence-based methods probably through structured education and modelling to improve positive relationships within the class or peers.

The positive effect of higher parental support on SCA severity demonstrated in this study has been reported elsewhere [22]. Though children with chronic disorders remain dependent on their families for care and support, their over protectiveness often leads to restrictions and loss of autonomy which the child desires [49]. Despite this, the manner in which the child perceives parental support can help them cope with their disease [49]. The former could thus be responsible for the negative correlation between SCA severity scores, and the parental support subscale scores obtained in this study.

In the teacher's domain, there was a weak relationship with SCA severity. Studies have shown that there is a high variability in support offered to children with sickle cell disease by teachers [50, 51]. Teachers have been reported to lack empathy and knowledge of sickle cell disease [50]. In addition, adolescents commonly do not disclose their condition to their teachers due to fear of alienation and stigmatization [49, 52]. This often led to a lack of support from those teachers whose input could otherwise have helped them get through crisis and stigmatization. In summary, there is some consensus that social support, on the whole, is beneficial from many different perspectives as shown in the index study.

Regarding perceived stress scores, the index study found a weak relationship with SCA severity. A significant relationship between stress and some indices of SCA

severity has been reported by several authors [13, 17, 18, 20, 53, 54]. Porter et al. [53, 54] reported a temporal relationship between stress and painful crisis. Similarly, Gil et al. [17] noted that higher levels of stress was associated with increased same day pain. This relationship between stress and sickle cell pain was corroborated by Shah et al. [18] in 2020. There is evidence that psychological stress causes parasympathetic withdrawal and sympathetic activation and a glucocorticoid hormone response, both of which culminate in reduced microvascular blood flow and pro-inflammatory response leading to vaso-occlusive events [18, 21]. However, painful crisis which is just an item in the global scoring system used in the index study was the sole marker of disease severity used in the above studies and this limits the generalizability of the findings. Moreso, the very low co-efficient of determination obtained in this study shows that only 0.3% of the variation in sickle cell severity was contributed by a change in perceived stress. This was also observed by Thompson [13] that perceived stress acting alone may not be enough of an independent mediator of disease severity in SCA but may act additively with other factors. This additive effect is such that the cumulative effect of perceived stress and other mediators is greater than the sum of their individual effect. The relationship between perceived stress and disease severity may also have been weakened by the absence in this study of participants with severe disease. Furthermore, the use of parent proxy report of perceived stress for younger participants may have influenced the scores in this study. Perceived stress is a subjective feeling and as such best reported by the individual, also parental mood has been shown to influence proxy reports [55].

Limitations

First, the use of clinic-based samples (care seekers); although it saved cost and time, and is the predominant methodology in the literature, a community sample may be more representative. Second, the confounding effects of the different medications such as disease modifying agents (e.g., hydroxyurea) were not controlled for.

Conclusion

The findings of this study support the available literature on the possible positive relationship between satisfactory perceived social support and lower SCA severity. These findings buttress the need for clinicians to consider psychosocial methods (e.g., family and classmates' support) in improving disease outcomes.

Abbreviations

CASSS	The Child and Adolescent Social Support Scale
HPLC	High Performance Liquid Chromatography
HbF	Foetal Haemoglobin
IBM	SPSS—International Business Machine—Statistical Package for Social Sciences
n	Final sample size

p	Estimated proportion of an attribute that is present in the population
q	1–p
e	Desired level of Precision
z	Abscissa of the Normal Curve (i.e., 95% Confidence Interval)
PSS	The Perceived Stress Scale
SCA	Sickle Cell Anaemia
UNTH	University of Nigeria Teaching Hospital

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12887-025-05572-1>.

Supplementary Material 1

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Author contributions

NNO, KIN, NIA, NAI, TCE and JUO were involved in conceptualization of the study. NNO and TCE collected the data under the supervision of KIN, NIA, and NAI. Data analysis and initial drafting of the manuscript was done by JUO and NNO, respectively. All authors read and approved the final draft of the manuscript.

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Data availability

The data was attached as a supplementary file.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Health Research and Ethics Committee of the University of Nigeria Teaching Hospital, Enugu, Nigeria, with reference number UNTH/NREC/2021/06/226. International ethical norms and standards were strictly adhered to; written informed consent was obtained from parents/guardians of the participants. Assent was obtained from all the participants. The participants were also informed that if in the process of the research, any previously undiagnosed clinical condition was found, the managing team would be appropriately informed. Information gathered in the course of the research was stored in an encrypted computer accessible only to the researcher.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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