International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 5, Issue 1, pp: (30-39), Month: April - September 2017, Available at: www.researchpublish.com

Awareness of Jazan University Students about Consanguineous Marriages and Inherited Disorders

[1]Bushra Al-Qadi, [2]Alaa Abu Taleb, [3]Sarah Salih, [4]Fatimah Alzaher, [5]Amnah Elaqi, [6]Raofah Hakami, [7]Sara Halawi, [8]Ebtesam Osaili, [9]Aisha Ogdi

Kingdom of Saudi Arabia, Ministry of Higher Education, Jazan University, Faculty of Medicine Research Methodology Module

Abstract: **Consanguineous marriage is a marriage between two individual close to each other genetically, which increase the probability of offspring to get recessive traits or any inherited diseases.**

Due to increased prevalence of inbreeding in Jazan we decided to work on this study to assess awareness of the community about this issue and it's consequences and figure out the rate of consanguinity among jazan university students.

The study can help to raise the awareness in the community about the seriousness of the relative marriages and its relation to different genetic diseases.

Study method and design: By using a cross-sectional study, the study sample selected by Randomization from both sex in Jazan community at the age (18-30) in different Jazan university colleges. We interviewed them by using a specially designed questionnaire. The data were analyzed by SPSS program.

Study results: The result of awareness were (42.25%) among students and the consanguinity was (66.7%) especially with the first degree that shows (49%) comparing with the other degrees the results indicate low awareness about this issue and high consanguinity.

The results of presents of diseases in students and their families show different numbers between different diseases, 47 (11.7%) of the students answered that they have inherited diseases, 118 (29.3%) of the students answered that their brothers or sisters have inherited diseases and 243 (60.3%) of the students answered that their relatives have inherited diseases.

Conclusion: The aim of this research to study the awareness about consanguineous marriages and it's inherited disorders and the prevalence of consanguinity among the students and their parents.

The result shows that the awareness of students was low comparing with the standard values which is below the 50 %

The prevalence of consanguinity among students was high especially with the first degree.

The presents of diseases in students and their families show different numbers between different diseases, the highest rate was sickle cell anemia was found in the students, brothers and sisters and their relatives. The lowest disease was cleft palate was found in the students and relatives and does not found in their brothers and sisters.

Recommendation: Premarital test is very important to avoid the inherited disorders specially the autosomal recessive, so the community need more data and awareness programs about the importance of this test.

Due to the low rate of the awareness among students about inherited disorders of consanguineous marriages, especially non-blood diseases, we suggest to do awareness campaigns to mention the most non-blood inherited disorders to increase their awareness.

Keywords: **Consanguineous marriage, inherited disorders.**

1. INTRODUCTION

Consanguineous marriage is traditionally most common throughout the Arab countries. This leads to an increased birth prevalence of infants with, congenital malformations, recessive disorders, such as, sickle cell anemia morbidity and mortality. (1)

Consanguineous marriages have a broad and a huge frame about genetic disorders, especially autosomal recessive, which have a big chance for transmitting to the offspring.

However, the awareness of the community about this issue is too important in order to diminish this phenomenon. The aim of this study to assess the community awareness about consanguineous marriages and it's inherited disorders and figure out the rate of consanguinity among the student .

As we know consanguinity is more common in Middle Eastern countries as a result of their beliefs and attitudes or even norms and customs that sometimes in some families force their descendants to get married from their own families and ignoring certain medical problems that may affect the next generation Middle Eastern countries as a result of their beliefs and attitudes or even norms and customs that sometimes in some families force their descendants to get married from their own families and ignoring certain medical problems that may affect the next generation.

The research Objectives:

General:-

To study the awareness and the prevalence of consanguineous marriages and the inherited disorders among Jazan university students.

Specific:-

1- To assess the awareness of Jazan university students about consanguineous marriages and its consequences.

2- To determine the rate of consanguinity among Jazan university students and their parents.

3- To study the prevalence of inherited disorder among Jazan university students.

2. LITERATURE REVIEW

What is consanguineous marriage?!

Consanguineous marriage is the union of individuals having a common ancestor. It is categorized as 1^{st}, 2^{nd} and 3^{rd} degree. The 1^{st} being the closest kinship. (2)

Consanguineous marriages are most common in many Middle Eastern countries with first cousin types.

On 2004-2005 a cross-sectional study has been studied in different regions of Saudi Arabia by a questionnaire giving to mother, father or both while visiting the household, 11554 from 11874 mothers answered the questions and 6470 of 11554 were consanguinity .

It's reported that the highest rate shows in congenital malformations , sickle cell anemia the highest example for autosomal recessive disorders , in single gene defect was glucose 6 phosphate deficiency has high rate , and down syndrome was the commonest chromosomal disorder in 30 families , finally the commonest type in genetic disorders among the first cousin type of consanguinity was chronic heart disease by 68% Also reported that Sickle cell anemia is mainly found in two regions of Saudi Arabia in Eastern and Southwestern but the carriers of this gene are found in all regions, so in case of consanguineous marriages theoretically their offspring will be susceptible to having SCD in higher risk. However Glucose-6-phosphate deficiency is also found in the same places, but the consanguineous marriages is not the factor of having the disease or not because it's restricted to ethnic groups. (3)

Another cross-sectional study on 11554 families at different regions during the period 2004-2005 reported the prevalence of consanguinity was 56%, (33.6 %) of them with first-degree cousin and being more common than the other relations (22.4%)

The overall prevalence was meaningfully more common in rural (59.5%) than in urban (54.7%) There are regions with high prevalence of 67.2% such as Al-Madina, and regions with lower prevalence of 42.1% such as Al-Baha. (4)

The highest rate of consanguinity was 86.6% in Samtah and the lowest rate was around 34.3% in Abha, these results derived from a cross sectional study occurred in 1995, collected from 3212 families from different areas in Saudi Arabia, 1852 of them were found to be consanguineous and rate of consanguinity was 57.7%. (5)

Consanguinity related to many problems as fertility, morbidity, mortality, increase risk of appearing autosomal recessive disorder, bleeding disorders and congenital heart disease.

A study in AL-Madinah city patient with permanent neonatal diabetes mellitus diagnosis between the periods 2001_2010, the PNDM autosomal recessive disease has multiple genetic causes and has higher relation to consanguineous marriage. (6)

Another case control study on 1989 – 2014 at King Khalid University Hospital in Riyadh, during this period the patients were diagnosed with congenital adrenal hyperplasia (80%) its cause (21- □ -hydroxylase deficiency) the results were that the congenital adrenal hyperplasia autosomal recessive has major correlation with consanguineous marriage. (7)

A Cross-section study during December 2012.The target population include 717 males. The study was about color visual defect, its X-linked disorder, it happens when there is a problem with the color in the cones of the retina .when there is missing in one pigment will cause problems between red green color.

The prevalence rates in the Arab population color visual defect are very limiting. In the Kingdom of Saudi Arabia very rare, but in Jazan there is the high prevalence rate of color visual defect because the high prevalence of consanguinity.

The results were in the first degree relative 30.4%, second degree relative 2%,far relative 19.7% .the first degree cousins were 35.8% ,second degree cousins or far 21.4 %, and the student not relative were 12.2 %. Because of the high results of prevalence of color visual defects in Jazan we need to aware the people decrease this problem. (8)

A studies in other countries:-

In United Arab Emirates:

A study was examined the frequency of consanguineous marriages between Dubai and Alain on October 1994 and March 1995 on a 2033 sample of married females to study the match between each female and her spouse, it's reported that the rate of consanguineous marriages was high (50.5 %) and the first cousins were the commonest type of consanguineous marriages by (26.2%).

The level of consanguinity was higher in Alain (54.2%) than in Dubai (40%).

Also the rate of consanguinity in the UAE was increased from 39% to 50% in one generation. (9)

In Palestine:-

A study in 11 February 1997 shows that the rate of consanguineous marriages is very high in Palestinian.

It's reported that 44.3% of marriages are between first cousins.

The consanguinity rate among the parents of patients with rare autosomal recessive disorders was much higher than the general population (92.5%) among parents of neural tube defect and cleft palate patients have the highest rate of consanguinity. (10)

In Morocco:-

A study in 2009 was applied in the department of Medical Genetics in Rebat on 176 families with autosomal recessive disorder of offspring and their consanguineous marriages were (59.09%) of all marriages. The result of this study shows that the autosomal recessive disorders have strongly associated with consanguinity. (1)

In Bahrain:-

A study in Bahrain determined the prevalence of genetic blood disorders in 5685 students and they found 1.2% sickle-cell anemia, 0.09% thalassemia and 23.2% G6PD deficiency. (11)

In Qatar

A study group reported that in the population with high rate consanguinity related to common diseases such as heart diseases, blood disease, hypertension, hearing and gastrointestinal diseases.

The prevalence rate compare higher with a rate of 51.0% first cousin marriages 26.7% of all marriages.

The rate of consanguinity was 51%, the common type of consanguineous marriage was first cousin marriage 26.7%, they significant difference in the prevalence between the offspring of consanguineous to the non-consanguineous for cancer cases. And all reported diseases were more frequent in offspring of consanguineous marriage. (12)

To study the prevalence of the awareness of community about the consanguineous marriages and its effect among the future offspring, a study done in 1991 in Saudi Arabia in Riyadh among 36 families.

They found that the parents had difficulty accepting the genetic explanation for these diseases and they explain it by religious beliefs. (13)

3. RESEARCH METHOD

Study design:

Cross sectional study.

Setting:

The study carried out in Jazan university colleges.

Subject:

A total 403 Saudi women and men selected by systemic random sampling from each college.

Tools of the study:

-Achieved by special designed questionnaire passes to both sex.

-The questioner was passed to 8 different colleges randomly which are medical and non- medical. 50 questioner for each college male and female, the collages are faculty of medicine, faculty of science, faculty of business administration and faculty of computer sciences, architecture and design.

-The data were analyzed by SPSS program.

4. RESULTS

-The total questioners are 480

-The response rate are 403/480= 84%

The questioners passed to different colleges of Jazan University to achieve the data from students and this were the result that obtained:-

		Age of students			
Sex of students		18-21	22-25	26-30	Total
	Male	48% (97)	50.5% (102)	1.5% (3)	100% (202)
	Female	52.2% (105)	45.3% (91)	2.5% (5)	100% (201)
	Total	50.1% (202)	47.9% (193)	2% (8)	100% (403)

Study level of students		
First-fourth	Fifth-eighth	Ninth-twelfth
29% (117)	70.7% (285)	0.2% (1)

Residence of students		
City	Village	Prefecture
46.7% (188)	12.2% (49)	41.2% (166)

The Attitude of students about consanguineous marriages was 43% of both male and female agree the consanguineous marriages and 56% of them disagree the consanguineous marriages.

Agree and disagree of consanguineous marriages

	Frequency	Percent	Valid Percent	Cumulative Percent
agree	174	43.2	43.2	43.2
disagree	229	56.8	56.8	100.0
Total	403	100.0	100.0	

And their Attitude about the advantages and disadvantages in this marriage were:-

Believe that the advantage more than disadvantage

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	124	30.8	30.8	30.8
No	279	69.2	69.2	100.0
Total	403	100.0	100.0	

30% of the participate believe that the advantage of consanguineous marriages more than disadvantage, and 69% of them were disagree which present the most category.

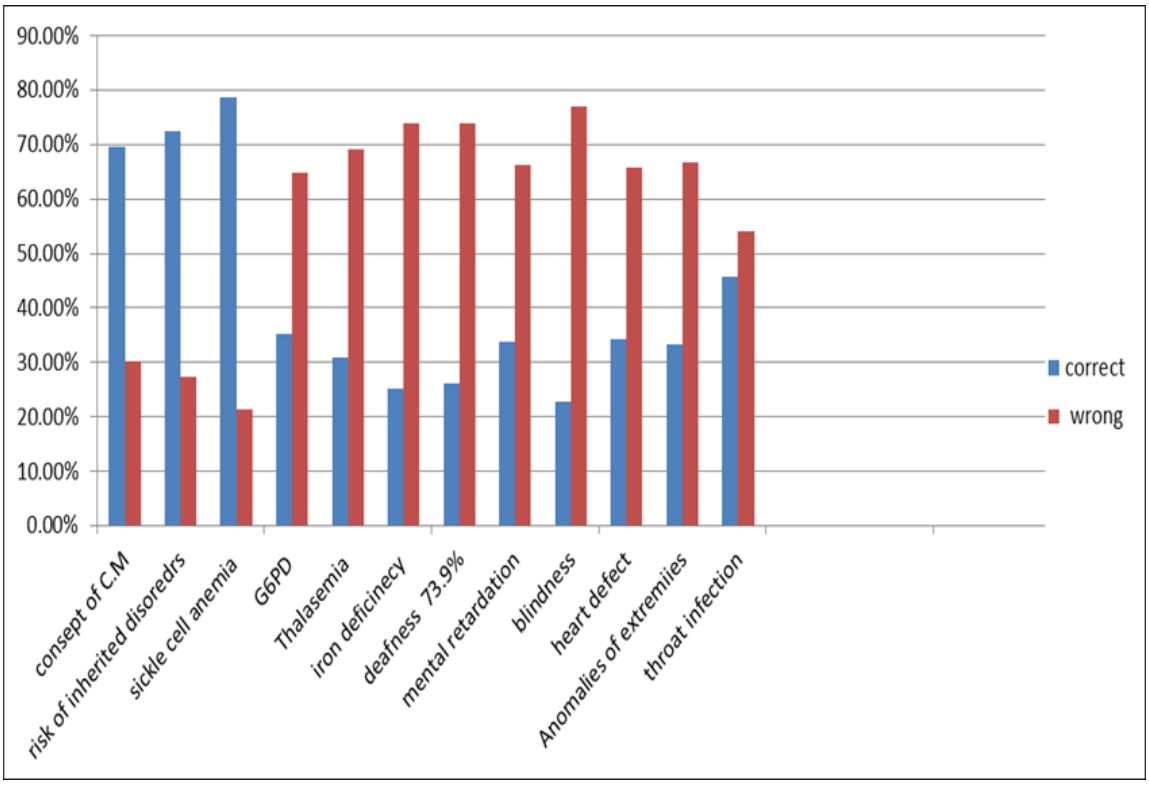
The table below indicate to the awareness of participate about the inherited disorders in consanguineous marriages :-

The concept	Correct answer		Wrong answer		Total	P-value
	frequency	Percent %	frequency	Percent %		
Concept of consanguineous marriages	281	69.7%	122	30.3%	403	0.0001
consanguineous marriage increase the risk of inherited disorders	292	72.5%	110	27.3%	403	0.0001
Is it inherited or not (Sickle cell anemia)	317	78.7%	86	21.3%	403	0.0001
Is it inherited or not (Glucose 6 phosphate deficiency)	142	35.2%	261	64.8%	403	0.0001
Is it inherited or not (thalassemia)	125	31%	278	69%	403	0.0001
is it inherited or not (iron deficinecy anemia)	101	25.1%	302	74.9%	403	0.0001
Is it inherited or not (Deafness)	105	26.1%	298	73.9%	403	0.0001
Is it inherited or not (mental retardation)	136	33.7%	267	66.3%	403	0.0001
Is it inherited or not (blindness)	92	22.8%	310	76.9%	403	0.0001
Is it inherited or not (heart defect)	138	34.2%	265	65.8%	403	0.0001
Is inherited or not (Anomalies of extremities)	134	33.3%	269	66.7%	403	0.0001
Is it inherited or not (throat infection)	184	45.7%	218	54.1%	403	0.0172
		Total of correct answers		Total of wrong answers		
		507/12 = 42.25%		691.3\12= 57.6%		

The total awareness of the participate was 42.25% which indicate low awareness about the relation between inherited disorders and consanguineous marriages according to the standard value.

Standard Value	
50% or below	Low awareness
51%-75%	Moderate awareness
More than 75%	High awareness

The chart below show present of the data



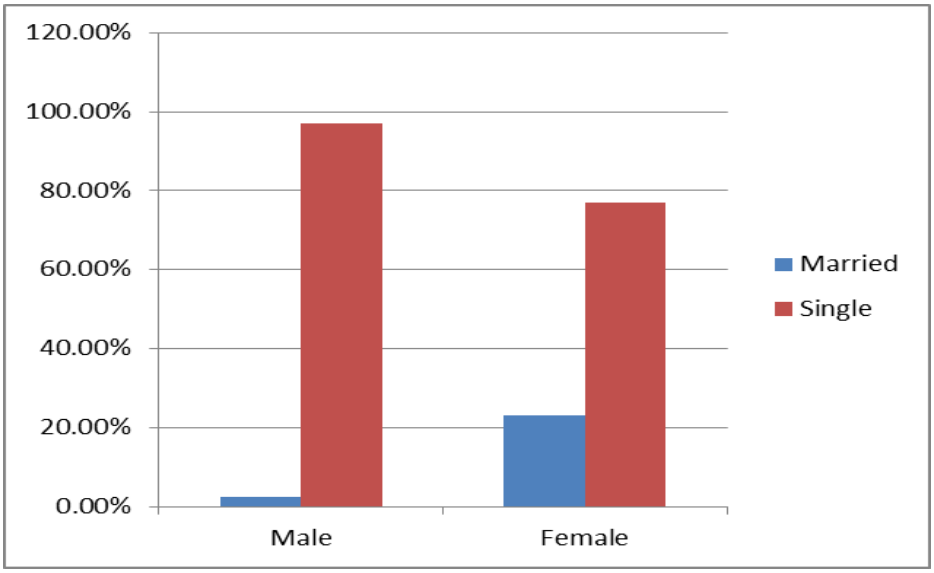
The highest awareness was in sickle cell anemia which is 78.7%. While the lowest awareness was in non-blood disorders which shows 22.8%

The table below indicate the prevalence of marriage between the students :-

Sex of students * marital status Crosstabulation

			marital status		Total
			married	single	
sex of students	Male	Count	5	198	203
		% within sex of students	2.5%	97.5%	100.0%
	female	Count	46	154	200
		% within sex of students	23.0%	77.0%	100.0%
Total		Count	51	352	403
		% within sex of students	12.7%	87.3%	100.0%

The Female students have the high prevalence of marriage which is 23% and the total prevalence of married in students is 12.7%



The table below shows the consanguinity among students and their parents:-

	consanguinity	No consanguinity	Don't know	Total
students	66.7% (34)	33.3% (17)	-	100% (51)
parents	44.4% (179)	50.6% (204)	5% (20)	100% (403)

The consanguinity of the married students is **66%** that present high ratio comparing with non- consanguinity **33.3%**.

Consanguinity between parents **44.4%,** and non-consanguineous **50.6%.**

The degree of consanguinity between parents of students and the married students

	The consanguinity degree of husband and wife					
	no consanguinity	first degree	second degree	farther degree	Don't know	Total
Married students	33.3% (17)	49% (25)	15.7% (8)	2% (1)	-	100% (51)
parents	50.6% (204)	26.1% (105)	7.4% (30)	9.4% (38)	1.5% (6)	100% (383)

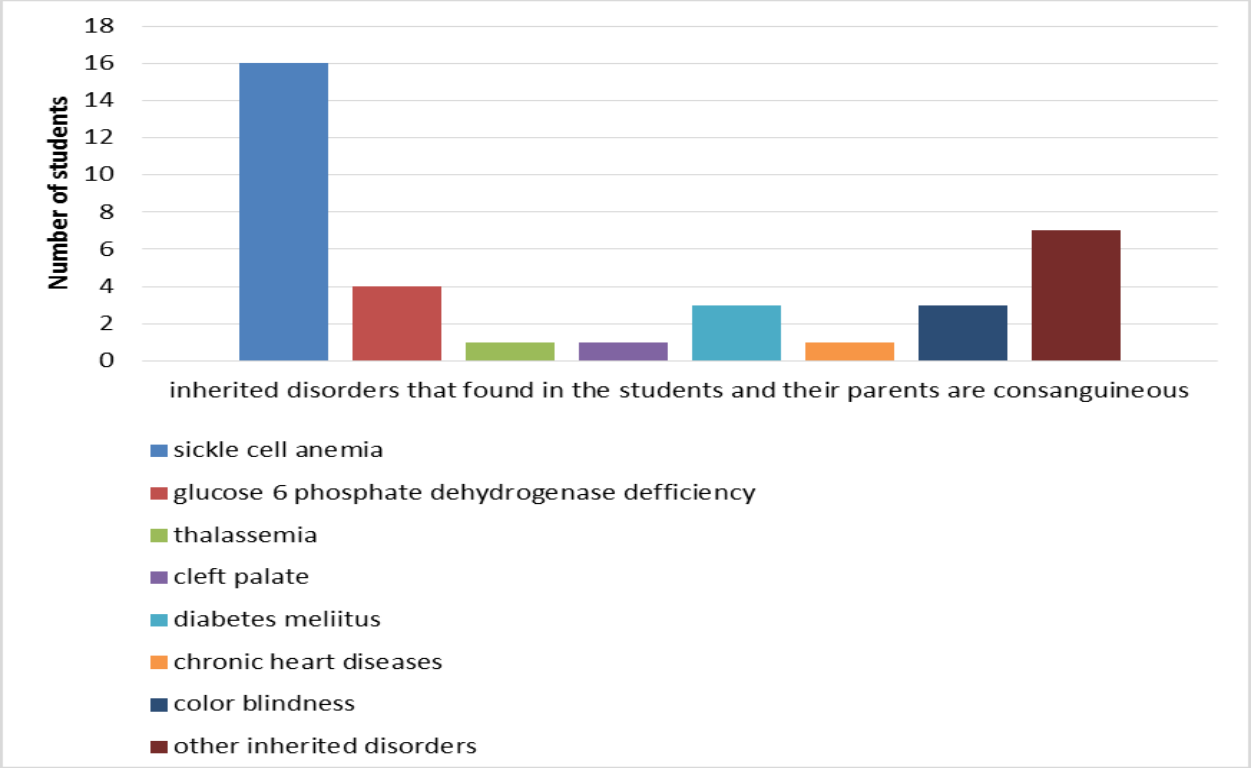
The highest rate of consanguinity in students was in the first degree 49%, and in parents also the first degree 26.1%.

The two tables below show the relation between presents of inherited disorders in students and consanguinity of their parents:

		The consanguinity of father and mother							
		Yes		No		I don't know		Total	
		Count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	Count	% within The consanguinity of father and mother
Do you have sickle cell anemia	Yes	16	8.9%	9	4.4%	3	15%	28	6.9%
	No	163	91.1%	195	95.6%	17	85%	375	93.1%
	Total	179	100%	204	100%	20	100%	403	100%
Do you have glucose 6 phosphate deficiency	Yes	4	2.2%	0	0%	0	0%	4	1%
	No	175	97.8%	203	100%	20	100%	398	99%
	Total	178	100%	203	100%	20	100%	402	100%
Do you have thalassemia	Yes	1	0.6%	0	0%	0	0%	1	0.2%
	No	178	99.4%	204	100%	20	100%	399	99%
	Total	179	100%	204	100%	20	100%	403	100%
Do you have cleft palate	Yes	1	0.6%	0	0%	0	0%	1	0.2%
	No	178	99.4%	204	100%	20	100%	402	99.8%
	Total	179	100%	204	100%	20	100%	403	100%

		The consanguinity of father and mother							
		Yes		No		I don't know		Total	
		Count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	Count	% within The consanguinity of father and mother
Do you have Diabetes mellitus	Yes	3	1.7%	2	1%	0	0%	5	1.2%
	No	176	98.3%	202	99%	20	100%	398	98.8%
	Total	179	100%	204	100%	20	100%	403	100%
Do you have chronic heart disease	Yes	1	0.6%	0	0%	0	0%	1	0.2%
	No	178	99.4%	204	100%	20	100%	402	99.8%
	Total	179	100%	204	100%	20	100%	403	100%
Do you have color blindness	Yes	3	1.7%	3	1.5%	2	10%	8	2%
	No	176	98.3%	201	98.5%	18	90%	395	98%
	Total	179	100%	204	100%	20	100%	403	100%
Do you have other inherited disorders	Yes	7	3.9%	4	2%	1	5%	12	3%
	No	172	96.1%	200	98%	19	95%	319	97%
	Total	179	100%	204	100%	20	100%	403	100%

This chart show number of students who have inherited disorders and their parents are consanguineous



The **highest rate** of diseases present in the students was **sickle cell anemia (8.9%)** and their parents are consanguineous and **(4.4%)** of students their parents are non- consanguineous which indicate to 50% difference.

The P .value is significant (P=0.0104).

The **second highest** of diseases present in the students was **other inherited diseases (3.9%)** and their parents are consanguineous and **(2%)** of students their parents are non- consanguineous (P=0.1112).

Then **G6PD deficiency (2.2%)** and their parents are consanguineous and **(0%)** of students their parents are non-consanguineous

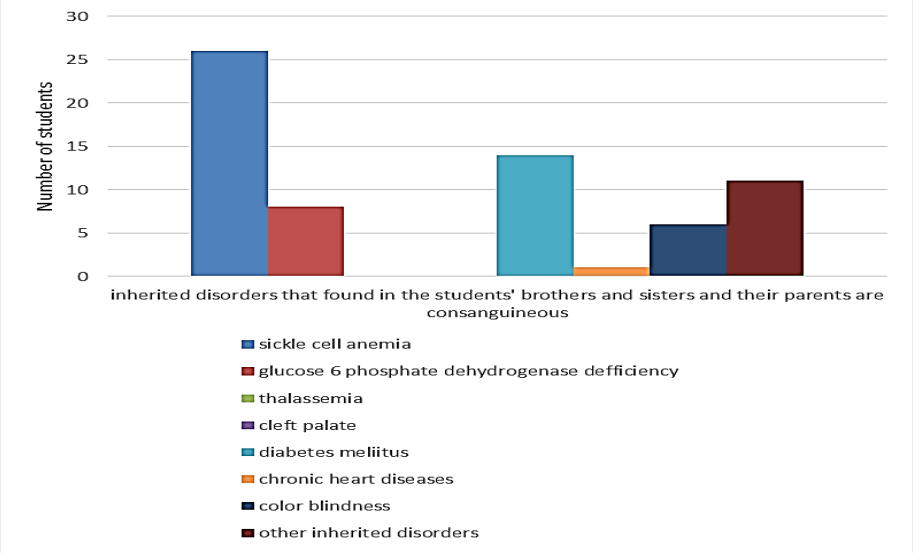
The P. value highly significant (P=0.0028).

The two tables below show the relation between presents of inherited disorders in students' brothers and sisters and consanguinity of their parents:

		The consanguinity of father and mother							
		Yes		No		I don't know		Total	
		Count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	count	% within The consanguinity of father and mother	Count	% within The consanguinity of father and mother
Brothers and sisters have sickle cell anemia	Yes	26	14.5%	30	14.7%	6	30%	62	15.4%
	No	153	85.5%	174	85.3%	14	70%	341	84.6%
	Total	179	100%	204	100%	20	100%	403	100%
Brothers and sisters have glucose 6 phosphate deficiency	Yes	8	4.5%	5	2.5%	1	5%	14	3.5%
	No	171	95.5%	199	97.5%	19	95%	389	96.5%
	Total	179	100%	204	100%	20	100%	403	100%
Brothers and sisters have thalassemia	Yes	0	0%	0	0%	1	5%	1	0.2%
	No	179	100%	204	100%	19	95%	403	99.8%
	Total	179	100%	204	100%	20	%100	403	100%
Brothers and sisters have cleft palate	Yes	0	0%	0	0%	0	0%	0	0%
	No	179	100%	204	100%	20	100%	403	100%
	Total	179	100%	204	100%	20	100%	403	100%

		The consanguinity of father and mother							
		Yes		**No**		**I don't know**		**Total**	
		Count	**% within the consanguinity of father and mother**	**Count**	**% within the consanguinity of father and mother**	**Count**	**% within the consanguinity of father and mother**	**Count**	**% Within the consanguinity of father and mother**
Brothers and sisters have Diabetes mellitus	Yes	14	7.8%	21	10.3%	4	20%	39	9.7%
	No	165	92.2%	183	89.7%	16	80%	364	90.3%
	Total	179	100%	204	100%	20	100%	403	100%
Brothers and sisters have chronic heart disease	Yes	1	0.6%	3	1.5	0	0%	4	1%
	No	178	99.4	201	98.5%	20	100%	399	99%
	Total	179	100%	204	100%	20	100%	403	100%
Brothers and sisters have color blindness	Yes	6	3.4%	3	1.5%	1	5%	10	2.5%
	No	173	96.6%	201	98.%	19	95%	393	97.5%
	Total	179	100%	204	100%	20	100%	403	100%
Brothers and sisters have other inherited disorders	Yes	8	4.5%	3	1.5%	0	0%	11	2.7%
	No	171	95.5%	201	98.5%	20	100%	392	97.3%
	Total	179	100%	204	100%	20	100%	403	100%

This chart show number of students' brothers and sisters who have inherited disorders and their parents are consanguineous



The disorders in the brother and sisters are **sickle cell anemia** as the **highest rate** of the disease **(14.5%)** and their parents are consanguineous and **(14.7%)** of them their parents are non- consanguineous (P=0.9360).

The second of disease was **diabetes mellitus (7.8%)** and their parents are consanguineous and **(10.3%)** of them their parents are non- consanguineous (P=0.2164).

Then **G6PD deficiency (4.5%)** and their parents are consanguineous and **(2.5%)** of them their parents are non-consanguineous (P=0.1226).

5. DISCUSSION

The study shows the rate of student's awareness about the relation between inherited disorders and consanguineous marriages that obtained from the questionnaire and it was **(42.25%),** which indicate low awareness according to the standard value.

We found **(44.4%)** of students' parents are consanguineous, **(26.1%)** of them with first-degree cousin, a study on 11554 families at different regions during the period 2004-2005 reported the prevalence of consanguinity was **(56%),(33.6 %)** of them with first-degree cousin. (4)

A study in Bahrain determined the prevalence of genetic blood disorders in 5685 students and they found **1.2% sickle-cell anemia**, **0.09% thalassemia** and **23.2% G6PD deficiency.** (11)

Our results in the same diseases were **6.9% sickle cell anemia**, **0.6% thalassemia** and **2.2% G6PD deficiency**.

The results of this study are close to other studies.

The other inherited disorders that mentioned by the students are :

Three diseases in three students, two have asthma and one has myopia.

Five cases in their brothers and sisters, two mental retardation، two myopia and one asthma

Three cases in their relatives, down syndrome, deafness and asthma.

6. CONCLUSION

The aim of this research to study the awareness about consanguineous marriages and the inherited disorders and the prevalence of consanguinity among the students and their parents.

The result shows that the awareness of students was low comparing with the standard values which is below the 50 %

The prevalence of consanguinity among students was high especially with the first degree.

The presents of diseases in students and their families show different numbers between different diseases, the highest rate was sickle cell anemia was found in the students, brothers and sisters and their relatives. The lowest disease was cleft palate was found in the students and relatives and does not found in their brothers and sisters.

7. RECOMMENDATION

- Premarital test is very important to avoid the inherited disorders specially the autosomal recessive, so the community need more data and awareness programs about the importance of this test.
- Due to the low rate of the awareness among students about inherited disorders of consanguineous marriages, especially non-blood diseases, we suggest to do awareness campaigns to mention the most non-blood inherited disorders to increase their awareness.

ACKNOWLEDGMENTS

We would like to thank our supervisor Dr. Sarah awdallah for guiding our research.

Many thanks to the mangers of colleges for giving us the permission to give their students the questioner.

Special thanks for Dr. Tariq Al-Bahawi and Dr. Ahmad Bahri for helping, guiding and giving us a lot of their time.

REFERENCES

[1] Jaouad IC, Elalaoui SC, Sbiti A, Elkerh F, Belmahi L, Sefiani A. Consanguineous marriages in Morocco and the consequence for the incidence of autosomal recessive disorders. J Biosoc Sci [Internet]. 2009;41(5):575–81. Available from: http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=5992388&fileId= s00 21932009003393

[2] Tamim H. Consanguinity and Apnea of Prematurity. Am J Epidemiol [Internet]. 2003;158(10):942–6. Available from: http://aje.oupjournals.org/cgi/doi/10.1093/aje/kwg226

[3] El Mouzan MI, Al Salloum A a., Al Herbish AS, Qurachi MM, Al Omar A a. Consanguinity and major genetic disorders in Saudi children: A community-based cross-sectional study. Ann Saudi Med [Internet]. 2008;28(3):169–73. Available from: http://applications.emro.who.int/imemrf/Ann_Saudi_Med/2008_28_3_169.pdf

[4] El-Mouzan MI, Al-Salloum AA, Al-Herbish AS, Qurachi MM, Al-Omar AA. Regional variations in the prevalence of consanguinity in Saudi Arabia. 2007; Available from: http://smj.org.sa/index.php/smj/article/view/6078/3852

[5] F El-Hazmi MA, Al-Swailem AR, Warsy AS, Al-Swailem AM, Sulaimani R, Al-Meshari AA, et al. Consanguinity among the Saudi Arabian population. JMed Genet [Internet]. 1995;32:623–6. Available from: http://jmg.bmj. com/content/32/8/623.full.pdf

[6] Abdelhadi M Habeb1,*, Mohamed SF Al-Magamsi1, Ihsan M Eid1, Mohamed I Ali1, Andrew T Hattersley2 KH andSian E. neonatal diabetes mellitus in northwest Saudi Arabia. 8 NOV 2011; 2012;13(6):499–505. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.1399-5448.2011.00828.x/abstract

[7] Nasir A. M. Al-Jurayyan, Huda AO. THE INCREASED PREVALENCE OF CONGENITAL ADRENAL HYPERPLASIA IN SAUDI ARABIA : THE ROLE OF CONSANGUINITY AND MULTIPLE. 2015;3(1):31–4. Available from: http://www.idpublications.org/wp-content/uploads/2015/01/THE-INCREASED-PREVALENCE-OF-CONGENITAL-ADRENAL-HYPERPLASIA-IN-SAUDI-ARABIA-THE-ROLE-OF-CONSANGUINITY-AND-MULTIPLE-SIBLINGS-INVOLVEMENT.pdf

[8] Dahlan H, Mostafa O. Screening for Color Vision Defects among Male Saudi Secondary School Children in Jizan City, Kingdom of Saudi Arabia. Med JCairo Univ [Internet]. 2013;81(1):513–7. Available from: http://medicaljournalofcairouniversity.net/index/images/pdf/2013/june/32.pdf

[9] Al-Gazali L, Bener A, Abdulrazzaq Y, Micallef R, Al-Khayat A, Gaber T. Consanguineous marriages in the United Arab Emirates. J Biosoc Sci [Internet]. 1997;29(4):491–7. Available from: http://www.ncbi.nlm.nih.gov/ pubmed/9881148

[10] Zlotogora J. Genetic disorders among Palestinian Arabs: 1. Effects of consanguinity. Am J Med Genet [Internet]. 1997;68(4):472–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9021024

[11] Revue L a, La DESDE, Orientale M. Student screening for inherited blood disorders in Bahrain [Internet]. Eastern Mediterranean Health Journal. 2003. p. 7–13. Available from: http://apps.who.int/iris/bitstream/10665/119283/ 1/emhj_2003_9_3_344_352.pdf

[12] Bener A, Hussain R, Teebi AS. Consanguineous marriages and their effects on common adult diseases: studies from an endogamous population. Med Princ Pract [Internet]. 2007;16(4):262–7. Available from: http://www.ncbi. nlm.nih.gov/pubmed/17541290

[13] Panter-Brick C. Parental responses to consanguinity and genetic disease in Saudi Arabia. Soc Sci Med [Internet]. 1991;33(11):1295–302. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1776043