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Research Article

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Efficacy of premarital genotype screening and counselling on knowledge toward Sickle Cell disease among university students in Dodoma Tanzania: an uncontrolled quasi-experimental study

Arnold Gideon Lumbe[1] and Stephen M Kibusi[2*]

[1]*Department of Clinical Nursing,School of Nursing and Public Health, The University of Dodoma*

[2]*Department of Public Health, School of Nursing and Public Health, The University of Dodoma*

[*]Corresponding author

Stephen M Kibusi, Department of Public Health, School of Nursing and Public Health, The University of Dodoma, Email:skibusi@gmail.com

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Abstract

Background: *Tanzania is experiencing an increasing burden of Sickle cell disease, with anestimate of20.6% prevalence of Sickle Cell carriers. However, there is no preventive measure has been put in this area by the government; a great focus has been directed on the diagnosis and management and national guideline emphasise the care of people affected by Sickle Cell Disease.*

Methods: *A non-controlled quasi-experimental study was conducted from June to September 2020 among 697 randomly recruited first-year university students from the University of Dodoma. Pre and post-test knowledge information were collected through structured self-administered questionnaires. Data were analyzed using SPSS v20.A simple and multiple linear analysis models was used to test for significant association of variables at 95% CI, at $p<0.05$. The results were presented using tables and figures.*

Results: *The mean knowledge score at the pretest was 0.009±1.014 which improved to 0.365±0.901 on the posttest, with a statistically significant difference ($t=6.965$, $p<0.01$). The results of linear regression showed that knowledge change was not statistically associated with other predictors ($p>0.05$)*

Conclusion: *Health education demonstrated to be effective towards change in knowledge on sickle cell disease among University students.*

Keywords: *efficacy, premarital, Screening, Sickle Cell disease, knowledge, university students, Dodoma-Tanzania*

Background

Sickle Cell Disease (SCD) is one of the biggest health challenges worldwide [1]. It is a group of inherited red blood disorders transmitted from parents to their offspring.Normally, healthy red blood cells are round and they move through small blood capillaries carrying oxygen to all parts of the body [2]. But in individuals affected with SCD, the red blood cells become hard and adhesive and appear like a C-shaped farm tool termed a "sickle". As a result, these abnormal Sickle cells die early within 10–17 days in contrast to the normal 120-day lifespan of non-sickled RBCs, leading to a constant shortage of red blood cells [3]. Sickle cells can get jammed in small blood vessels and block the flow of blood and oxygen to organs in the body. These blockages cause repeated episodes of severe pain, organdamage, serious infections, or even stroke [4].

Regardless of the increase in the disease, diagnosis, and understanding of causes of the inherited disorders, thousands of children die through the lack of preventive measures, like premarital Sickle Cell genotype screening by two intending married individuals to identify their genotype before marriage [5].

According to WHO(2018), 300,000 children with SCD are born worldwide every year. Moreover, about 5% of the population in the world carries hemoglobinopathy genes that cause SCD [5]. Most of the affected people are those coming from sub-Saharan Africa, Saudi, India, Arabia, and the Mediterranean which carries 75% of all SCD diseases [1].

There are 275,000 babies in Africa born with SCD annually. In the absence of adequate preventive intervention, this projection is expected to reach 400,000 by 2050 [1]. This increase in affected people is compounded by 6.4% of under-five mortality in Africa

due to SCD [6]. The most affected countries are Nigeria with a prevalence of SCT at 24%, SCD between 2 to 3% [7] and Ghana, 24–30 % of the population carries the SCT and 2% has SCD [8]. In the Democratic Republic of Congo, SCT prevalence is estimated to be 18.3% and SCD at 1.4% [9].

Despite the that many people are affected by SCD, the level of knowledge on SCD remains low. Various studies have revealed low knowledge of SCD among university students [8, 10-12]. Thus, there is a need to improve SCD knowledge to break the Sickle Cell disease cycle in the population. Improved knowledge of premarital screening and counselling are some of the principal approaches to achieving this purpose [13].

Another possible intervention to make is genetic counselling. In this, a person is informed about their genetic predisposition to diseases. Couples need to be aware of the possible genetic features of their unborn children [14]. This, along with premarital screening can help in achieving the desired level of knowledge, promoting health and improving the quality of life of young people who are about to start planning for long-term relationships and marriage [15]. Knowledge about screening premarital Sickle Cell genotypes can be obtained through training programmes [16, 17].

Since university life is complex and interactive, some students can start the marital engagement or even become mothers and fathers while at college [18, 19]. This is a reason why some studies support the assessment of university students' knowledge of premarital screening and counselling as they continue with their studies [20, 21].

Tanzania is one of the countries that have high annual births of Sickle Cell disease worldwide [5]. The prevalence of Sickle Cell carriers (HbAS) is 20.6% (MoHCDGEC, 2020). The statistics show that there 6 in every 1000 children are born with SCD annually (Makani et al., 2018). This contributes to up to 7% of total deaths of the under-five children,if this situation continues without intervention, up to 90% of the affected children are predicted not to survive beyond childhood [22].

What gives hope is that the problem can be contained if timely and appropriate intervention is made. There is evidence that increased awareness and knowledge in the community, especially the youth on premarital Sickle Cell genotype screening and counselling work better toward preventing SCD and, hence, alleviate the impact on the general population [1]. While this observation if fortiori, there is limited information on the level of knowledge among the youth in Tanzania. This information is required for appropriate interventions, especially among the university students who most of them are observed to get married in the course of their studies at university. However, studies from other areas of Africa reported that university students are a good target for imparting knowledge on premarital Sickle Cell genotype screening and counselling [12, 14].

Little attention has been put to this area by the government and stakeholders; however, a great focus has been directed on the diagnosis and management of SCD and national guidelines emphasise the care of people affected by SCD [23, 24]. There fore, this study attempted to fill this gap by testing the efficacy of premarital genotype screening and counselling on knowledge of SCD among university students in Tanzania.

Methods

Study Area and Design

Uncontrolled quasi-experimental (pre and post-test only) coupled with the quantitative approachwas conducted in Dodoma Region from June to September 2020 involving the university students from the University of Dodoma. Current the universityenrollment rate is around 30,000 students, which is 80% of its capacity to enrol (UDOM 2019). Moreover, the university has seven colleges, namely the College of Earth Science, College of Natural and Mathematical Sciences, College of Informatics and Virtual Education, College of Education, College of Humanities and Social Sciences, and College of Health and Allied Science.It is a big university in central and east Africa, which occupies students from all regions of Tanzania.

Study Population: The research included all unmarried first-year bachelor's degree students at the University of Dodoma, sampled from different degree programmes offered at the University.

Inclusion and ExclusionCriteria: The research includedfirst-year bachelor's degree students who were perusing different degree programmes, aged between 19 to 29 years, consentedto participate in the study, and all unmarried and not known to have Sickle Cell disease. The study excludedall pregnant female students, and students who were severely ill. Likewise, all first-year students who had repeated the course were excluded from the study.

Sample Size Determination and Sampling Technique

The sample size for the pre and post-test group was computed by using A Cochran formula (1977), whereby 95% confidence level,19.7 mean knowledge score at post-test with 3.1 statistical significant difference with a normal standard deviation of 0.84.The estimated total sample size was 697 participants.

$$n = 2SD^2 (Z_{\alpha/2} + Z\beta^2)/d^2$$

Sampling techniques: Multistage sampling technique was used to select the required subjects for the study. The procedure followedfour stages as shown below:

Stage one: Six colleges which did not provide health and allied sciences programmes from the University of Dodoma were selected purposively.

Stage two: On average, every college comprises about 6 bachelor's degree programmes giving a total of 45 programmes. Out of this, 18 programmes were selected. A simple random technique

was employed to select 3 bachelor programs per college using a replacement lottery method.

Stage three: Each selected programme was categorized as a stratum. The stratified sampling techniques were employed to get the proportional allocation of participants from every programme selected.

Stage four: The study participants were selected using a systematic sampling technique after calculating the kth to get the interval of picking the eligible participant for the study.

Data Collection Procedure

The data were collected using a structured questionnaire adapted and modified to fit the current study. The questionnaire before it was employed for data collection, its internal consistency measured 0.908. The questionnaire was also pretested involving 64students from St.Johns' University of Tanzania.

Data Collection Techniques

Data were collected from 5th June to 10thSeptember 2020. Before data collection; the researcher employedpurposively 6 researcher assistants who were 4 nurses, their responsibility was to deliver health education and counselling, and 2 laboratory technicians who were employed for screening purposes. They were trained to deliver health information, and use questionnaires. The data was collected in three stages; named, pre-test, health education intervention, and post-test. The details of each phase are given hereunder:

Pre-test Intervention Stage

This involved the collection of baseline data from the students through a self-administered questionnaire. In this stage, the researcher categorized participants into six groups based on their respective colleges. Then, six lecture rooms were selected from each college which was used by the study participants during the first stage of the data collection "pretest". The procedure started with rapport building by introducing each other to participants and briefly explaining the nature and the purpose of the study. After that, the researcher and research assistant provided an overview of the purpose of the study and the assessment tool which will be used during data collection. Then, the participants were given a consent form to seek either to accept or refuse to participate in the study. After obtaining the consent, self-administered questionnaires were distributed to each study participant, to obtain their social-demographic information, baseline knowledge, and attitude toward Sickle Cell disease. The whole process took 30 minutes, and then questionnaires were collected for initial analysis, to identify baseline knowledge.

The Health Education Stage

This was the interventional stage at which health education was conducted, the whole intervention process took 8weeks. This procedure was done in the participants' respective colleges. The participants were divided into 11 groups comprised of 53 participants each. The lectures and discussions method was used to deliver materials to participants. Audio-visual equipment like the computer and LCD projector was used to facilitate effective communication. The sessions used the Sickle Cell teaching package adopted from WHO (2006) [25]. The contents of the package comprise the definition of Sickle Cell disease, causes of the disease, signs, and symptoms, complications of SCD, and prevention through premarital screening. The time allocated for sessions was 45 minutes for lecture-discussion. The participants were given take-home reading hand handouts to keep them revising contents taught in the class.

Post Intervention Stage

This was performed on the 8th week after implementing health education and screening for the same participants. The researcher communicated with group representatives by phone to inform the participants to be in the same venue used during the pre-test. The same questionnaireswere used to obtain a post-intervention level of knowledge on Sickle Cell disease. The researcher and research assistant were divided into six previous groups used in the pre-test to participants' respective colleges, whereby they re-introduced and explain the purpose of the second round of data collection. Then, questionnaires were distributed to participants, and after 25 minutes it was completed filled out and collected for data analysis. This stage marked the end of data collection; the obtained data were subjected to analysis.

Validity and Reliability

Validity

According to Parahoo (2006, p. 300–309), validity is classified in three forms namely; content, construct, and criterion. Content validity of questionnaires means an item of the questionnaire represents the phenomenon being studied; Construct validity of questionnaires is the ability of the questionnaire to measure what is intended, and criterion validity is the extent to which a measure is related to an outcome.To achieve the validity of the instrument, the researcher used the standardized tool adopted from previous research with Chronbach's Alpha of 0.908 indicating content acceptance for its usefulness. Moreover, content validity was observed by formulating an adequate sample of the question for the variables included in the topic under study, based on the objectives that measured the intended outcome. Moreover, the construct validity of the questionnaire was assured by careful formulating the questionnaire after a thorough theoretical and research literature review on the topic under study was done to get in-depth knowledge of formulating data collection tools.

Reliability

To ensure reliability in this research, the researcher did the following: the first six research assistants were trained on the use of the questionnaire, use of SCD content to train participants and counselling to participants found to have traits of Sickle Cell. Training took one week and research assistants were given a chance to practice training before they went to intervene. To ensure consistency of the variables included in the study, data collection tools were pre-tested on 64 students at St. Johns University of Tanzania. The participants who were used in the pre-test were not involved in the actual study. Minor correction for typographic errors and clarity was done.

Measurement of Variables

Covariate variable: Demographic information was considered a covariate variable. They were measured by 17 questions. The age of the respondent was measured in a continuous variable while place of residence, program of study, tribe, sex, religion, college, parents' education, type of family and history of Sickle Cell disease was measured in the categorical variable.

Knowledge: Knowledge of sickle cell disease was measured by using 7 domains with 5 sub-domain each including; the concept of SCD, causes of SCD, Screening, management, complication, preventive measures and benefits of SCD screening. The response of each item was yes/no and not sure answers, which were then converted into correct and incorrect.The principal component analysis (PCA) was done to determine the mean scores that determined the cut-point for individual knowledge levels [26]. Percentile was used as a cutoff point to categorize the level of knowledge in low-level knowledge, moderate and high-level knowledge.

Data Analysis

The Statistical Package for Social Science (SPSS) software version 20 developed by IBM Corporation in 2015 was used for data entry, coding, scoring, and analysis. Descriptive statistics analysis was done to present the frequency and percentages of data consisting of social demographic and prevalence of Sickle Cell Disease (SCD status). The graphical presentation was used for illustrations such as frequency distribution table and histogram. Moreover, Chi-square was used for categorical data to determine the factors related to the outcome variables. In addition to that, paired sample t-test analysis was employed to determine the difference between pre and post-intervention sample mean scores for outcome variables.

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Results

Socio-demographic characteristics of the study participants

Six hundred and ninety-sevenparticipants were involved in the study.The majority of the respondents 549 (78.8%) were aged 19 to 29 years, with a mean (SD) age of 23.20□2.00 years. By gender composition, more than half of the participants 416 (59.7%) were male. Concerning residence, most of the participants 469(67.3 %) were from rural and about 216 (31.0 %) had come from lake zones. Concerning religion, 579(83.1%) were Christian.Regarding the history of sickle cell in participants' families; only 110(15.8%) reported having a sickle cell in their family. About the head of the family of the participants, the majority of the 592 (84.9%) were headed by their fathers. Concerning media of communication majority, 691 (99.1%) used phones as a source of getting information. Findings of other socio-demographic characteristics are found in (Table 1).

Table 1:Social-demographic Characteristics of the Study Participants (n = 697)

Variable	Frequency (N)	Percentage (%)
Age		
Mean (M) 23.20		
Minimum 19 years		
Maximum 29 years		
19 to 24 years	549	78.8
25 to 29 years	148	21.2
Sex		
Male	416	59.7
Female	281	40.3
Zone distribution of participants		
Central zone	92	13.2
Coastal zone	102	14.6
Lake zone	216	31
Northern zone	122	17.5
South highland zone	126	18.1
Western zone	25	3.6
Zanzibar	14	2
Residence group of participants		
Rural	469	67.3
Urban	228	32.7
Religion of participants		
Christians	579	83.1

Muslim	118	16.9
Occupation status of participants		
Employed		
Yes	19	2.7
No	678	97.3
College of participants		
COED	159	22.8
CIVE	103	14.8
CNMS	52	7.5
CBSL	145	20.8
COES	127	18.2
CHSS	111	15.9
Type of media used by participants to get information		
Phone		
Yes	691	99.1
No	6	0.9
Magazine		
Yes	49	7
No	648	93
Television		
Yes	113	16.2
No	584	83.8
Total number of media used		
1 media	561	80.5
2media	101	14.5
>2 media	35	5
Type of participants' family		
Nuclear	539	77.3
Extended	158	22.7
Head of the family		
Father	592	84.9
Mother	90	12.9
Relatives	15	2.2
History of Sickle Cell disease in participants' family		
Yes	110	15.8
No	587	84.2

Level of knowledge responses in pre and post-test items analysis of sickle cell disease among university students in the Dodoma region

About 16 questions were asked on knowledge of Sickle Cell disease. The responses were yes, no and not sure, and then converted into correct/incorrect responses. The findings on the item asked about Sickle Cell disease-cause red blood cell to become sickle-shaped and hard, the proportion of participants who responded correctly were 143(20.5%)at pre-test, after health education most of them at post-test 423(60.7%) responded correctly. About causes of SCD on item asked, when both parents have SCD trait, the chance of each pregnant having a child with Sickle Cell disease is-25%, the proportion of participants who responded correctly at pre-test were 200(28.7%)while after health education most of them 572(82.1%) at post-test answered correctly. Moreover, about the prevention domain in the pre-test of them, 182(26.1%) answered correctlyon the item askedthe best way to prevent Sickle Cell disease is for two persons with SCD not to marry each other, while in the post-test most of them 471(67.6%) responded correctly. More details about the Level of knowledge responses in pre and post-test items analysis of sickle cell disease among university students in the Dodoma region are shown in table 2.

Table 2: Level of knowledge responses in pre and post-test items analysis of sickle cell disease among university students in Dodoma region (n=697)

		Pretest		Posttest	
Variable	**Response**	**(n)**	**(%)**	**(f)**	**(%)**
Sickle Cell disease-cause red blood cell to become sickle-shaped and hard	Correct	143	20.5	423	60.7
	Incorrect	554	79.5	274	39.3
People who inherit one Sickle Cell gene and one normal gene have Sickle Cell trait (SCT)	Correct	177	25.4	523	75.0
	Incorrect	520	74.6	174	25.0
People with SCD have mainly hemoglobin S in their red blood cells	Correct	324	46.5	511	73.3
	Incorrect	373	53.5	186	26.7
When both parents have SCD trait, chance of each pregnant having a child with Sickle Cell disease is-25%	Correct	200	28.7	572	82.1
	Incorrect	497	71.3	125	17.9
SCD screening Is-Test done before marriage to rule out Sickle Cell disorder	Correct	272	39.0	613	87.9
	Incorrect	425	61.0	84	12.1
A negative Sickle Cell carrier test Means-Personal is very unlikely to have a disease	Correct	293	42.0	552	79.2
	Incorrect	404	58.0	145	20.8
People with SCD-Need Regular Medicine	Correct	207	29.7	554	79.5
	Incorrect	490	70.3	143	20.5
People with SCD-Need regular blood transfusion	Correct	317	45.5	589	84.5
	Incorrect	380	54.5	108	15.5
People with sickle SCD are more likely to develop -Pain requiring hospitalization	Correct	253	36.3	527	75.6
	Incorrect	444	63.7	170	24.4
People with sickle SCD are more likely to develop -Kidney failure	Correct	158	22.7	615	88.2
	Incorrect	539	77.3	82	11.8
People with sickle SCD are more likely to develop -Stroke	Correct	148	21.2	635	91.1
	Incorrect	549	78.8	62	8.9
The best way to prevent Sickle Cell disease is -Premarital SCD screening	Correct	181	26.0	581	83.4
	Incorrect	516	74.0	116	16.6
The best way to prevent Sickle Cell disease is -Two persons with SCD not marrying each other	Correct	182	26.1	471	67.6
	Incorrect	515	73.9	226	32.4
Benefit of premarital Sickle Cell ScreeningIs-It help to prevent having a child with SCD	Correct	297	42.6	620	89.0
	Incorrect	400	57.4	77	11.0
Major consequences of not adhering to Premarital SCD Screening-Separation/ divorce from couple	Correct	157	22.5	574	82.4
	Incorrect	540	77.5	123	17.6
Major consequences of not adhering to Premarital SCD Screening-Spend a lot of time for treating a sick child	Correct	192	27.5	577	82.8
	Incorrect	505	72.5	120	17.2
Key: (n)=frequency (%)=percentage					

The overall level of knowledge on sickle cell disease among university students in the Dodoma Region

The knowledge score index of participants was categorized by use of percentiles, described into 25, 50, 75 and 100 percentiles. The scoring index was categorized as 0 – 49 had a low level of knowledge, 50 – 74 had a moderate level of knowledge and 75 – 100 had a high level of knowledge. The results indicated that in the pre-test, about half of the participants 356 (51.1%) had a low level of knowledge, while 168(24.1%) had a moderate level of knowledge and 173(24.8%) had a high level of knowledge. The knowledge score increased at the post-test posttest of which the majority 467(67%) had a high level of knowledge, some of them 119 (17%) had a moderate level of knowledge and a few111(16 %) had a low level of knowledge (Figure1).

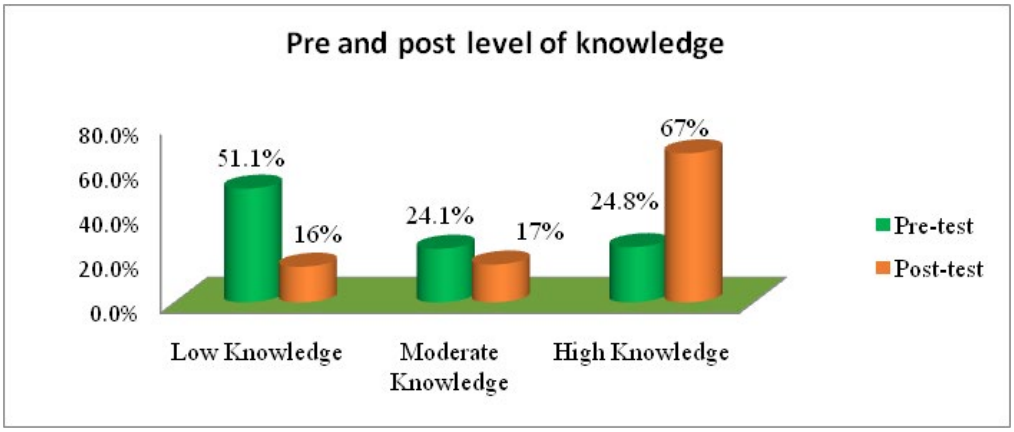

Figure 1: Overall pre and posttest knowledge on sickle cell disease among university students in Dodoma Region (*n*=697)

Mean score differences of knowledge on Sickle Cell disease in pre and post-test among university students in the Dodoma Region

A comparative analysis by paired t-test was performed to determine pre and post-test mean score differences of knowledge on Sickle Cell disease among university students. Findings in Table 3, revealed there was a statistical significant means score differences of overall knowledge about premarital Sickle Cell disease between pretest (M=0.009; SD 1.014) and posttest (M=0.365; SD 0.930) with mean score difference (MD=0.365; SD=1.384) [t (696) =6.965; p <0.01; 95% CI: 0.262, 0.468)].(Table 3)

Table 3:Mean score differences of knowledge on Sickle Cell disease in pre and post-test among university students in Dodoma Region (n=697)

Variable	Intervention		Mean diff. MD(SD)	95% CI		t-value	p-value
	Pretest M(SD)	Posttest M(SD)		Lower	Upper		
Overall Knowledge	0.009(1.014)	0.365(0.93)	0.365(0.07)	0.262	0.468	6.965	0.001

Simple linear regression on predictors of level of knowledge change towards Sickle Cell disease among university students in the Dodoma region

The level of knowledge changes as the dependent variable was analyzed and associated with other predictors. The findings indicate predictors did not significantly associate with knowledge change (p>0.05) (Table 4).

Table 4: Simple linear regression on predictors of level of knowledgechange towards Sickle Cell disease among university students(n=697)

Variable	B	95% CI		P-Value
		Lower	Upper	
Age group of participants				
Constant	0.321	0.098	0.545	0.005
19-24	0.056	-0.196	0.307	0.665
25-29	-0.056	-0.307	0.196	0.665
Sex of participants				
Constant	0.370	0.190	0.551	0.001
Male	-0.007	-0.227	0.212	0.948
Female	0.007	-0.212	0.227	0.948
Residence area of participants				
constant	0.393	0.213	0.573	0.001
Rural	-0.041	-0.260	0.179	0.716
Urban	0.041	-0.179	0.260	0.716

Zone of participants				
Constant	0.417	0.232	0.603	0.001
Central Zone	-0.087	-0.426	0.253	0.615
Coastal Zone	-0.110	-0.437	0.218	0.511
Northern Zone	-0.114	-0.423	0.195	0.469
Southern Highland Zone	0.203	-0.373	0.246	0.704
Western Zone	0.203	-0.373	0.779	0.489
Zanzibar	-0.064	-0.816	0.688	0.868
Media uses				
Constant	0.210	-0.900	1.320	0.001
Phone	0.157	-0.958	1.272	0.783
Magazine	-0.256	-0.658	0.147	0.213
Television	0.001	-0.995	0.280	0.995
Total number of media	-0.040	-0.300	0.220	0.764
Education of participant's Father				
Constant	0.371	0.265	0.477	0.001
Never gone to school	-0.112	--0.560	0.336	0.625
Primary education	0.037	-0.244	0.169	0.724
Secondary education	-0.014	-0.245	0.217	0.903
College education	0.112	-0.145	0.369	0.393
Occupation of participant's Father				
Constant	0.352	0.245	0.458	0.001
Not working	0.232	-0.205	0.670	0.298
Self-employed	-0.080	-0.313	0.154	0.498
Employed	0.018	-0.236	0.271	0.892
Occupation of participant's Mother				
Constant	0.385	0.276	0.493	0.001
Not working	-0.195	-0.540	0.149	0.266
Self-employed	0.103	-0.140	0.345	0.407
Employed	-0.009	-0.309	0.292	0.955
Type of participant's family				
Constant	0.464	0.248	0.680	0.001
Nuclear	-0.128	-0.374	0.118	0.308
Extended	0.128	-0.118	0.374	0.308
History of SCD in participant's family				
Constant	0.377	0.264	0.489	0.001
Yes	-0.072	-0.354	0.211	0.619
No	0.072	-0.211	0.354	0.619

Multiple linear Regression Results on the Level of Knowledge Change toward Sickle Cell Disease among University Students

Multiple linear regression analysis models of knowledge against predictors such as the use of media television and the history of SCD in participants 'familywas performed. The results indicated knowledge change was not significantly associated with other predictors ($p>0.05$). (Table 5)

Table 5: Multiple linear Regression Results on the Level of Knowledge Change on Sickle Cell Disease among University Students (n=697)

Knowledge Change				
Variable	**B**	**95% CI**		**P-Value**
		Lower	**Upper**	
(Constant)	0.187	-0.149	0.523	0.275
Zones of participants				
Coastal Zone	-0.003	-0.323	0.317	0.985
Northern Zone	0.096	-0.158	0.349	0.458
Southern Highland Zone	0.017	-0.280	0.314	0.909
Media uses by participants				
Television	0.007	-0.274	0.287	0.964
Education level of participants 'father				
College	-0.133	-0.479	0.213	0.450
Education level of participants 'mother				
College	0.440	0.033	0.846	0.034
Primary education	-0.059	-0.297	0.178	0.623
Occupational status of participants 'father				
Self employed	-0.183	-0.476	0.111	0.222
Occupational status of participants 'mother				
Self employed	0.321	0.016	0.626	0.039
Type of participant's family				
Extended	0.138	-0.111	0.387	0.277

4.7 Discussion of the Findings

Distribution of Social-Demographic characteristics of the study participants

The results of the current study concerning the participant's age, indicate that majority of them were early young adults and unmarried. This implies, that during this age majority are at the university level thus we can impart and promote the importance of improving health behaviour on knowledge on preventing genetic inheritance diseases like Sickle Cell. This result is similar to the study conducted by Mohamed *et al.* (2015) [27], who reported that the age of students ranged between 20 and 25 years. Moreover, the study was done at Tertiary Institution in Sokoto State, Nigeria by Ango et al. (2018), which reported the most prevalent age was 20 to 24 years [15].

Regarding sex, a larger proportion were males as compared to females, the proportional imitation with national statistics of high education enrollment, of which more male students enrol in high education as compared to girls (TCU, 2017). This is in agreement with the study by Ango et al. (2018) reported that 70.3% of participants were males [15]. Contrary to this finding, a study done at Lagos state University by Olatona&Odeyemi (2012), reported females to be more than half (59.1%) [19]. Although in most low and middle economical income countries males are more dominant in high educational levels as compared to females, still both have an equal chance to gain knowledge towards premarital Sickle Cell genotype screening.

In respect of media for communication, mobile phones were most frequently used followed by other sources such as magazines, radio, and television. This matches the study conducted by Ugwu, (2016), who reported radio, and television was (10.3%) used by students as a source for getting information. Similar findings in a cross-sectional study in Ghana by Boadu (2018) who reported media use was (12.6%) among students [10]. This indicates that media can be an effective way of educating the community, especially university students importance of screening for SCD before marriage. Moreover, special apparatus can be designed and uploaded to mobile phones which can be reminding the phone users of the importance of SCD screening. This could help the community as a whole to be informed and take appropriate action towards the prevention of Sickle Cell disease.

Overall Level of Knowledge on sickle cell disease among university students

The results of the current study showed a significant increase in post-test mean scores on the level of knowledge on Sickle Cell disease among university students. The result is related to the study in Saudi Arabia by Kotb et al. (2019) assessing the effect of a health education programme on the knowledge of and attitude about Sickle Cell disease among male secondary school students which reported, that the mean student knowledge score was 6.04 ± 3.02 on the pretest, which improved to 10.73 ± 3.47 on the posttest, with a statistically significant difference ($t = 15.2$, $p < 0.001$) [26].

Moreover, the current results correlate to those of the study by Ango et al. (2018b) reported the proportion of respondents with good knowledge at the pretest was 55(49.54%) which increase to 97 (87.38%) at the post-test after health education ($p < 0.05$). Although there were increases in knowledge level, as compared to previous studies the sample size was different. This implies that health education has positive effects on knowledge change regardless of the number of people.

For items analysis, the majority of participants at pretest were having low knowledge on most of the items of Sickle Cell diseasesuch as; the domain of SCD causes, at pretest, few of them responded correctly about, when both parents have SCD trait, the chance of each pregnant having a child with Sickle Cell disease is 25% after heath education more than three quarter responded properly. This result is correlating to findings of the study conducted by Bagudo (2019), assessing the level of knowledge on the cause and prevention of Sickle Cell disease among Primary Education Students in Nigeria, where at the pretest, only (22%) responded correctly to the causes of SCD, but at posttest (88%) responded correctly.

About, the screening domain, at the pretest more than half of the participants were incapable of items as SCD screening is a test done before marriage to rule out Sickle Cell disorder, and a negative Sickle Cell carrier test means Personal is very unlikely to have a disease but after intervention majority. The current finding is correlated with Kotb et al. (2019b) who reported at the pretest the screening domain was (23.2%), after health education intervention the scores raised to (86.7%). Likewise, in the management domain, in an item which required knowing if people with SCD need Medicine and people with SCD need a regular blood transfusion, participants less than half at the pretest responded correctly while at post-test more than three quarters were able to respond appropriately. This finding is similar to Bagudo (2019), who reported at the pretest only (33.3%) responded correctly to the management of Sickle Cell disease while at post-test (91.3%) responded correctly to the management of SCD.

Moreover, regarding Sickle Cell disease complications domain the items such; as people with sickle SCD are more likely to develop pain requiring hospitalization; people with sickle SCD are more likely to develop kidney failure and Stroke, and less than a quarter of participants were able to respond correctly, after intervention at posttest more than three quarters were able to answer properly. Nevertheless, in Tanzania, though the prevalence of Sickle Cell disease is higher, there is a low level of knowledge on SCD in the community [23]. This creates a need for developing a curriculum from primary education to the university level which introduces topics related to premarital genotype Sickle Cell screening and counselling equally to arts and science studies to control the disease in the country.

4.8.2 Mean score differences in pre and post-test level of knowledge on sickle cell disease among university students

The findings of this study indicated a significant difference between pre and post-test levels of knowledge towards premarital genotype sickle screening among university students. Improvement of the level of knowledge was the outcome of health education. This is in agreement with the results of the previous study carried out in Saudi Arabia which found that imparting health education could significantly raise the level of participants' knowledge concerning Sickle Cell disease [26]. Similar findings to the study by Ango et al. (2018) reported there were mean score differences between pretest and post-test.

Furthermore, the current results are following the study conducted among Students in Sokoto State which reported the mean scores were significantly improved regarding premarital genetic screening at pre-counselling and post counselling intervention [20]. This also matches a study conducted at Baghdad University by Salman and Abass (2019), who reported highly significant mean differences in pre and post-tests toward the impact of the programme through raising the knowledge grades of studied participants. The similarities to current and previous studies could be due to the same study design, study populations, and inclusion criteria for study participants. On another hand both current and previous studies insisted significance of health education in improving the level of knowledge towards premarital genotype Sickle Cell screening, the focus is to prevent the inheritance of disease traits to coming offspring.

The predictors associated with knowledge change towards Sickle Cell disease among university students

The results of the current study indicate that no predictors were associated with knowledge change. Change in knowledge was associated with Health education provided to participants. The findings are similar to a study in Saudi Arabia assessing the effect of a health education programme on the knowledge about sickle cell disease among male Secondary students by Kotb et al., (2019) who reported that health education programme significantly improved the overall level of students' knowledge of sickle cell anaemiaand premarital screening. The results are congruent with the study by Ango et al., (2018) which reported Health education intervention was effective in improving the knowledge of SCD and the practice of genotype Voluntary screening and Counseling among the participants. Moreover, similar findings were reported by Abioye-Kuteyi, Oyegbade, Bello, & Osakwe, (2018). Additionally, a study at El Minia University regarding premarital Screening and Counseling aimed to improve SCD knowledge among medical and non-medical students conducted by Abedel-Azim Mohamed, (2015) reported health education improved the knowledge of both groups respectively [27]. These findings imply that education could be effective on influence behaviour changes. Regularly, informing students about sickle cell disease and the importance of screening before marriage brings positive outcomes to the community regarding the disease and its preventive measures.

5.1 Conclusion

The current study has tested the efficacy of premarital genotype screening and counselling on knowledge of Sickle Cell disease among university students at baseline and re-assessed after applying education intervention to the same employed participants. The findings showed that there was a significant mean difference in knowledge between pre and post-test. Moreover, the results indicate scientific confirmation that predictors were not significantly associated with the change of knowledge, only health education on sickle cell disease was associated with knowledge change among participants.

5.3 Recommendations

- There is a need for the Ministry of Health, Community Development, Gender, Elderly and Children Tanzania to develop a policy which will motivate youth in the community to build an attitude toward performing Sickle Cell screening before marriage to minimize transmitting Sickle Cell genetic disorder to their offspring. Whereby those with Sickle Cell trait (Hb AS) should be encouraged to marry those who do not have sickle genotype (Hb AA).
- In all Universities in Tanzania, Premarital genotype Sickle Cell screening and counselling education should be continuous and essential to all first-year students by highlighting to them the risk of having a generation of Sickle Cell in our Nation.

5.4 Suggestions for Further Research

- The present study was based on college students, it could be another study to be conducted among adolescents from primary and secondary school because they have not so far started a relationship as compared to college students, which sometimes it makes difficult for them to break a relationship if found both of them have Sickle Cell Trait.
- The current study was uncontrolled quasi-experimental, the suggestion for the coming study could be with a control group to obtain the effectiveness of intervention between intervention and control groups.

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Informed consent: For their participation in the current study, all participants were requested for informed consent.

Conflicts of Interest: The authors declare no conflict of interest.

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