Knowledge and Beliefs, towards Sickle Cell Disease among Senior High School Students in Tamale Metropolis

ABSTRACT

Aim: Sickle cell disease is a public health problem with a global spread. As a hereditary disease, sickle cell disease comes with many complications, including anemia. With the increasing incidence of Sickle cell disease in Ghana, the study assessed students' knowledge, attitude, and belief about the disease.

M**ethods:** a descriptive cross-sectional design was used in the study. A systematic sampling technique was used to select 386 participants. A questionnaire was used to gather the data in four selected schools. Data were analyzed using SPSS.

Results: About 47% of the participants were 18-20 years old. The study found that 81% of the participants have heard about Sickle cell disease. A few of them (11.66%) could tell their sickle cell status. In the case of curability of the disease, 31% believed that sickle cell disease is curable. The majority, 48.70%, would seek spiritual intervention to treat Sickle cell disease. Participants provided different explanations for the cause of sickle cell including the belief that sickle cell disease is transmitted at birth (72.28%), sexual intercourse (20.21%), airborne (3.37%), food (1.5%), and spiritual (13.47%). About 88.34% had not been screened for sickle cell disease, and the reasons assigned included not falling sick easily (22.22%), not considering it as necessary (14.53%), and the fear of testing positive (13.11%).

Conclusion: There was fair knowledge of Sickle Cell Disease, with few knowing their status. There were statistically significant associations between class, the course of study, and knowledge of Sickle Cell Disease. Some of the beliefs regarding the transmission of the disease include; Sickle Cell Disease is transmitted at birth, through sexual intercourse, and airborne.

Keywords: Belief, Knowledge, Sickle Cell Disease, Senior High School.

1.0 Introduction

Sickle cell disease is a genetic blood disorder and is associated with complications such as severe anemia, chronic pain, acute chest syndrome, and stroke [1-4]. These complications are the major causes of hospitalizations, morbidity, and premature mortality among sickle cell patients [5]. The World Health Organization [6] has designated Sickle Cell Disease (SCD) as a global health problem. Estimates since 1992 reveal that SCD is an important public health concern in sub-Saharan Africa [7-8]. Research shows that only 10% of the world's sickle cell disease patients are from advanced economies [9].

SCD in women often comes with challenges as it relates to reproductive health and practices. It has been observed that SCD is very common in obstetric practice because advances in medical care have led to more girls having this condition surviving to childbearing age [10]. Research has shown that women with SCD are at a higher risk for having children with SCD, in addition to other crises including, urinary tract infections, gestational diabetes, pneumonia, and anemia [11-12].

Early childhood mortalities from SCD-related complications ranged between 50% in places with good access to health care and 90% in places with limited access to health care [13-14]. Though it is a global problem, sickle cell disease is most common among people with lineages coming from African countries, and there is growing evidence that the presence of malaria in Africa is influencing sickle cell disease, and if not treated, may lead to infant death [15-17].

Pain is very common among sickle cell patients [18], and reflects the type of names given to the disease in parts of West Africa [16]. For instance, in Ghana, SCD is called 'Ahotutuo' by the people who speak Twi, which literally means 'body biting,' 'body chewing,' or 'beaten up' [16]. It is called 'chwechweechwee' among the Ga people and 'nuidudui' among the Ewes people [16]. Among the people of Tamale who are predominantly Dagombas, it is called 'Darimihi' literally means 'skinny' or 'rope-like.' In Ghana, more than 2% of the population is born with sickle cell disease every year, and about 25% to 30% are sickle cell carriers [20]. In Ghana, about 5,815 people had SCD in 2010 [21].

Good knowledge, early detection, and diagnosis of SCD is essential for the prevention and management of the condition since more people with SCD are likely to reach reproductive age and beyond. However, a study among university students in Ghana found limited understanding and inadequate knowledge of SCD [22]. A similar study in Nigeria revealed that 55% of students did not know their genotype and only 18% had some right ideas about SCD [23]. There exists a knowledge gap regardless of the high prevalence of sickle cell carrier status and the current newborn

screening program in Ghana [24]. This makes it imperative to educate people on the misconceptions about SCD and make them understand the risks of having a child with SCD. This study sought to explore the knowledge of Senior High School (SHS) students on SCD so that gaps if any could be identified for proportionate interventions to be instituted.

2.0 METHODOLOGY

2.1 Research Setting and Design

The study was conducted in the Tamale Metropolis in the Northern Region of Ghana. The Tamale Metropolis comprises three constituencies (Tamale Central, Tamale South, and Tamale North). The metropolis shares boundaries with the Sagnarigu District to the west and north, Mion District to the east, East Gonja to the south, and Central Gonja to the southwest. Geographically, the Metropolis lies between latitudes 9º16 and 9º 34 North and longitudes 0º 36 and 0º 57 West. The Metropolis has a total estimated land size of 646.90180sqkm. The design used in the study was a quantitative research approach. A descriptive cross-sectional study design examined senior high school students' knowledge, beliefs, and attitudes toward sickle cell disease in the Tamale Metropolis.

2.2 Study Population and Sampling

The study population consisted of students from SHS (year 1 to year 3) in the Tamale Metropolis. The respondents were drawn from each academic year group (SHS 1-3). Simple random sampling by ballot method was used to select four out of the ten public SHS schools in the Tamale Metropolis. The selected schools were Ambariya SHS, Vittin SHS, Business SHS, and Ghana SHS. A proportionate sampling technique was used to ensure fairness and equity in the selection process. In all, 386 participants, consisting of 168 males and 218 females were selected.

2.3 Inclusion and exclusion criteria

Participants were eligible if they were aged 15 to 24 years and were in SHS.

Participants were not eligible if they were below 15 years or above 24 years and were in SHS.

2.4 Recruitment and Training of field assistants

The study employed three field assistants who were trained for the data collection. They were trained to administer the research questionnaires.

2.5 Data Collection and Analysis

Structured open and closed-ended questionnaires were used to gather responses for this study. Statistical Package for Social Sciences, version 23 was used in the data analysis. The results were presented in tables. A determination of the association between variables was done with Chi-square. A statistical significance level of $p<0.05$ was applied in statistical tests.

3. Results

3.1 Sociodemographic Characteristics

A total of 386 participants took part in the study, which included 43.52% males and 56.48% females (Table 1). The mean age was 17.94 (SD: 1.97) years. Also, 47% were between 18 - 20 years representing the highest proportion. In the case of the Forms of the Participants, 43% of the participants were in Form 1, 36.53% were in Form 2, and the remaining 20.73% were in Form 3. Most of the participants were Muslims (68.65%), 0.78% were traditionalists, and 30.57% professed Christian religion. About 33% of the participants were General Science students, 31.35% were Home Economics students, and 18.91% and 16.32% were offering General Arts and Business, respectively.

Table 1: Distribution of sex, age, Form, religion, and course

Variable	Frequency	Percent
Sex		
Male	168	43.52
Female	218	56.48
Total	**386**	**100.00**
Age		
15 - 17	171	44.30
18 - 20	182	47.15
21 - 22	21	5.44

23 - 24	12	3.11
Total	**386**	**100.00**
Form		
One	165	42.75
Two	141	36.53
Three	80	20.73
Total	**386**	**100.00**
Religion		
Christian	118	30.65
Islam	265	68.83
African Traditional Religion	2	0.53
Total	**386**	**100.00**
Course		
General Science	129	33.42
Home Economics	121	31.35
General Arts	73	18.91
Business	63	16.32
Total	**386**	**100.00**

Source: **Field data, 2020**

3.2 Distribution of Age, sex, and Course of Study

Regarding the sex distribution, the majority (56.48%) of the students interviewed were females, with the remaining about 44% reported as males. The highest number (33.42%) of students interviewed pursued General Science, 31.35% were Home Economics students, 18.91% were General Arts students, and the remaining 16.32% offered Business (Table 2).

Table 2: Distribution of age, sex, and course of study

Variables	**Bisco**		**Ghanasco**		**Ambariya**		**Vittin**		**Pooled**	
	Fre	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Course of study										
Home Economics	41	10.62	40	10.36	25	6.48	15	3.89	121	31.35
General Science	40	10.36	39	10.10	30	7.77	20	5.18	129	33.42
General Arts	18	4.66	22	5.70	23	5.96	10	2.59	73	18.91

Business	20	5.18	21	5.44	20	5.18	2	0.52	63	16.32
Total	**119**	**30.83**	**122**	**31.61**	**98**	**25.39**	**47**	**12.18**	**386**	**100.00**

Source: **Field data, 2020**

3.3 Level of Knowledge of Sickle Cell Disease among Participants

About 81% of the participants have heard of SCD, and the majority of them, 38.08%, heard it from their friends (Table 3). Of the 11.66% who knew their sickle cell status, 44% were of the genotype AA, 34.88% were of the genotype SS, 18.60% were of the genotype AS, and 2.33% were of the genotype SC. About 7% of the participants responded that they had family members who suffered from SCD, and 59.22% responded none of their family members had SCD. The rest of the 33.51% were not sure if any family members had SCD. Also, 15% knew people outside their families who had SCD, 67.27% did not know anyone outside their family having SCD, and 17.92% were not sure if they knew anyone outside their family who had the condition.

Table 3: Knowledge of sickle cell disease

Students' knowledge of SCD	Frequency	Percent
Have you ever heard of SCD?		
Yes	313	81.09
No	73	18.91
Total	**386**	**100.00**
If yes, from where? Relatives	31	9.60

Friends	123	38.08
Health personnel	97	30.03
Media	48	14.86
Others	24	7.43
Total	**386**	**100.00**
Do you know your status?		
Yes	45	11.66
No	341	88.34
Total	**386**	**100.00**
If yes, which of the following is it?		
AA	19	44.19
SS	15	34.88
AS	8	18.60
SC	1	2.33
Total	**386**	**100.00**
Does anyone in your family have SCD?		
Yes	28	7.27
No	228	59.22
Not sure	129	33.51
Total	**386**	**100.00**
Do you know anyone outside the family?		
Yes	57	14.81
No	259	67.27
Not sure	69	17.92
Total	**386**	**100.00**

Source: Field data, 2020

3.4 Association between sociodemographic characteristics and level of Knowledge of SCD

Pearson's chi-square test of association was conducted to examine any statistical associations between whether the participants have heard about SCD and the characteristics mentioned (Table 4). About 81.09% of the participants indicated that they have heard about SCD. However, the statistical association test was not significant (χ^2= *2.86; P-value = 0.413*), which indicates that there was no statistical association between having heard about SCD and the ages of the participants. The results for sex, form, and the various courses of study are similar to age. Regarding the distribution of participants who have heard about the disease by sex, form, and courses, 44% were female, with most of them in Form One (33.16%) and pursuing Home Economics (26.17%). In terms of statistical association among the variables, Pearson's chi2 test outcome

was insignificant in all four (4) tests, implying no associations between sex, form, and courses; and having heard about SCD.

Table 4. Knowledge of students on the sickle cell disease and student characteristics

Variables	Have you ever heard of SCD?						Pearson's chi2 (p-value)
	Yes		No		Pooled		
	Freq.	%	Freq.	%	Freq.	%	
Age							χ^2 = 2.86
15 – 17	144	37.31	27	6.99	171	44.30	p-value =
18 – 20	144	37.31	38	9.84	182	47.15	0.413
21 & 22	15	3.89	6	1.55	21	5.44	
23 & 24	10	2.59	2	0.52	12	3.11	
Total	**313**	**81.09**	**73**	**18.91**	**386**	**100.00**	
Sex							χ^2 = 2.29
Male	142	36.79	26	6.74	168	43.52	p-value =
Female	171	44.30	47	12.18	218	56.48	0.130
Total	**313**	**81.09**	**73**	**18.91**	**386**	**100.00**	
Form							χ^2 = 3.49
One	128	33.16	37	9.59	165	42.75	p-value =
Two	115	29.79	26	6.74	141	36.53	0.174
Three	70	18.13	10	2.59	80	20.73	
Total	**313**	**81.09**	**73**	**18.91**	**386**	**100.00**	
Course							χ^2 = 5.86
Home Economics	101	26.17	20	5.18	121	31.35	p-value =
General Science	96	24.87	33	8.55	129	33.42	0.118
General Arts	63	16.32	10	2.59	73	18.91	
Business	53	13.73	10	2.59	63	16.32	
Total	**313**	**81.09**	**73**	**18.91**	**386**	**100.00**	

Source: Field data, 2020

3.5 Knowledge of cure across age, sex, and course

The results indicate that 31% thought SCD is curable. In terms of statistical association, there was no statistical association between age and SCD being curable on the one hand and sex and the disease being curable on the other hand (Table 5).

Table 5: Knowledge of cure across age, sex, and course

Variables	Do you think the disease is curable?								**Pearson's chi2 (p-value)**
	Yes		No		Not sure		Don't know		
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
Age									χ^2=13.74

15 - 17	39	10.10	54	13.99	36	9.33	42	10.88	p-value =
18 - 20	68	17.62	55	14.25	27	6.99	32	8.29	0.132
21 & 22	8	2.07	5	1.30	5	1.30	3	0.78	
23 & 24	6	1.55	2	0.52	2	0.52	2	0.52	
Total	**121**	**31.35**	**116**	**30.05**	**70**	**18.13**	**79**	**20.47**	
Sex									χ^2=4.16
Male	46	11.92	48	12.44	36	9.33	38	9.84	p-value =
Female	75	19.43	68	17.62	34	8.81	41	10.62	0.244
Total	**121**	**31.35**	**116**	**30.05**	**70**	**18.13**	**79**	**20.47**	
Course									χ^2=18.77
Home Economics	44	11.40	31	8.03	20	5.18	26	6.74	p-value =
General Science	26	6.74	48	12.44	24	6.22	31	8.03	0.027
General Arts	33	8.55	19	4.92	13	3.37	8	2.07	
Business	18	4.66	18	4.66	13	3.37	14	3.63	
Total	**121**	**31.35**	**116**	**30.05**	**70**	**18.13**	**79**	**20.47**	

Source: Field data, 2020

3.6 Knowledge of prevention across age, sex, and course

Results show that 52% of the participants thought SCD was preventable. About 14% of the respondents were neither sure nor knew about the preventable disease. Participants who perceived SCD as preventable were 24.35%. Regarding any statistical associations among the variables, the P-values from all three tests indicate no statistical associations (Table 6).

Table 6: Knowledge of prevention across age, sex, and course

Variables	Do you think the disease is preventable? (n = 386)								**Pearson's chi2**
	Yes		No		Not sure		Don't know		
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	**(p-value)**

Age									χ^2=7.88
15 - 17	87	22.54	35	9.07	23	5.96	26	6.74	p-value =
18 - 20	94	24.35	39	10.10	28	7.25	21	5.44	0.546
21 & 22	11	2.85	2	0.52	3	0.78	5	1.30	
23 & 24	9	2.33	1	0.26	0	0.00	2	0.52	
Total	**201**	**52.07**	**77**	**19.95**	**54**	**13.99**	**54**	**13.99**	
Sex									χ^2=1.92
Male	86	22.28	31	8.03	28	7.25	23	5.96	p-value =
Female	115	29.79	46	11.92	26	6.74	31	8.03	0.589
Total	**201**	**52.07**	**77**	**19.95**	**54**	**13.99**	**54**	**13.99**	
Course									χ^2=9.31
Home Economics	69	17.88	19	4.92	14	3.63	19	4.92	p-value =
General Science	59	15.28	33	8.55	17	4.40	20	5.18	0.409
General Arts	36	9.33	16	4.15	13	3.37	8	2.07	
Business	37	9.59	9	2.33	10	2.59	7	1.81	
Total	**201**	**52.07**	**77**	**19.95**	**54**	**13.99**	**54**	**13.99**	

Source: Field data, 2020

3.7 Beliefs about Sickle Cell Disease

The results show that the majority (72.28%) of the participants believed that SCD is transmitted at birth. Interestingly, 58% thought that SCD is a problem in Ghana. The majority (61.66%) stated that SCD is not transmitted spiritually. Again, 48.70% indicated they would seek spiritual intervention when they are confronted with SCD. Additionally, 34% agreed that having a child with SCD can be challenging and scary (Table 7).

Table 7: Students' Beliefs about SCD

Summary of beliefs of students	Frequency	Percent
SCD transmission		
Sexual intercourse	78	20.21
Birth	279	72.28
Airborne	13	3.37
Food	6	1.55

Others	10	2.59
Is SCD a problem in Ghana		
Yes	225	58.29
No	43	11.14
Not sure	65	16.84
Don't know	53	13.73
Is the transmission of SCD spiritual?		
Yes	52	13.47
No	238	61.66
Not sure	54	13.99
Don't know	42	10.88
Would you seek spiritual intervention?		
Yes	188	48.70
No	149	38.60
Not sure	49	12.69
Having a child with SCD could be scary		
Strongly disagree	52	13.47
Disagree	79	20.47
Don’t care	43	11.14
Agree	132	34.20
Strongly agree	80	20.73
Total	**386**	**100.00**

Source: Field data, 2020

4. DISCUSSION

From the study, 88.84% could not tell their SCD status. Though they may be aware of SCD, they probably did not want to know or are not aware that they need to know. This ties in well with Ogamdi [25] and Singh et al. [26] findings which suggest that the majority of their participants, mostly students, were unaware of their SCD status. Though this may be the case for the current cohort of study participants, other studies such as Acharya et al. [27] and Ameade et al. [28] revealed that over half of married couples were aware of their genotypes of hemoglobin.

These differences in knowledge could partially be explained by the differences in the sample size and the fact that some of the participants could have gone for a test when they were getting married. Notwithstanding these differences, the statistics portrayed in these studies remain significant and disturbing, as knowledge about carrier status would guide individuals to make good decisions when it comes to making decisions concerning their reproductive choices.

The observation of knowledge about SCDs in the current study, combined with other studies by Acharya et al. [27], Ameade et al. [28], and Boyd et al. [29] gives enough evidence that most populations of reproductive age are not adequately informed on SCDs. This observation is disturbing as most of these populations would start childbearing. Adequate information about SCD, its incidence, and the inheritance patterns among individuals within the reproductive age are considered instrumental in decisions concerning marriage and childbearing [30].

The current study noted that 88.34% had not been screened for SCD. Reasons for not screening include not falling sick easily, not considering it as necessary, fear of testing positive, and other reasons. Beliefs regarding the causes of SCD point to the fact that it is an inherited disorder [31-32]. However, other perceived causes, as noted among the participants in the current study, included airborne (3.37%) and food (1.5%). This observation reflects the misconceptions and the shared lack of knowledge of SCD among the participants. It rings the clarion call for stakeholders to address the observed misconceptions, especially among students who also form an important part of the general population. Alghamdi et al. [33] highlighted some misconceptions about SCDs in a related study, indicating that some participants reported fever, infection, and high altitudes believed to be responsible for SCDs. Alghamdi et al. [33] equally added that foods, including fava beans, lentils, falafel made with fava beans, and vigna nuts, were associated with SCDs by some participants.

Though adolescents may have several years to live before dying [34], if these misconceptions about SCDs, as noted among the current study participants, are not addressed, it may go a long way to influence their health-seeking behaviors negatively. Another study in Ghana has shown a significant relationship between religious beliefs and medical care. Dennis Antwi et al. [35] and Cotton et al. [36] have indicated that young adults with SCD typically attended religious events, believed in God, prayed regularly, and had elevated levels of spirituality.

Many of the participants (43.59%) could not provide any reason for not testing. Again, 13.11% were scared of testing positive, 14.53% considered it unnecessary to screen, and 22.22% said they did not test because they don't fall sick easily. Consistent with similar findings from other studies [37-38], females in this study had more knowledge about SCD than males. Looking at the hereditary nature of SCD, both sexes must know about the disease, especially the reproductive consequences.

Conclusion

The study concluded that most of the study participants have heard about SCD, with only a few knowing their SCD status. There was an observed statistically significant association between the levels of students (Form) and knowledge of SCD, the course of study, and whether they knew SCD or not. The beliefs of students on sickle cell disease among the participants included the belief that SCD is transmitted at birth (72.28%), sexual intercourse (20.21%), and airborne (3.37%). Other participants indicated that they had not been screened for SCD, and one of the reasons for not doing so is the fact that they do not fall sick easily. It is therefore imperative to encourage the youth to do health screening to know their health status including SCD.

Ethical Approval and Consent

The research protocol was submitted to the University for Development Studies Institutional and Ethical Review Committee. The study was approved by the University for Development Studies Institutional and Ethical Review Committee. All methods in the study were carried out in accordance with the relevant regulations and guidelines of the Ethical Review Committee. All the participants provided Informed consent to participate before the survey questions were sent to them. The survey questions did not capture the personal identities of the participants.

Strengths and Limitations of the study

The study's findings have demonstrated the knowledge and belief of SCD among Senior High School students in the Tamale Metropolis of Northern Ghana. Due to the use of an anonymous questionnaire presented to the students, the prospect of social desirability bias is ruled out, as the subject matter of the study is not disclosed.

The study design is cross-sectional; hence, it is challenging to establish a causal relationship among the variables assessed. The findings of this study can only be generalized to adolescents in Senior High Schools in similar settings, such as Ghana.

References

1. Rees D.C., Williams TN, Gladwin MT. Sickle-cell disease. Lancet. 2010;376(9757):2018–49. https://doi.org/10.1016/S0140-6736(10)61029-X.

2. Sims, A.M., Bonsu, K.O., Urbonya, R. *et al*. Diagnosis patterns of sickle cell disease in Ghana: a secondary analysis. *BMC Public Health* **21**, 1719 (2021). https://doi.org/10.1186/s12889-021-11794-6

3. Moumni, I., Ben Mustapha, M., Ben Mansour, I., Zoraï, A., Douzi, K., Sassi, S., Chaouachi, D., Mellouli, F., Bejaoui, M., & Abbes, S. Fetal Hemoglobin in Tunisian Sickle Cell Disease Patient: Relationship with Polymorphic Sequences Cis to the β-Globin Gene. *Indian Journal of Hematology & Blood transfusion: an official journal of Indian Society of Hematology and Blood Transfusion*, *32*(1), 114–119. 2016. https://doi.org/10.1007/s12288-015-0504-7

4. Aljabry MS, Alhoshan A, Alrawaf F, Alhowidi A, Alsahli A, Alrubaia S., et al. Prevalence of glucose-6-phosphate dehydrogenase deficiency and sickle-cell trait among blood donors: Revisited after 10 years in the same institute. J Appl Hematol; 10:84-7. 2019.

5. Fowora M.A. Adherence to Self-Care Management of Sickle Cell Disease Among Caregivers. 2016. https://scholarworks.waldenu.edu/dissertations.

6. World Health Organization. Sickle-cell disease and other haemoglobin Disorders, 2011. http://www. who.int/mediacentre/factsheets/fs308/en/(accessed on 6th June, 2017).

7. Ezenwa, M.O., Dennis-Antwi, J.A., Dallas, C.M. et al. The Crisis of Sickle Cell Disease in Africa from Insights into Primary Prevention in Ghana and Nigeria: Notes from the Field. *J Immigrant Minority Health* **23**, 871–878 (2021). https://doi.org/10.1007/s10903-021-01186-8

8. Modell B, Darlison M. Global epidemiology of haemoglobin disorders and derived service indicators. Bull World Health Organ 2008; **86**:480 7.doi:10.2471/BLT.06.036673 pmid:http://www.ncbi.nlm.nih.gov/pubmed/18568278

9. Aygun B. and Odame, I. "A global perspective on sickle cell disease," *Pediatric Blood & Cancer*, vol. 59, no. 2, pp. 386–390, 2012.

10. Wilson, N.O., Ceesay, F.K., Hibbert, J.M., Driss, A., Obed, S.A., Adjei, A.A., et a. Pregnancy Outcomes among Patients with Sickle Cell Disease at Korle-Bu Teaching Hospital, Accra, Ghana: Retrospective Cohort Study. The American Journal of Tropical Medicine and Hygiene, 86, 936-942. 2012. https://doi.org/10.4269/ajtmh.2012.11-0625

11. Elenga, N., Adeline, A., Balcaen, J., Vaz, T., Calvez, M., Terraz, A., et al. Pregnancy in Sickle Cell Disease Is a Very High-Risk Situation: An Observational Study. Obstetrics and Gynecology International, 2016, Article ID: 9069054. https://doi.org/10.1155/2016/9069054

12. Nwafor, J. , Ugoji, D. , Ibo, C. , Onwe, B. , Onuchukwu, V. , Obi, C. and Obi, V. Pregnancy Outcome among Women with Sickle Cell Disease in a Tertiary Health Institution in Abakaliki: A Retrospective Case-Control Study. *International Journal of Clinical Medicine*, **10**, 395-403. 2019. doi: 10.4236/ijcm.2019.108032.

13. Asare, E. V., Wilson, I., Kuma, A. A. B., Dei Adomakoh, Y., Sey, F., and Olayemi1, E. Ghana Burden of Sickle Cell Disease in Ghana: The Korle-Bu Experience. Advances in Hematology, 2018. https://doi.org/10.1155/2018/6161270.

14. Grosse, S.D., Odame, I., Atrash, H.K., Amendah, D.D., Piel, F.B., & Williams, T.N. Sickle cell disease in Africa*:* A neglected cause of early childhood mortality. American Journal of Preventive Medicine, 41(6), S398–S405. 2011.

15. World Health Organization. 59*t* World Health Assembly, Provisional Agenda Item 11.4, pp. 1-5. 2006. Geneva: WHO.

16. Anie, K. A., & Green, J. Psychological therapies for sickle cell disease and pain. The Cochrane Database of Systematic Reviews, 5(5), 1916. 2015.

17. Oguntoye O.O, Ndububa D.A., Yusuf M., Bolarinwa R.A., and Ayoola O.O. "Clinical and Biochemical Manifestations of Severe Sickle Cell Anemia in Adult Patients in Steady State in Ile-Ife, Nigeria," Sudan Journal of Medical Sciences, vol. 14, issue no. 1, pages 52–63. 2019. DOI 10.18502/sjms.v14i1.4381.

18. Edwards, C. L., Scales, M. T., Loughlin, C., Bennett, G. G., Harris-Peterson, S., De Castro, L. M., Whitworth, E., Abrams, M., Feliu, M., Johnson, S., Wood, M., Harrison, O., & Killough, A. A Brief Review of the Pathophysiology, Associated Pain and Psychosocial Issues in Sickle Cell Disease, 12(3), 171–179. 2005.

19. Konotey-Ahulu F.I.D. The Sickle Cell Disease Patient. www.thelancet.com Vol 365. 2005.

20. Ohene-Frempong, K., Oduro, J., Tetteh, H., & Nkrumah, F. Screening newborns for sickle cell disease in Ghana. Pediatrics, 121(Supplement 2), S120-S121. 2008. State of Sickle Cell Disease 2016 Report.pdf

21. Piel, F. B., Patil, A. P., Howes, R. E., Nyangiri, O. A., Gething, P. W., Dewi, M., Hay, S. I. *Global Epidemiology of Sickle Haemoglobin in Neonates: A Contemporary Geostatistical Model-based Map and Population Estimates. The Lancet,* 381(9861), 42– 151. 2013. doi:10.1016/S0140-6736(12)61229-X.

22. Boadu, I., & Addoah, T. *Knowledge, Beliefs, and Attitude towards Sickle Cell Disease among University Students*; 2018. DOI: 10.4172/2161-0711.1000593.

23. Bazuaye, G.N., and Olayemi, E.E. Knowledge and Attitude of Senior Secondary School Students in Benin City Nigeria to Sickle Cell Disease, World Journal of Medical Sciences 4 (1): 46-49, 2009. ISSN 1817-3055

24. Paula, T. R., Monica L. L., Daniel C. U., Lesley A. E., Onike R., and Andrew D. C. Attitudes of Ghanaian women toward genetic testing for sickle cell trait, International Journal of Gynecology and Obstetrics 115: 264–268. 2011.

25. Ogamdi, S. African American students' awareness of sickle cell disease. J. Am. Coll. Health 42(5): 234-236. 1994.

26. Singh, H., Dulhani, N., Kumar, B. N., Singh, P., & Tiwari, P. Effective control of sickle cell disease with hydroxyurea therapy. Indian Journal of Pharmacology, 42(1), 32–35. 2010. https://doi.org/10.4103/0253-7613.62409.

27. Acharya K, Lang C.W, Ross L.F. A pilot study to explore knowledge, attitudes, and beliefs about sickle cell trait and disease. J Natl Med Assoc 101: 1163-1172. 2009.

28. Ameade, E.P.K, Mohammed, B.S, Helegbe, G.K, Yakubu, S. *Sickle cell genetransmission: Do public servants in Tamale, Ghana, Have the right knowledge and attitude to curb It?* Open J Preven Med 5: 299. 2015.

29. Boyd, J.H., Watkins, A.R., Price, C.L., Fleming, F., & DeBaun, M.R. *Inadequate community knowledge about Sickle Cell Disease among African-American women. Journal of the National Medical Association 97*(1), 62-67. 2005.

30. Boyd, J.H., Macklin, E.A., Strunk, R.C., DeBaun M.R., Asthma is associated with increased mortality in individuals with sickle cell anemia Hematological, 92, pp. 1 115-1118. 2007.

31. Hollister, M.C., & Anema, M.G. *Health behavior models and oral health: A review. Journal of Dental Hygiene, 78*(3), 1-8. 2004.

32. Access, O. *Knowledge and attitude of secondary school students in Jos, Nigeria on sickle cell disease*. *8688*, 1–9. 2013. https://doi.org/10.11604/pamj.2013.15.127.2712.

33. Alghamdi, S. Y. S., Alzahrani, F. A. M., Alzahrani, S. A. S., & Albishi, A. M. *Perceptions about Sickle Cell Disease among Adults in Albaha Region: A Cross-sectional Study*. *70*(January), 357–363. 2018. https://doi.org/10.12816/0043105

34. Atorkey, P., Doku, P. N., Danquah, S. A., & Akwei, M. *No Title*. *25*(2), 180–195. 2017.

35. Dennis□Antwi, J.A., Ohene□Frempong, K., Anie, K.A., Dzikunu, H., Agyare, V.A., Boadu, R.O., Antwi, J.S., Asafo, M.K., Anim□Boamah, O., et al., *Relation Between Religious Perspectives and Views on Sickle Cell Disease Research and Associated Public Health Interventions in Ghana*; 2018. https://doi.org/10.1007/s10897-018-0296-7.

36. Cotton, S., Grossoehme, D., Rosenthal, S. L., McGrady, M. E., Roberts, Y. H., Hines, J., Yi, M.S., & Tsevat, J. *Religious/spiritual coping in adolescents with sickle cell disease: a pilot study*. *Journal of Pediatric Hematology/Oncology*, 31(5), 313– 318. 2009. https://doi.org/10.1097/MPH.0b013e31819e40e3.

37. Stewart, K.A. An examination of African American college students' knowledge and attitudes regarding Sickle Cell Disease and Sickle Cell Disease carrier testing: A mixed methods study. (Doctoral Dissertation). Retrieved from ProQuest Dissertations and Theses Database (PQTD). (UMI No 3286404). 2007.

38. Treadwell, M.J., McClough, L., & Vichinsky, E. *Using qualitative and quantitative strategies to evaluate knowledge and perceptions about Sickle Cell Disease and Sickle Cell Trait. Journal of the National Medical Association*, *98*(5), 704-710. 20