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Gender differences in the knowledge of genetic disabilities and attitudes towards genetic counselling and testing in Zambia.

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Abstract

In Zambia, there appears to be scarcity of information on genetic testing and counselling, and the services involved, to inform prospective parents of the need to make good decisions about having children. Literature shows that while there are many causes of disabilities, many other disabilities are carried through genetic transmission and if people were aware, they would reduce the chances of having a child with a disability that is genetically transmitted. This study was conducted to establish gender differences in the knowledge about and attitudes towards genetic testing and counselling among students in some tertiary education institutions in Zambia. The study adopted a survey design to collect data from respondents. One hundred and fifty seven (157) respondents from four tertiary institutions were recruited for the study by means of stratified and simple random sampling. Structured questionnaires were used to collect data. Data were analysed using the Statistical Package for Social Sciences – SPSS version 16. Chi-square tests were used to compare gender differences. Three main findings were noted in the present study. First, no significant gender differences were observed among students regarding the knowledge and attitudes towards genetic testing and counselling. Second, although most of the respondents (N=95; 60%) had a positive attitude towards genetic testing and counselling, the majority (N=145; 92%) never visited the hospital to seek this service. Thirdly, some respondents did not know that diabetes mellitus II, muscular dystrophy and albinism were genetic diseases. The study established that knowledge about and attitude towards genetic testing and counselling was adequate. However, more sensitization on the types of genetic diseases that caused disabilities and the significance of genetic testing and counselling to students and families needed to be intensified through the public health system.

Keywords: *Attitudes. Disability. Gender. Genetic counselling. Testing. Tertiary students.*

Introduction

Genetic testing and counselling is a profession that originated in the United States of America when it was observed that 5% of children were born with congenital disabilities (Harper, 2004). The need for genetic testing and counselling therefore became eminent to establish the genetic related causes

of disabilities. The profession has expanded to other regions such as Europe, the Middle East, Oceana, Africa, Asia and Central or South America. The terms genetic counselling and testing are concomitantly used although they do not mean the same. This is because testing for genetic composition requires pre and post counselling to allow the client being tested to understand and accept the results of genetic testing.

Genetic testing involves screening for genetic diseases or disorders that are transmitted through chromosomes and genes. Through genetic testing, the carrier status of a client is detected (Leach, 2010). Medical doctors carry such tests to identify genes that may transmit diseases and disorders to their unborn children. Genetic counselling on the other hand provides information about the significance of testing and prepares the person tested to accept the results of the tests. Since marriage has a strong association with procreation, one of the major reasons for marriage is to have children. As such genetic compatibility and avoiding genetic inheritance that causes grave effects on the family, needs to be considered (Oyedele, Emmanuel, Gaji, & Ahure-Do'om, 2015). Visiting genetic counsellors helps in making decisions about marriage and procreation. The role of genetic counsellors as service providers for patients across the lifespan, is to assess family and environmental history to determine risk diseases. They also assist in genetic testing, diagnosis, and disease prevention and management. Further, genetic counsellors offer psychosocial and ethical guidance to help clients make informed, autonomous health care and reproductive decisions (Ciarleglio, Bennett, Williamson, Mandell & Marks, 2003).

Genetic counselling and testing is quite significant in helping prospective couples in making decisions about the children they are likely to have. Premarital genotype screening presents an opportunity for individuals to become informed about their genetic predisposition to diseases and for couples to be aware of the possible genetic characteristics of their unborn children (Oyedele *et al.,* 2015). According to Hann, Freeman, Fraser, Waller, Sanderson, Rahman, Side, Gessler & Lanceley (2017), genetic testing can help patients of hereditary diseases to make important decisions about prevention or early detection. Genetic testing or premarital screening is quite common when couples want to get married (Oyedele et al, 2015).

In Zambia, 2% out of the more than 13.4 million people in the country are persons with disabilities (Central Statistical Office, 2012).Disabilities are caused by hereditary and environmental factors. The causes of disabilities in Zambia have been grouped into congenital, diseases, injury, spousal violence and other unknown causes (Central Statistical Office, 2012). There is no doubt that some of the causes of disability are more related to genetic transmission than environmental factors. According to Central Statistical Office, (2012), congenital causes of disability in Zambia account for 14.2%, only second to disease at 35.2%. It is clear that Zambia is not spared from congenital and inheritable diseases that bring about disability. Knowledge of genetic diseases that cause disabilities and the services that can help reduce the prevalence of disabilities is crucial to people that are planning to marry and have children. Preventing the prevalence of disabilities especially those caused by genetic similarities between couples would help reduce the prevalence of disabilities and the stress that comes with disability on a family. Although literature shows more emphasis by Zambian health care

systems on educating and testing for diseases such as HIV/AIDS, there appears to be no records of genetic testing for diseases that cause disabilities in Zambia. A knowledge gap also exists as to whether Zambians have knowledge about genetic testing and counselling or not and what their attitudes towards the practice are. In Zambia, if not in Africa as a whole, the cultural practice is that a man is the head of a house and commands most decisions. It is not known whether differences in gender has an impact on student's knowledge of genetic diseases that cause disabilities and attitudes towards genetic testing and counselling.

The major argument under discussion in this paper is that disabilities can be reduced if people had knowledge that some disabilities are genetically transmitted and can be stopped if people could have access to genetic testing and counselling services. A disability is defined as a loss of function or a restriction in function caused by disease, injury or accident (Muzata, 2019). Diseases cause disorders before, during or after birth of a child. However, this paper concentrates on diseases that are genetically transmitted. Depending on the impact of the genetic transmission of the genetic disease, a child can be impaired or disabled. Impairment is a loss of a body organ as a result of disease, injury or accident (Muzata, 2019). The severity of impairment determines whether one has a disability or not.

The aim of this study was therefore to determine gender differences in knowledge of genetic diseases that cause disabilities and to assess gender differences in attitudes towards genetic testing and counselling among students in higher learning institutions in Zambia. The study used the following hypotheses:

1. **H0**: There is no significant difference between male and female tertiary students' awareness about genetic counselling and testing; and the genetic causes of disability.

2. **H1**: There is a significant difference between male and female tertiary students' awareness about genetic counselling and testing; and the genetic causes of disability.

3. **H0**: There is no significant gender difference among tertiary students in terms of attitude towards genetic counselling and testing.

4. **H1**: There is a significant gender difference among tertiary students in terms of attitude towards genetic counselling and testing.

Literature review

Available literature shows that many disabilities are caused by gene transmission from parents to the unborn baby. For instance, sickle cell disease, cystic fibrosis and Tay-Sach's disease are inherited (Oyedele *et al.,* 2015). Other inherited diseases include asthma, and diabetes mellitus II. Albinism, a disorder of the skin known to be caused by gene mutation, is an inheritable disorder that often causes low vision in victims. Other disorders associated with genetic and chromosomal transmission are

Muscular Dystrophy, Fragile X Syndrome, Klinefelter syndrome, Down syndrome, Colour blindness, Cri du chat syndrome, Haemophilia, Huntington's disease and many others. Learning disabilities such as reading, writing and arithmetic, hyperactivity and emotional disorders have research evidence associating them to running in families. Heredity plays a role in the prevalence of disabilities. For instance, congenital defects in Bangladesh were about 2-4% with Down syndrome, a chromosomal abnormality at 71%, associating the causes to consanguineous marriages, inadequate antenatal check-ups, unskilled home deliveries and lack of home community services (Roy, & Shengelia, 2016).

Disabilities associated with genes and chromosomal transmission can be easily prevented if families screen for compatibility of genes before deciding to have children. Studies have shown gender differences in relation to genetic testing and counselling. For instance, some early studies on men and women in Finland showed that women have a more negative attitude towards genetic tests compared to men (Toiviainen, Jallinoja, Aro, & Hemminki, 2003). Equally, (Leach, 2010) identified potential differences between men and women's views about genetic testing. According to, (Leach, 2010) gender differences were not significant in many results on genetic diseases, results that provided an understanding of which areas of genetic testing respondents knew better and those they did not. Adeyemo, Omidiji and Shabi (2007) in a study of awareness of genetic counselling in Lagos found that most individuals had knowledge of genetic disease with 122 (86%) individuals showing knowledge of genetic disease and 43 (30.3%) individuals having been exposed to genetic counselling and 64% of those exposed to genetic counselling agreeing that genetic counselling helps prevent genetic diseases. These results appeared supportive of the practice and its significance, meaning respondents were positive about it.

A study by Boadu and Addoah (2018) on student awareness of sickle cell disease revealed that almost all students (98.6%) were aware of sickle cell disease with their source of information being the school (84.6%) and the media (12.6%). However, students generally had limited understanding and inadequate knowledge of sickle cell as an inherited disease. In a study of regional differences in awareness and attitudes towards genetic testing found that New York participants were more likely than other cities to seek genetic testing for disease (Jonassaint, Santos, Glover, Payne, Fasaye, Oji-Njideka, Hooker, Hernandez, Foster, Kittles & Royal, 2010). Attitudes to genetic testing and counselling can be influenced by many factors which include education, religious and cultural beliefs among others.

A study by Siani and Assraf (2015) of university students found that students studying life sciences had more knowledge about genetics than others although among the life science students', gender and religious affiliation did not significantly influence their knowledge of genetic diseases and attitudes towards genetic testing. In this study, a comparison was also made to see if there were differences between the different fields of study in their construction of genetic disease and attitude towards genetic testing. It has been postulated that students studying life sciences were more knowledgeable because life sciences expose students to scientific knowledge expanding their scope and having more positive attitude towards genetic testing (Siani & Assraf, 2015). Pivetti, Melotti, Marselli and

Olivieri (2013) reported that genetic literacy did not predict positive attitude towards prenatal genetic testing.

Methods and material

Research Approach and design

The study adopted a quantitative approach to collect data that would be generalizable to other populations. A survey design was used. Data on awareness about genetic diseases that cause disabilities and respondents' attitudes towards genetic testing and counselling were collected and compared against gender.

Sampling and sampling procedure

The study adopted stratified random sampling technique to collect data. Stratified random sampling involves dividing the population into homogeneous subgroups and then taking a simple random sample in each subgroup. This method is appropriate when the researcher is interested in issues related to gender, race or age disparities in the population (Kombo & Tromp, 2006). In this study therefore, students from three selected universities and one college of education; both public and private were involved in the study. Thus, the study captured 86 (54.8%) male and 71 (45.2%) female respondents in the age range of 20-40 years studying different programmes from diploma to post postgraduate levels. Respondents were students from the University of Zambia in Lusaka, Nkrumah University in Kabwe, Mufulira College of Education in Mufulira- Copperbelt province, and Chreso private university in Lusaka. Students were studying programmes such as Diploma in Education, Degree in Education, Masters in Education, Bachelor of Science Agriculture, and Bachelor of law, Bachelor of Science Public Health and Hospitality Industry. Respondents were randomly picked from 1st to 5th year of their study.

Description of instruments

Researcher made non-standardised structured questionnaires were used to collect data from respondents. Questions in questionnaires comprised demographic characteristics such as gender, institutions where respondents were studying and the programmes they were studying. A total of seven questions were asked to respondents. The following were some of the questions asked:

- Are you aware about genetic testing and counselling?
- Have you ever visited the hospital for genetic testing and counselling with partner?
- Are you planning to visit hospital for genetic counselling and testing before having first child?
- Which of the following is a genetic disease/condition? (Diseases such as HIV/AIDS, Sickle Cell Anaemia, Diabetes, and Muscular Dystrophy were listed).

The other question asked respondents to demonstrate awareness of genetic disease and knowledge of the causes of genetic disease. Three questions were given to respondents to say 'Yes' or 'No' to whether a genetic disease was caused by sexual transmission, genes or poverty.

The first set of questions in (3.3.1) above was asked to establish awareness of genetic diseases. The second and the third question was aimed at establishing respondents' attitude towards genetic counselling and testing while the fourth question was to establish knowledge of genetic disease.

Data analysis

Since the study adopted the quantitative approach, analysis was done using the Statistical Package for Social Sciences (SPSS- version 16). Chi-square test was specifically used to calculate to calculate gender differences regarding respondents' knowledge level of genetic diseases and their attitudes towards genetic testing and counselling. The level of significance was placed at 0.05.

Ethical considerations

The study did not involve experiments or any form of control and none control tests. It was a survey of their knowledge of the concepts involved in the study. However, respondents participated in the study willingly by signing consent forms. Their personal identities were neither reflected on the questionnaires nor in the report. Respondents were further guided not to answer questions they felt were inappropriate to their conscious.

Presentation of results and interpretation

In the first set of questions, respondents were asked to indicate whether they were aware of genetic counselling and testing and genetic disease. They were also asked whether they had ever visited the hospital for genetic disease testing and counselling or not. Further, they were asked whether they were intending to visit the hospital for genetic testing and counselling before having a child or not. Table 1 has results of the first set of questions. The observed and expected figures and the Chi-square computation to show differences in gender have been presented:

Table 1: *Awareness of genetic counselling, disease and visits for genetic testing and counselling*

Characteristic	Category	Yes	No	Chi-square Result
1. Awareness of genetic counselling and testing?	**Male**			
	Observed	56	30	(χ2 (1, N = 157) = 2.7, p = .099 >.05)
	Expected	50.9	35.1	
	Female			
	Observed	37	34	
	Expected	42.1	28.9	
2. Awareness of genetic disease?	**Male**			(χ2 (1, N = 157) = .17, p = .069 >.05)
	Observed	70	16	
	Expected	69	17	
	Female			
	Observed	56	15	
	Expected	57	14	
3. Whether visited the hospital with partner for genetic counselling and testing or not?	**Male**			(χ2 (1, N = 157) = .74, p = .389 >.05)
	Observed	8	78	
	Expected	6.6	79.4	
	Female			
	Observed	4	67	
	Expected	5.4	65.6	
4. Whether planning to visit hospital for genetic counselling and testing before having first child or not?	**Male**			(χ2 (1, N = 157) = .99, p = .319 >.05)
	Observed	49	37	
	Expected	52	34	
	Female			
	Observed	46	25	
	Expected	43	28	

Significant = 0.05 level

On the first question represented by characteristic 1 in table1, the results show that majority of male and female respondents that answered the questionnaire were aware of genetic counselling and testing. There were no significant differences in gender. The *p*-value was .099, above the level of significance (.05). Similarly, respondents of both gender in characteristic 2 in table 1 indicated that they were aware of genetic diseases. There were no significant differences in gender (p=.069 > .05).

When respondents were asked as to whether they had ever visited hospital for genetic testing and counselling, majority response was 'No' and there were no differences with regard to gender; (p=.389).

However, when respondents were asked whether they were intending to visit the hospital for genetic counselling and testing or not, majority males and females were positive about visiting the hospital. For instance, literal descriptive percentages showed that (N=49; 31%) males and (N=46; 29%) were positive about visiting the hospital for genetic counselling and testing. However, a considerable number of both males and females were equally not positive about visiting the hospital for genetic testing and counselling before deciding to have a child. Literal descriptive percentages showed that (N=37; 24%) males and (N=25; 16%) females were not positive about the idea. The computation however showed no significant gender differences in their responses; (p= .319).

To further establish respondents' knowledge of genetic diseases, we then selected and outlined some diseases and asked respondents to tick diseases which were genetic and those which were not. The table 2 shows the results of the observed and expected as well as the Chi-square result:

Table 2: *Knowledge of genetic diseases*

Characteristic		Category	Yes	No	Chi-square Result
Which of the following is a genetic disease?	HIV/AIDS	**Male**			(χ^2 (1, N = 157) = 1.59, p = .208 >.05)
		Observed	8	77	
		Expected	6.0	79.0	
		Female			
		Observed	3	68	
		Expected	5	66	
	Sickle cell anemia	**Male**			(χ^2 (1, N = 157) = .05, p = .817 >.05)
		Observed	69	17	
		Expected	69.6	16.4	
		Female			
		Observed	58	13	
		Expected	57.4	13.6	
	Diabetes	**Male**			

	mellitus II	*Observed*	17	69	
		Expected	19.2	66.8	(χ^2 (1, N = 157) = .70, p = .403 >.05)
		Female			
		Observed	18	53	
		Expected	15.8	55.2	
	Muscular dystrophy	**Male**			
		Observed	9	77	(χ^2 (1, N = 157) = . 53, p = . 468 >.05)
		Expected	10.5	75.5	
		Female			
		Observed	10	60	
		Expected	8.5	61.5	
	Albinism	**Male**			
		Observed	49	37	
		Expected	47.1	38.9	(χ^2 (1, N = 157) = . 37, p = . 542 >.05)
		Female			
		Observed	37	34	
		Expected	38.9	32.1	

Significant = 0.05 level

The results show that respondents demonstrated knowledge that HIV/AIDS is not a genetic disease. There were no significant gender differences in their responses with a *p*-value = .208. Respondents further demonstrated knowledge that Sickle Cell disease is genetic. Thus, both males and females agreed that Sickle Cell was genetic. There were no significant differences between males and females. The *p*-value was =. 817. However, respondents did not show knowledge that Diabetes Mellitus II was a genetic disease. There were no significant gender differences in their knowledge of this disease. Both males and females indicated Diabetes Mellitus not genetic. Further, majority of the respondents indicated that that Muscular Dystrophy was not a genetic disease. There were no significant gender differences with this variable, (*p*= .468).

On Albinism, the difference in understanding it as a genetic condition between males and females was 9.6%. Specifically, (N=49; 31 %) male and (N=37; 24%) female said albinism was a genetic condition while (N=37; 24%) males and (N=34; 22%) females said Albinism was not a genetic condition. There were no significant differences between male and female in their responses to the question on Albinism (p= .542 > .05). From the results, it appears a large percentage of respondents understood Albinism as a genetic condition, and equally a considerable number did not understand it as a genetic condition.

Another set of questions was asked to assess respondents' knowledge of the causes of genetic diseases. The items given were to seek respondents' understanding of whether genetic diseases were transmitted through genes, poverty or through sex. Table 3 shows the observed and expected results. The Chi-square result has also been presented.

Table 3: *Knowledge of causes of genetic diseases*

Characteristic	Category	Yes	No	Chi-square Result
Genetic disease is caused through genes	**Male**			(χ2 (1, N = 157) = .82, p = .365 >.05)
	Observed	81	5	
	Expected	82.2	3.8	
	Female			
	Observed	69	2	
	Expected	67.8	3.2	
Genetic diseases are caused by poverty	**Male**			(χ2 (1, N = 157) = .02, p = .891 >.05)
	Observed	1	85	
	Expected	1.1	84.9	
	Female			
	Observed	1	70	
	Expected	0.9	70.1	
A Genetic disease is sexually transmitted	**Male**			(χ2 (1, N = 157) = 2.15, p = .143 >.05)
	Observed	9	77	
	Expected	6.6	79.4	
	Female			
	Observed	3	68	
	Expected	5.4	65.6	

Significant = 0.05 level

The results show that regardless of gender, respondents showed knowledge of genetic diseases. When respondents were asked whether genetic diseases were passed through genes, majority males and females agreed. There were no differences in gender. The *p*=value was .365 > .05. On whether genetic disease was caused by poverty, no significant differences were also noted in the respondents' responses (*p*-value=.891 > .05). The respondents could not agree that genetic diseases were caused by poverty. Similarly, there were no significant differences in the respondents' responses to the question of whether a genetic disease was a sexually transmitted disease or not. Both males and females understand that genetic diseases are not sexually transmitted (*p* = .143 > .05).

Discussion of the results

Genetic counselling and testing awareness is a very significant service to couples. They need to know why it is important to go for genetic counselling and testing. It helps them in making decisions about their wishes of having healthy children. The results of this study showed that majority males and female respondents were aware about genetic counselling and testing. Few males and females were not aware.

There were no significant differences established between males and females in terms of awareness about genetic testing and counselling, (p = .099 > .05). Although, Oyedele, Emmanuel, Gaji, and Ahure-Do'om, (2015) did not compare males and females in their study, the results of this study appear similar with theirs in terms of overall percentages of awareness about genetic testing and counselling. In this study, the overall percentage of awareness was (N=126; 80.3%) above Oyedele, Emmanuel, Gaji, and Ahure-Do'om, (2015) who discovered that 93 (62%) of the respondents in Nigeria were aware of genetic disease while (N=57; 38%) were not aware. The differences in the studies could be in the characteristics of respondents that were involved in the study. This study used students from three universities and one college of education, while the Nigerian study compared sampled youths only without providing their education background. Level of awareness about genetic counselling and testing maybe depend on factors such as level of education, ignorance, religion and culture. Although this study did not delve into the influencing factors of awareness, available literature shows some level of relationship in factors such as education level, culture, gender, and religion. For instance, Haga, Barry, Mills, Ginsburg, Svetkey, Sullivan and Willard (2013) postulated that cultural differences may account for disparities in knowledge as well as differing perceptions of the role of genes in disease, and national differences between the U.S. and Europe in science education curricula, and health systems. A study by Siani and Assraf (2015) found that university students' knowledge of genetic disease and attitudes towards genetic testing and counselling did not show gender and religious differences.

Further, this study established that students had knowledge about some diseases that were genetically transmitted. For instance, students had knowledge that sickle cell was a genetic disease. There were no gender differences observed. This is contrary to the study by Boadu & Addoah (2018) who revealed that even though students were aware about sickle cell disease, they had limited understanding that the disease was inherited. Students also demonstrated knowledge that Albinism was genetic. No significant gender differences were observed (p-value=.542). However, even though no significant gender differences were observed, it appears there was a considerable number of respondents, both male and female that equally indicated that Albinism was not an inherited condition. For instance, literal descriptive statistical calculations showed that (N=49; 31%) males and (N=37; 24%) understood Albinism as an inherited condition while (N= 37; 24%) males and (N=34; 22%) females said Albinism was not an inherited condition. With the many myths about albinism which are usually negative in nature (Muzata, 2019; Durojaye & Nabane, 2019), the results of this study still show that even though many students at university and college level had a better understanding of the biological nature and causes of the condition, a need to educate an equally large number about the condition is eminent. It's possible that those who believe Albinism is not inherited hold to myths and beliefs that Albinism is a superstitious condition. It should be understood that Albinism is non-contagious and is inherited through genetic transmission between two heterogeneous couples with dominant genes lacking the pigmentation (melanin) responsible skin colour formation (Durojaye & Nabane, 2019). Such knowledge can be used to change people's negative perceptions towards albinism in the communities in which they live. If young people are used to influence positive attitude change, the results are likely to be appealing. Persons with albinism particularly and other disabilities face discrimination and violence due to various reasons which include ignorance, myths and beliefs. While it is against human rights to discriminate someone on the basis of the disability they have, University students can help influence change in their communities especially that they have the knowledge of the causes of genetically transmitted diseases. University students can also help to influence

change in attitudes and help guide couples to seek genetic testing and counselling before they get married or decide to have a child.

However, students did not demonstrate knowledge that Diabetes Mellitus and Muscular Dystrophy were genetic diseases as well. Their lack of understanding that Diabetes Mellitus and Muscular Dystrophy are genetic diseases shows that students need more information to understand the various genetically related diseases so that they can be well informed about their decisions about child bearing. Aartsma-Rus, Ginjaar and Bushby (2016) explain that Muscular dystrophy, which manifests in two forms namely; Duchenne muscular dystrophy (DMD) and Becker muscular dystrophy are caused by mutations in the dystrophin-encoding DMD gene. The condition is a degenerative genetic muscle disorder which presents itself in muscle weaknesses causing other comorbidities and reducing daily strength to do routine tasks (Cardamone, Darras, & Ryan, 2008). Aartsma-Rus, Ginjaar and Bushby (2016) advise prospective parents to take correct diagnosis because it is important for family planning and providing proper care to patients. For Diabetes Mellitus II, the causes have been under debate for some time now, some alluding to environmentally and bad health styles. However, although there are other factors said to cause Diabetes Mellitus type 2, there is strong evidence that heredity plays a role (Olokoba, Obateru & Olokoba, 2012; Ali, 2013). While evidence of hereditability is there (Ali, 2013), it is important that families or prospective couples take note of the history of each other to be able to know the risks of the disease on the child they would want to have.

This study generally revealed that respondents understood diseases and conditions that were genetically transmitted. There were no significant differences with regard to gender. The knowledge of diseases that can be genetically transmitted is cardinal in making decisions to go for counselling and testing before couples decide to marry and have children. The results are informative of the need to educate students on the types of genetic diseases. Knowledge of the diseases and their impact may help them make decisions to take genetic testing and counselling seriously. According to Calsbeek, Morren, Bensing and Ripken (2007), adequate knowledge and personal attitude are major determinants of optimal utilization of genetic testing and counselling. Providing adequate knowledge to consumers on genetic diseases would also help to change their attitudes towards testing and counselling.

Another positive score in this study is that university students also demonstrated adequate knowledge of the causes of genetic diseases. There were no gender differences in their understanding. Contrary to a study by Siani and Assraf (2015) which found that university students studying life sciences had more knowledge about genetics than others, this study which drew students from both life sciences and education did not find such a difference. The results were however similar to many other studies demonstrating that students are generally aware of genetic diseases and testing though they may not have access to the services of testing. For instance Boadu and Addoah (2018) established that students were aware (98.6%) about sickle cell anaemia as a genetic disease with their source of information being the school (84.6%) and the media (12.6%).

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