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Clinical depression prevalence and associated factors among adolescents with sickle cell anemia in dar es salaam, tanzania: a cross-sectional study

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Abstract

Background Depression commonly arises among adolescents who have experienced long-standing psychosocial difficulties, especially those facing chronic illnesses such as sickle cell anemia (SCA). SCA is a global health concern, and Tanzania is one of the countries with a high incidence, estimated at 8,000–11,000 births per year. This study aims to assess the magnitude and factors associated with depression among adolescents with SCA.

Methodology A cross-sectional analytical study was conducted on adolescents aged 10–19 years attending sickle cell clinics in referral hospitals in Dar-es-Salaam, Tanzania, from October 2023 to March 2024. Socio-demographic and SCA severity data were collected using pre-structured and pre-tested questionnaires. A validated Patient Health Questionnaire (PHQ-9) tool was used to screen for depression. Univariate and multivariate regression models were used to determine factors associated with clinical depression. A P value of less than 0.05 was considered statistically significant.

Results Among the 326 adolescents enrolled and screened, 49 adolescents (15%) had clinical depression, encompassing those in the moderate, moderately severe, and severe depression categories. Overall 216 (53.7%) adolescents exhibited varying degrees of depression, ranging from mild to severe. Specifically, 167 participants (38.7%) had mild depression, 44 (13.5%) had moderate depression, 4 (1.2%) had moderately severe depression, and 1 (0.3%) had severe depression. Painful episodes within the previous 12 months were significantly associated with clinical depression (aOR = 2.49) (95% CI: 1.17–5.29, $p = 0.01$).

Conclusion Depression is common among adolescents with SCA in our setting. Painful episodes experienced within the previous 12 months were significantly associated with clinical depression. This study highlights the need to screen adolescents with SCA for depression and integrate mental health services in sickle cell clinics.

Keywords Depression, Adolescents, Sickle cell anemia, Clinical depression

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Background

Depression is a mood disorder that affects how a person feels, thinks, and performs daily activities. Major depressive disorder (MDD), also known as "clinical depression", is a mental health disorder characterized by a persistent and intense feeling of sadness, hopelessness, or emptiness that affects a person's thoughts, behavior, and overall well-being [1, 2]. Globally, it has been estimated that 1 in every 7 (13%) 10–19-year-olds experience mental health conditions, with the majority experiencing depression, anxiety, and behavioral disorders. Depression occurs in 1.1% of adolescents aged 10–14 years and 2.8% of those aged 15–19 years [3]. By 2030, depression alone is likely to be the 3rd leading cause of disease burden in low-income countries and the 2nd highest in middle-income countries [4].

Sickle cell disease (SCD) is a global disease that occurs as a result of a genetic mutation that leads to abnormal hemoglobin molecules that polymerize when deoxidized [5, 6]. Sickle cell anemia (SCA) is an autosomal recessive hemoglobin S mutation (HbSS) that has been linked to significant mortality and morbidity in individuals of African and Mediterranean ancestry [7]. Tanzania is among the top 5 countries in Sub-Saharan Africa and the top leading country in East Africa, with the highest incidence of SCD estimated at 8000–11,000 births per year [8].

Nearly half of the SCA patients (47.4%) in Tanzania are aged 5–17 years [9]. With improved care and advanced treatment modalities, mortality has decreased, thus increasing survival and transforming SCA into a chronic illness, accompanied by psychosocial and mental health burdens. The occurrence of acute and chronic painful episodes, delayed puberty, recurrent hospital admissions and blood transfusions, among other conditions, have been strongly linked to the development of depressive symptoms in adolescents. Depression rates are higher in adolescents with SCA than in the general adolescent population [10].

Adolescents with SCA are at an increased risk of depression due to a combination of biological and psychosocial factors. Chronic pain from vaso-occlusive crises and the release of pro-inflammatory cytokines, such as IL-6 and TNF-α, contribute to neuro-inflammation, which is associated with mood dysregulation [11, 12]. Additionally, cerebral hypoxia and silent cerebral infarcts impair brain regions responsible for mood regulation, such as the prefrontal cortex and limbic system, further increasing vulnerability to depression [13].

Psychosocial factors also play a significant role. Frequent hospitalizations, physical limitations, and associated stigma often lead to social isolation and difficulties in maintaining peer relationships [14]. Cognitive impairments caused by silent cerebral infarcts can impact academic performance, contributing to low self-esteem and depressive symptoms [15, 16].

The magnitude of depression among adolescents in Tanzania is unknown; however, depression prevalence rates were high in some African countries like Congo and other countries outside Africa like Jamaica, Saudi Arabia, India and United states of America with prevalence ranging from 22 to 84% [17–22]. In studies conducted to assess factors associated with depression in Saudi Arabia and India, socio-demographic factors, such as gender, low educational attainment, and low socioeconomic status, were significantly linked to depression [18, 23]. However, Asnani et al. in Jamaica revealed that a higher level of education was associated with greater odds of depression [19].

Despite the enormous burden of SCA in sub-Saharan Africa, very few studies have explored the burden of depression among adolescents with SCA. This study provides data on the prevalence and severity of depression in adolescents with SCA in Tanzania. This study further elucidates the factors associated with depression among adolescents with SCA.

Methodology

Study design and setting

A cross-sectional analytical study was conducted among adolescents attending sickle cell clinics in Dar es Salaam from October 2023 to March 2024. Dar es Salaam is among the largest and fastest growing cities in Tanzania, with an estimated population of 7.4 million residents as per the 2022 census and a rapid growth rate of approximately 5.6% per year. It comprises 4 referral hospitals, including Muhimbili National Hospital (MNH) and three Regional Referral Hospitals (RRHs), Mwananyamala RRH, Amana RRH and Temeke RRH. These hospitals conduct weekly sickle cell clinics offering various services, including routine health assessments, pain management, hydroxyurea therapy, vaccinations, infection prevention, monitoring for complications, patient and family education, and the coordination of specialized care. Clients are attended by hemato-oncologists, pediatricians or general practitioners. Figure 1.

Study participants

All adolescents aged 10–19 years confirmed with SCA by hemoglobin (Hb) electrophoresis or high-performance liquid chromatography (HPLC) were included in the study. Among these, adolescents who declined assent and/or consent, those with painful crises at that time and those with additional comorbid illnesses that could further contribute to depression were excluded.

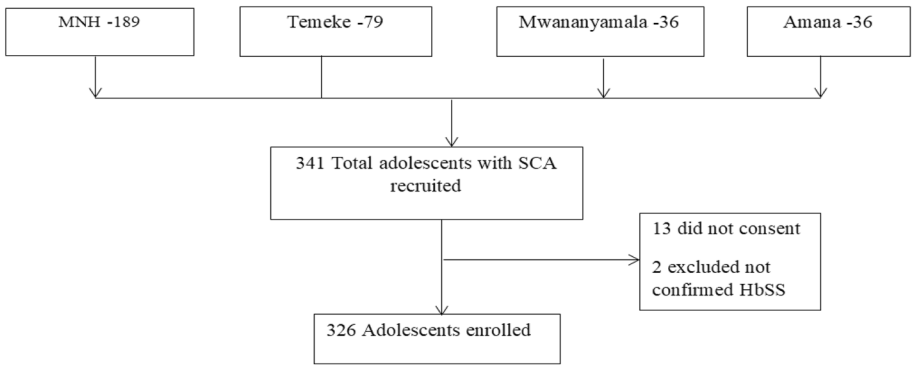

Fig. 1 Flow chart showing recruitment of participants

Sample size and selection

The sample size (N) was calculated using the formula for proportion, where N = minimum sample size needed, P = 86% mean prevalence of depression in adolescents with SCA in the Democratic Republic of the Congo [20]; E = maximum allowable error of the study, which is 5%; and Z = standard normal distribution that corresponds to a 95% confidence level, which is 2.85. Therefore, the minimum sample size required was 320 participants. Five percent of the non-respondents were 16 participants. Convenience sampling was used to obtain participants, and eligible participants who attended the sickle cell clinic on that particular day were recruited for study.

$$\frac{N = Z^2P\ (1-P)}{E^2}\quad \frac{N = 2.58^2 \times 0.86\ (1-0.86)}{0.05} = 320$$

Data collection methods

Data were collected by the principal investigator with the help of 2 research assistants, (medical doctors,) who were trained on the entire data collection process and had a good understanding of the study. The study was conducted via a pre-structured and pretested questionnaire to assess the prevalence, severity and factors associated with depression. The questionnaire had three sections, including socio-demographic data, severity of SCA and Patient Health Questionnaire (PHQ-9) tools.

The interviews took place during the time at which clients waited to see the attending doctor or after they were done with their visit. This did not affect their access to necessary services during their clinic visit. The researcher administered the questionnaire because of the sensitivity of the data and the ease of obtaining data from participants who could not read or write.

Data collection tools

A structured questionnaire was used to obtain socio-demographic data and clinical profiles of the study participants. Sickle cell disease severity scores adapted from a study by Ezenwosu et al. were analyzed as follows [24]. Items in the previous 12 months (number of hospitalizations, number of blood transfusions, and number of painful crises) were scored according to the frequency of their occurrence (0–3). Items related to present-state splenic and liver enlargement were scored by severity {0 = ≤5 cm, 1 = (5–10) cm, 2 = >10 cm}, while lifetime complications of SCA, including leg ulcers, stroke, priapism, respiratory complications, arthritis, osteomyelitis, sickle cell nephropathy and gallstones (0 = absent, 1 = present), were recorded. The total score was 21.

- Scores ≤ 6 (mild),
- Scores 7–12 (moderate)
- Scores > 12 (severe).

The Patient Health Questionnaire (PHQ-9) tool was used to screen for depression. The severity of depression was obtained from the PHQ-9 tool scores, whereas the total score from the 9 items ranged from 0 to 27. Clinical depression or major depressive disorder was suggested if the PHQ-9 score was ≥ 10 or if of the 9 items, 5 or more were checked as "at least more than half the days", or each item 1 or 2 was checked as "at least more than half the days".

- Scores from 0–4 (none-minimal depression),
- Scores from 5–9 (mild depression)
- Scores from 10–14 (moderate depression)
- Scores from 15–19 (moderate severe depression)
- Scores from 20–27 (severe depression)

A diagnostic meta-analysis tested and found that a PHQ-9 score > 10 has a specificity of 88% and sensitivity of 88% for major depression [25]. It was both valid and reliable in identifying sound psychometric properties.

Data analysis

The data were entered into SPSS V23, and data cleaning was performed. For numerical variables, the mean and standard deviation were used following the normal distribution pattern of continuous variables. Categorical variables are presented as frequencies and proportions, and differences in proportions were analyzed via the chi-square test or Fisher's exact test, as appropriate. Univariate and multivariate analyses were used for the associated factors. A P value of less than 0.05 was considered statistically significant.

Results

Participant's socio-demographic characteristics

The participants' socio-demographic characteristics, as shown in Table 1, revealed that most of the participants (64.7%) were 10–14 years of age, with a mean age of 13.9 ± 2.4 years. There was an equal sex distribution. Most of the participants enrolled were from the national referral hospital clinic MNH (49.1%), followed by the regional hospital clinics Temeke (23.6%), and almost equal proportions were from Mwananyamala (10.1%) and Amana (10.4%).

Participants had either primary-level education (48.2%) or secondary-level education (46.9%), with a small proportion (4.9%) having no formal education at all. The majority of the participants were from Dar es salaam (urban and rural) (87.7%), and few (12.3%) were from the upper country (other regions in Tanzania). Sixty-five percent of the participants had health insurance coverage.

Table 1 Socio-demographic characteristics of adolescents with SCA

		Frequency, *N* = 326	Percentage (%)
Age(years)	10–14	211	64.7
	15–19	115	35.3
Sex	Male	160	49.1
	Female	166	50.9
Clinic	MNH	182	55.8
	Temeke	77	23.6
	Mwananyamala	33	10.1
	Amana	34	10.4
Education	No formal education	16	4.9
	Primary	157	48.2
	Secondary	153	46.9
Address	Dar es salaam	286	87.7
	Upcountry	40	12.3
Health insurance	present	212	65
	absent	114	35

Participant's clinical profile

Table 2 and Fig. 2 shows the clinical profile of recruited participants. When looking at the occurrence painful episodes in the past 12 months; 39.6% of the adolescents reported to be pain-free while the remaining had either one painful episode (26.4%), two to three painful episodes (22.7%), or more than three painful episodes (11.3%). In the past 12 months, most participants in the study had not received blood transfusions (85.0%) or required hospitalization (66.3%), and the majority showed no current signs of hepatomegaly or splenomegaly (97.9% and 91.1% of participants, respectively). Three quarters of the adolescents (74.5%) with SCA were on hydroxyurea treatment.

Among adolescents recruited in this study, very few had present complications related to SCA. Among the few reported complications, the most commonly observed complication was respiratory complications (pneumonia) 4.0%, others included priapism 1.8%, stroke 1.2%, chronic leg ulcer 0.9%, osteomyelitis 0.6%, sickle cell nephropathy 0.6%, arthritis 0.6% and gallstones 0.3%.

The sickle cell disease severity score (SSS) in Fig. 3 was used to determine the severity of SCA among participants, who were classified into mild, moderate and severe disease categories. A total of 96.3% of the

Table 2 Participant's Clinical profile

		Frequency, *N* = 326	Percentage (%)
Hydroxyurea use	No	80	24.5
	yes	246	75.5
Items in the past 12 months			
Painful Episodes	none	129	39.6
	once	89	26.4
	2–3	74	22.7
	> 3	37	11.3
Hospital admission	none	216	66.3
	once	69	21.2
	2–3	32	9.8
	> 3	9	2.8
Blood transfusion	none	277	85.0
	once	34	10.4
	2–3	13	4.0
	> 3	2	0.6
Items in the present			
Spleen enlargement	< 5 cm	319	97.9
	5–10 cm	6	1.8
	> 10 cm	1	0.3
Liver enlargement	< 5 cm	323	99.1
	5–10 cm	3	0.9

Table 3 Univariate analysis showing factors associated with clinical depression

		Univariate analysis		
		cOR	95% CI	*P* value
Age(years)	10–14	ref		
	15–19	1.46	0.79—2.71	0.23
Gender	Male	ref		
	Female	1.34	0.73—2.48	0.34
Education level	No formal education	ref		
	Primary	0.59	0.16—2.29	0.45
	Secondary	0.93	0.25—3.48	0.91
Health insurance	Non insured			
	Insured	1.41	0.73–2.75	0.31
SCA disease severity	Mild	ref		
	Moderate	0.58	0.07—4.44	0.56
Use of hydroxyurea	No use			
	Use	1.80	0.80—4.02	0.15
Items in the previous 12 months				
Painful episodes	No	ref		
	Yes	2.56	1.25—5.23	0.01
Hospital admission	No	ref		
	Yes	1.30	0.69—2.42	0.42
Blood transfusion	No	ref		
	Yes	0.76	0.30—1.89	0.55

Table 4 Multivariable analysis showing factors associated with clinical depression

		Multivariable analysis		
		aOR	95% CI	*P*-value
Age(years)	10–14	ref		
	15–19	1.29	0.56—2.97	0.54
Gender	Male	ref		
	Female	1.35	0.70 – 2.58	0.37
Education level	No formal education	ref		
	Primary	0.60	0.14 – 2.50	0.48
	Secondary	0.74	0.19—2.90	0.69
Health insurance	Non insured	ref		
	Insured	1.47	0.72—3.02	0.29
SCA severity	Mild	ref		
	Moderate	0.35	0.04—3.39	0.36
Painful episodes	No	ref		
	Yes	2.49	1.17—5.29	0.01
Hospital admission	No	ref		
	Yes	1.14	0.53 – 2.43	0.73

patients had mild disease severity, 3.7% had moderate disease severity, and none of them had severe disease.

Prevalence of depression among adolescents with SCA

Among the 326 adolescents screened, 49 adolescents (15%) had clinical depression, encompassing those in the moderate, moderately severe, and severe depression categories. Overall 216 (53.7%) adolescents exhibited varying degrees of depression, ranging from mild to severe. Specifically, 167 participants (38.7%) had mild depression, 44 (13.5%) had moderate depression, 4 (1.2%) had moderately severe depression, and 1 (0.3%) had severe depression Fig. 4.

Factors associated with clinical depression

The association between socio-demographic factors, clinical profiles, and clinical depression was evaluated in this study using Chi-square and Fisher's exact tests. Notably, experiencing painful episodes within the past 12 months emerged as the only factor significantly associated with clinical depression ($p=0.008$). Other factors, including age, gender, education level, residence, clinic attended, SCA disease severity, hydroxyurea use, history of blood transfusion, hospital admissions, and organomegaly, showed no significant associations.

The logistic regression analysis investigated factors associated with clinical depression. In the univariate and multivariate analyses, variables such as age, sex, education level, health insurance, use of hydroxyurea, hospital admission and blood transfusion were not significantly associated with depression ($p>0.05$). However, adolescents who experienced painful episodes in the previous 12 months had significantly higher odds of depression than those who had no painful episodes, with a crude OR of 2.56 (95% CI: 1.25–5.23, $p=0.01$). After adjusting for other variables in the multivariate analysis, those who experienced painful episodes in the previous 12 months still presented higher odds of depression (adjusted OR = 2.49, 95% CI: 1.17–5.29; $p=0.01$) Tables 3, and 4.

Discussion

This study contributes critical insights into mental health within this population. Clinical depression was found with prevalence rate of 15% among adolescents with sickle cell anemia in Dar es Salaam, with an overall depression rate of 53.7%, where mild, moderate, moderate-severe and severe depression accounted for 38.7%, 13.5%, 1.2% and 0.3% of cases, respectively.

These findings are consistent with studies conducted internationally that also reported high depression rates among adolescents with SCA. For example, prevalence estimates in other regions, such as America and Saudi Arabia, similarly show depression rates ranging from 46–48%, with some countries in Africa, such as the Congo, reporting rates as high as 86% among adolescents with SCA [18, 20, 23].

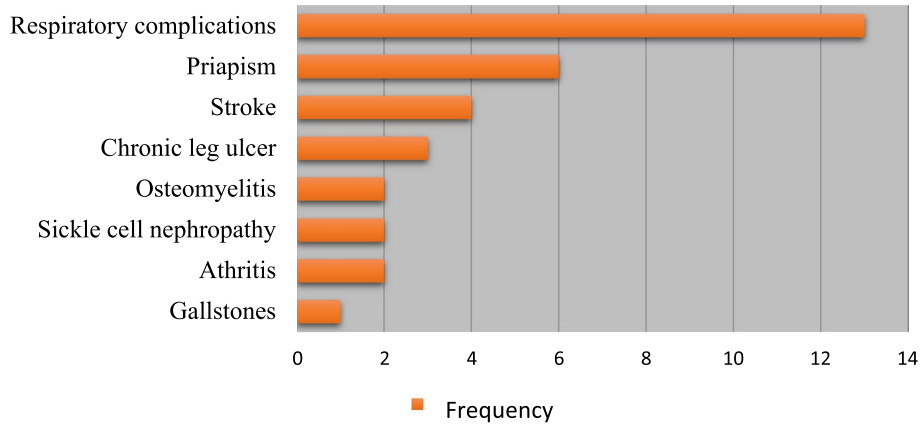

Fig. 2 Clinical profile: Complications of SCA among participants

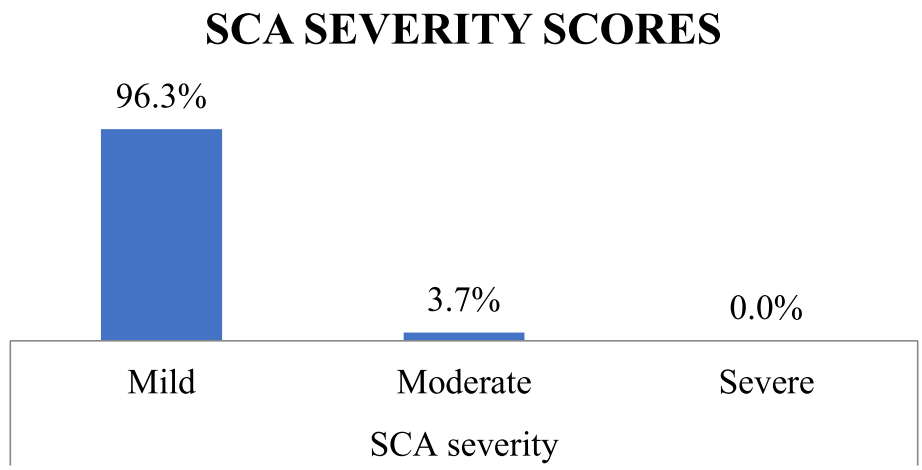

Fig. 3 SCA Severity

The variations in prevalence estimates across different studies and between different countries could be attributed to differences in awareness of mental health and mental health-seeking behavior, which are not common in low-income settings. Advancement in psychosocial care in high-income settings lessens the burden of depression. Other minor variations could be due to different diagnostic tools (PHQ-9, BDI, DSM-V, etc.), adopted classifications, and study methods used.

The predominance of mild depressive symptoms, as observed in this study, suggests that while many adolescents may experience temporary mood disturbances, a smaller subset progresses to moderate and severe symptoms that might require clinical intervention. These findings align with patterns reported by Aljumah et al. in Saudi Arabia, where mild, moderate, and severe depression rates were 23.2%, 20.6%, and 6.8%, respectively [23]. The presence of mild symptoms, however, should not be underestimated, as they can impact quality of life and may increase the risk of more severe depression if left unaddressed. Depression severity has implications for the choice of treatment and prognosis.

In contrast to the findings of some existing studies, socio-demographic factors such as age, sex, education level, and health insurance status did not significantly correlate with depression among participants in this study. Studies in other settings, such as Alhamoud et al. in Saudi Arabia and Mallicka et al. in India, have revealed significant associations between depression and factors such as gender, lower educational levels, and socio-economic status [22, 26]. Interestingly, our findings contrast with those of a study by Asnani et al. in Jamaica, which reported higher odds of depression among those with higher education levels. These inconsistencies underscore the complexity of depression and the potential role of diverse socio-cultural and systemic factors in shaping mental health outcomes across different settings [19].

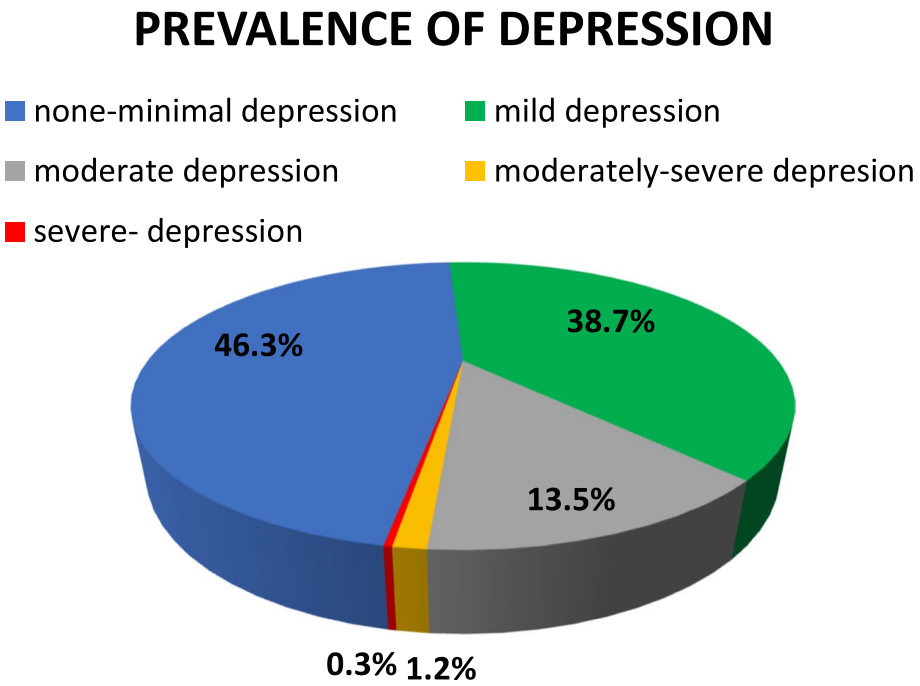

Fig. 4 Prevalence of depression among adolescents with SCA

In terms of clinical characteristics, most participants presented with mild to moderate disease severity, with no significant association found between disease severity and depression. This observation is similar to findings by Ezenwosu et al. in Nigeria, where SCA severity did not predict depressive symptoms among adolescents. The mild to moderate severity observed among participants in this study could be attributed to the outpatient clinic setting, as patients with severe disease likely require more intensive inpatient management [24].

One factor that demonstrated a strong association with depression was the frequency of painful episodes in the preceding year. Compared with those without pain episodes, adolescents who experienced painful crises in the past 12 months had a 2.4-fold greater likelihood of depression, with a significant p value of 0.01. This finding aligns with research by Asnani et al. in Jamaica, which reported that frequent pain crises increased the odds of depression by 2.5 times [19]. Another study by Ballah et al. (2023) revealed that among adolescents who had experienced crisis, more than half had mild to moderate depression [27]. Chronic or frequent painful episodes, if not well controlled, are associated with unusually high levels of stress hormone production, which disrupts sleep patterns and affects mood, hence associated with the development of mood disorders such as depression.

Conclusion

Depression is common among adolescents with SCA in our setting, with a prevalence of 54%, whereas mild, moderate and severe symptoms were found in 38.7%, 14.7% and 0.3%, respectively. Painful episodes experienced by these adolescents were significantly associated with depression. This study highlights the need for screening adolescents with SCA for depression as part of comprehensive care. It is critical to integrate regular mental health screening into routine care for adolescents with SCA. Addressing depressive symptoms early and ensuring access to psychological support services within sickle cell clinics could improve quality of life and reduce the risk of severe depression.

Clinicians must prioritize effective prevention and comprehensive management of chronic pain or frequent painful episodes to mitigate one of the drivers of depression in this population. This study was not without limitations. Recall bias from interviewees, where participants had to remember some symptoms in the previous 12 months or 2 weeks and the frequency of their occurrence. This approach could easily underestimate or overestimate reported events. However, this was mitigated by shortening the recall duration periods and having parents/guardians confirm the responses. Limitations from the PHQ-9 tool were mitigated by ensuring cultural and linguistic adaptation. The questions were modified similarly to the PHQ-A

(Adolescent version) aiming at increasing its contextual validity. Due to logistical constraints, this study did not include a control group hence we suggested that future research incorporate such comparisons to strengthen conclusions.

Abbreviations

cOR	Crude odds ratio
aOR	Adjusted odds ratio
Hb	Hemoglobin
HbSS	Homozygous sickled hemoglobin
HPLC	High-performance liquid chromatography
IDI	In Depth Interview
MUHAS	Muhimbili University of Health and Allied Sciences
MNH	Muhimbili National Hospital
NIH	National Institutes of Health
NHLBI	National Heart, Lung, and Blood Institute
RBC	Red blood cells
PHQ	Patient Health Questionnaire
RRH	Regional referral hospital
SCA	Sickle cell anemia
SCD	Sickle cell disease
SPSS	Statistical Package for Social Sciences
SSS	Severity score of sickle cell anemia
SPARCO	Sickle Pan-African Research Consortium

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12887-024-05359-w.

Additional file 1.

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Authors' contributions
L.P.A. wrote the main manuscript text. L.P.A, A.J, F.M, and H.K were involved in the conception and design of the work. L.P.A and I.M were engaged in the acquisition of data. All authors substantively reviewed the work and added inputs.

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Data availability
The raw data used in this study are available from the corresponding author (L.P.A.) upon reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval was obtained from the Muhimbili University of Health and Allied Sciences Ethical Board Committee MUHAS-REC-06–2023-1770. Permission letters for data collection were also obtained from each health facility. The study was conducted in full compliance with the ethical principles outlined in the Declaration of Helsinki, ensuring the protection of participants' rights, safety, and well-being. The data collection process did not interfere with the routine care provided at the clinic. Informed consent to participate was obtained from parents or legal guardians of participants younger than 18 years and from participants older than 18 years. Participants who were found to have moderate to severe depressive symptoms were contacted and channeled to a clinical psychologist for further evaluation and therapy.

Consent for publication
Written informed consent for publication was obtained from parents or legal guardians of participants younger than 18 years and from participants older than 18 years.

Competing interests
The authors declare no competing interests.

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