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Article

Does consanguinity increase the risk of schizophrenia? Study based on primary health care centre visits

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ABSTRACT

Background Consanguinity has been suggested as a risk factor for the development of schizophrenia in offspring in some Middle Eastern countries.

Aim The purpose of this study was to review the frequency, pattern of parental consanguinity, and family history of schizophrenia among schizophrenia patients in Qatar, and to determine their impact on the associated risk factors.

Design This is a cross-sectional study which was conducted between January 2009 and December 2010, in the setting of primary health care (PHC) centres of the Supreme Council of Health, State of Qatar.

Subjects A total of 1491 patients aged 18–55 years were approached, of whom 1184 individuals agreed to participate in the study, giving a response rate of 79.4%.

Methods The study was based on face-to-face interviews using a specially designed questionnaire that covered sociodemographic characteristics and genetic and other biological factors (e.g. obstetric complications), and a diagnostic screening questionnaire which consisted of six questions about the symptoms of schizophrenia. The diagnostic screening questionnaire was reviewed and used to calculate the final score, which determined a provisional diagnosis. The psychiatrists discussed the psychiatric diagnosis and confirmed it using DSM-IV criteria. The degree of consanguinity between the patient's parents was recorded. Consanguinity was evaluated based on the coefficient of inbreeding (F), which is the probability of homozygosity.

Results More than half of the schizophrenia patients were female (57.1%) and over 45 years of age (62.5%). A family history of schizophrenia was significantly more common in parents of schizophrenia patients than in the Arab population without schizophrenia (24.6% vs. 17.1%; $P = 0.038$). Parental consanguinity was elevated among the patients with schizophrenia (41.3%) with a higher mean coefficient of inbreeding (0.04356 ± 0.028) than in non-schizophrenic subjects (28.7%) with a lower mean coefficient of inbreeding (0.0298 ± 0.035). Schizophrenia diagnoses were more frequent among the offspring of consanguineous parents than among the offspring of non-consanguineous parents.

Conclusion The substantial risk observed in the present study reveals that consanguinity is an important risk factor for schizophrenia in Qatar. In addition, the study confirms that the higher familial risks provide strong genetic epidemiological evidence for the overall heritable effects in the aetiology of schizophrenia.

Keywords: birth complication, consanguinity, genetic disorders, inbreeding, obstetric complication, schizophrenia

Introduction

Genetic factors play a significant role in the transmission of schizophrenia, a serious neuropsychiatric disorder that is the leading cause of chronic psychiatric hospitalisation.[1] Schizophrenia occurs worldwide and is among the most severe mental disorders.[2] It has been generally accepted that, like all other complex diseases, schizophrenia is caused by genetic and environmental factors. This severe mental disorder affects 1% of the world population and is characterised by psychotic symptoms and cognitive, affective and psychosocial impairment.[3] There is substantial evidence that schizophrenia has a genetic basis and that environmental factors influence susceptibility to the disorder. The World Health Organization has documented schizophrenia as a major public health problem with fourth position among the global burden of diseases.[4] This devastating neuropsychiatric illness has an estimated annual cost of $32 billion in the USA.[5]

It has been reported that consanguinity (inbreeding) may be associated with an increased risk of developing a wide range of genetically complex disorders.[6] In the Middle Eastern population, approximately 20–70% of marriages are between consanguineous individuals.[7–9] The detrimental health effects associated with consanguinity are caused by the expression of rare, recessive genes inherited from one or more common ancestors. In populations where inbred unions are common, increased levels of morbidity and mortality caused by the action of detrimental recessive genes can be predicted. Dobrusin *et al*[10] reported that consanguinity is more likely among parents of patients with schizophrenia in Middle Eastern countries. Mansour *et al*[11] concluded in his article that consanguineous marriages increase the risk of developing schizophrenia. Consanguineous marriages, which are known to have adverse effects on morbidity and mortality, are a traditional practice in Middle Eastern and Arab cultures, with a frequency of more than 50% in some countries.[12] As consanguinity is widely practised in the Eastern Mediterranean Regions (EMR), it was considered useful to study the effect on the risk of developing schizophrenia in this population.

It is important to address this issue in Qatar, as a previous study on the prevalence of mental illness showed a high prevalence of schizophrenia in the Qatari population.[13] Moreover, our recent studies[9–14] have reported an elevated parental consanguinity rate of 52% in Qatar. Qatar is a small country located in the Arabian Peninsula, and its population is characterised by a rapid rate of growth, large family size and a high rate of consanguineous marriages. Bener *et al*[6] recently reported that, because of increased consanguinity, the families of Arabs in Qatar have played a major role in the identification of many forms of severe common adult diseases such as cancer, heart disease, gastrointestinal disorders, hypertension, hearing deficits, diabetes mellitus and mental disorders.[6] The authors have now extended the research to schizophrenia in the same population. In Qatar, this is the first study to have examined the impact of consanguinity on the risk of developing schizophrenia and investigated the inbreeding characteristics of patients with schizophrenia.

Subjects and methods

This cross-sectional study was conducted in the State of Qatar between January 2009 and December 2010 in order to determine the effects of consanguinity on schizophrenia disorders. The study included Arab patients aged 18–55 years who attended primary health care (PHC) centres throughout Qatar. PHC centres are used by all levels of the general population as a gateway to specialist care. The study was conducted among patients who were visiting 13 health centres (10 centres in an urban area and 3 centres in a semi-urban area, to provide a geographically representative sample of the Arab population). We have used an estimated prevalence of schizophrenia of 10%, as reported in neighbouring countries,[15–17] and for computing 99% confidence limits with a 2% error bound, giving a sample size estimate of 1491 subjects. IRB approval for conducting this research in Qatar was obtained from the Hamad Medical Corporation.

A multi-stage stratified sampling design was utilised and subjects were selected by simple random sampling. A total of 1491 Qatari and other Arab patients were approached, of whom 1184 patients agreed to participate in the study (i.e. the response rate was 79.4%). In total, 20.6% of the individuals who were approached were excluded from the study, either because they refused to take part or because their questionnaire data were incomplete. Patients with physical impairments were also excluded from the study. Qualified nurses with previous experience of participating in mental health research projects were trained to interview the patients and complete the questionnaires.

The data were collected by means of a validated self-administered questionnaire based on face-to-face interviews by physicians and qualified nurses using the local language. The nurses were aware of the Arabic culture and were able to overcome any reluctance of the study participants to answer the

questions. The questionnaire consisted of several parts. The first part covered the sociodemographic details of the patient, the second part covered the genetic factors (including the consanguinity and family history of the patient), the third part covered other biological factors (including maternal and birth complications), and the fourth part was a diagnostic screening questionnaire for schizophrenia. Data on maternal complications were collected from the patients' medical records, which contained fairly detailed demographic and medical information about any complications prior to their birth. In cases where information on maternal complications was missing, the obstetric records of the mothers were reviewed for the missing information. The diagnostic screening questionnaire contains six questions about the symptoms of schizophrenia:

1 Do you hear voices talking when you are alone?
2 Do you feel that you are being followed?
3 Do you feel that you are being spied on, or that a stranger is talking about you?
4 Do other forces control your actions, thoughts and feeling?
5 Can others understand your thoughts?

Patients were asked to answer the questions by grading them from 0 to 4 (where 0 = 'not at all', 1 = 'a little', 2 = 'moderately', 3 = 'quite a bit' and 4 = 'extremely'). Psychiatrists made psychiatric diagnoses. Two senior psychiatrists independently reassessed the diagnoses through a systematic review of the symptoms. Using the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)* criteria, the psychiatrists validated these psychiatric diagnoses and confirmed schizophrenia cases. We have sent the summary of diagnoses to an Arab native psychiatrist in a western country for verification of the diagnoses. The survey instrument was tested on 100 patients who visited the health centres and thus validated the questionnaire. The content validity, face validity and reliability of the questionnaire were tested using 100 subjects. These tests demonstrated a high level of validity and a high degree of repeatability (kappa = 0.85). This diagnostic screening questionnaire identified 126 individuals who were at high risk of developing schizophrenia.

Measuring consanguinity

Consanguineous marriages are marriages between close relatives. The average level of inbreeding was assessed in terms of coefficient of kinship values for each population ($\alpha = \Sigma p_i F_i$) where α is the probability that a gene taken at random from one partner is identical by descent to a gene from the same locus taken at random from the other partner. Consanguinity was evaluated based on the coefficient of inbreeding (F), which is the probability of homozygosity by descent, and was determined in the offspring of six types of consanguineous union as follows:[6,8]

Consanguinity type	*Coefficient of inbreeding (F)*
Double first cousins	1/8
First cousin	1/16
First cousin once removed	1/32
Second cousin	1/64
Second cousin once removed	1/128

All other types of unions were considered non-consanguineous, with the coefficient of inbreeding set at 0.

Student's *t*-test was used to ascertain the significance of differences between the mean values of two continuous variables, and confirmed by a non-parametric Mann–Whitney test. Chi-square and Fisher's exact test were used to test for differences in the proportions of categorical variables between two or more groups. A P-value of < 0.05 was considered to be statistically significant.

Results

Table 1 shows the sociodemographic characteristics of the study participants and the patients with schizophrenia according to gender. The mean age ($\pm$ SD) of the study participants was 39 ± 13.3 years, while that of the patients with schizophrenia was 41.9 ± 12.8 years. Of the study participants, 50.4% were Qataris and 49.6% were other Arab nationals. Most of them were married (75%), educated to secondary school level or above (58.7%), and living in urban areas (79.7%).

In total, 10.6% of the study participants were diagnosed with schizophrenia. More than half of the schizophrenia patients were over 45 years of age (52.4%). Female schizophrenia patients (57.1%) outnumbered male patients with schizophrenia (42.9%). The majority of the schizophrenia patients were Qataris (78.6%), married (81.7%), educated to secondary school level or above (62.7%), and residing in urban areas (65.9%).

Table 2 shows the genetic factors for the study participants with and without schizophrenia. Among the 126 schizophrenia patients, the rate of first-cousin marriages was 24.6%, whereas it was lower

Table 1 Sociodemographic characteristics of the study participants and schizophrenic patients by gender ($n = 126$)

Variable	Total study participants n =1184 n (%)	With schizophrenia			P-value
		Total n = 126 n (%)	Male n = 54 n (%)	Female n = 72 n (%)	
Age (mean ± SD)	39.0 ± 13.3	41.9 ± 12.8	32.0 ± 7.3	49.3 ± 10.9	< 0.001
Age (years)					
< 30	354 (29.9)	22 (17.5)	16 (29.6)	6 (8.3)	0.003
30–45	485 (41.0)	38 (30.2)	17 (31.5)	21 (29.2)	
> 45	345 (29.1)	66 (52.4)	21 (38.9)	45 (62.5)	
BMI (kg/m^2)					
Normal (< 25)	507 (42.8)	54 (42.9)	23 (42.6)	31 (43.1)	0.845
Overweight (26–39)	262 (22.1)	33 (26.2)	13 (24.1)	20 (27.8)	
Obese (> 30)	415 (35.1)	39 (31.0)	18 (33.3)	21 (29.2)	
Ethnicity					
Qatari	597 (50.4)	99 (78.6)	52 (96.3)	47 (65.3)	< 0.001
Other Arab nationality	587 (49.6)	27 (21.4)	2 (3.7)	25 (34.7)	
Marital status					
Single	296 (25.0)	23 (18.3)	16 (29.6)	7 (9.7)	0.005
Married	888 (75.0)	103 (81.7)	38 (70.4)	65 (90.3)	
Education level					
Illiterate	120 (10.1)	12 (9.5)	4 (7.4)	8 (11.1)	
Primary	172 (14.5)	14 (11.1)	5 (9.3)	9 (12.5)	0.437
Intermediate	197 (16.6)	21 (16.7)	7 (13.0)	14 (19.4)	
Secondary	427 (36.1)	51 (40.5)	27 (50.0)	24 (33.3)	
University	268 (22.6)	28 (22.2)	11 (20.3)	17 (23.6)	
Occupation					
Non-working/housewife	475 (40.1)	27 (21.4)	5 (9.3)	22 (30.6)	0.020
Sedentary/professional	408 (34.5)	21 (16.7)	14 (25.9)	7 (9.7)	
Manual	139 (11.7)	23 (18.3)	10 (18.5)	13 (18.1)	
Businessman	100 (8.4)	27 (21.4)	13 (24.1)	14 (19.4)	
Army/police	62 (5.2)	28 (22.2)	12 (22.2)	16 (22.2)	
Household income (QR/month)					
< 10 000	240 (20.3)	21 (16.7)	15 (27.8)	6 (8.3)	
10 000–19 999	701 (59.2)	50 (39.7)	22 (40.7)	28 (38.9)	0.006
> 20 000	243 (20.5)	55 (43.7)	17 (31.5)	38 (52.8)	
Place of residence					
Urban	944 (79.7)	83 (65.9)	28 (51.9)	55 (76.4)	0.004
Semi-urban	240 (20.3)	43 (34.1)	26 (48.1)	17 (23.6)	

in the Arab population without schizophrenia (17.6%). Parental consanguinity was significantly elevated among the patients with schizophrenia (41.3%), with a higher mean coefficient of inbreeding (0.04356 ± 0.028), compared with individuals without schizophrenia (28.7%) (P = 0.005), with a lower mean inbreeding coefficient (0.0298 ± 0.035) (P < 0.001). The inbreeding coefficient was higher in schizophrenia patients compared with non-schizophrenia patients (males: 0.03947 ± 0.025 vs. 0.0254 ± 0.027; P = 0.034; females: 0.04592 ± 0.030 vs. 0.0437 ± 0.026; P = 0.001), Qatari nationals (0.03578 ± 0.028 vs. 0.2778 ± 0.030) and other Arab nationals (0.04910 ± 0.029 vs. 0.02851 ± 0.035).

Table 2 Genetic factors of the study participants with and without schizophrenia ($n = 1184$)

Variable	Study participants		*P*-value
	With schizophrenia ($n = 126$)	Without schizophrenia ($n = 1058$)	
Parental consanguinity n (%)*			
None	74 (58.7)	754 (71.2)	0.014
First-degree	31 (24.6)	186 (17.6)	
Second-degree	21 (16.7)	118 (11.2)	
Family history of schizophrenia			
Parents			
Yes	31 (24.6)	181 (17.1)	0.038
No	95 (75.4)	877 (82.9)	
Grandparents			
Yes	22 (17.5)	115 (10.9)	0.029
No	104 (82.5)	943 (89.1)	
Cousins			
Yes	26 (20.6)	166 (15.7)	0.155
No	100 (79.4)	892 (84.3)	
Aunts			
Yes	27 (21.4)	125 (11.8)	0.002
No	99 (78.6)	933 (88.2)	
Uncles			
Yes	24 (19.0)	165 (15.6)	0.317
No	102 (81.0)	893 (84.4)	
Inbreeding characteristics			
All subjects			
Parental consanguinity	52 (41.3)	304 (28.7)	0.005
Mean coefficient of inbreeding	0.04356 ± 0.028	0.0298 ± 0.035	< 0.001
Males			
Parental consanguinity	19 (36.6)	128 (42.3)	0.414
Mean coefficient of inbreeding	0.03947 ± 0.025	0.0254 ± 0.027	0.034
Females			
Parental consanguinity	33 (63.5)	175 (57.7)	0.010
Mean coefficient of inbreeding	0.04592 ± 0.030	0.0437 ± 0.026	0.001
Qatari nationals			
Parental consanguinity	31 (59.6)	158 (51.8)	0.007
Mean coefficient of inbreeding	0.03578 ± 0.028	0.2778 ± 0.030	0.253
Other Arab nationals			
Parental consanguinity	21 (40.4)	146 (48.2)	0.460
Mean coefficient of inbreeding	0.04910 ± 0.029	0.02851 ± 0.035	0.010

Table 3 shows the obstetric complications for patients with schizophrenia and the inbreeding coefficients. Consanguinity and inbreeding coefficients were more likely to be frequent in schizophrenia patients with complications of abnormal fetal growth (11.5% vs. 6.8%; 0.029829), rhesus incompatibility (11.5% vs. 9.5%; 0.015625), viral infections (17.3% vs. 16.2%; 0.022321), congenital malformations (5.8% vs. 5.4%; 0.026785) and pregnancy stress (26.9% vs. 18.9%; 0.025669), compared with individuals without a diagnosis of schizophrenia.

Table 3 Role of obstetric complications and measure of consanguinity in schizophrenic subjects ($n = 126$)

Category	$n = 126$ n (%)	Parental consanguinity (%)		Mean of coefficient of inbreeding
		Yes n (%)	No n (%)	
All subjects	126 (100.0)	52 (41.3)	72 (58.7)	0.043565
*Maternal complication**				
Stress during pregnancy	28 (22.2)	14 (26.9)	14 (18.9)	0.025669
Diabetes	15 (11.9)	5 (9.6)	10 (13.5)	0.011458
Prenatal malnutrition	17 (13.5)	9 (17.3)	8 (10.8)	0.022058
Viral infections	21 (16.7)	9 (17.3)	12 (16.2)	0.022321
Bleeding	7 (5.6)	2 (3.8)	5 (6.8)	0.044643
Pre-eclampsia	17 (13.5)	5 (9.6)	12 (16.2)	0.015625
Rhesus incompatibility	13 (10.3)	6 (11.5)	7 (9.5)	0.015625
Congenital malformation	7 (5.6)	3 (5.8)	4 (5.4)	0.026785
Abnormal fetal growth	11 (8.7)	6 (11.5)	5 (6.8)	0.029829

*Multiple options, so they do not give a total sum of 100%.

Table 4 Distribution of schizophrenia diagnosis among parents and their offspring by consanguineous and non-consanguineous status

Parental consanguinity	Parents	Offspring	Incidence of schizophrenia in offspring (increase/ decrease)	P-value
Consanguineous	31	52	+67.7%	0.007
Non-consanguineous	140	74	–47.1%	< 0.001

Table 4 compares the incidence of schizophrenia in offspring of consanguineous and non-consanguineous parents. A significant association was found between the incidence of schizophrenia and consanguineous parents ($P = 0.007$). A schizophrenia diagnosis was observed nearly twice as often in the offspring (52 children) of consanguineous parents (31 parents), whereas schizophrenia was less common in the offspring (74 children) of non-consanguineous parents (140 parents) ($P < 0.001$).

Discussion

Schizophrenia represents a significant public health problem for Middle Eastern countries. It is most probably a multi-factorial disorder in which both genetic and environmental factors may have a contributory role. Research on schizophrenia has helped scientists to understand and identify some of the risk factors for its development. To our knowledge, the present study is the first to describe an association between consanguinity and schizophrenia in

the Arab population of Qatar. Among the Arab population that was surveyed, schizophrenia was diagnosed in 10.6% of individuals. The most important finding of this study is that the morbidity of schizophrenia was increased in the first-degree relatives of patients with schizophrenia. In total, 24.6% of these were first-cousin parental marriages, whereas the proportion was lower in the Arab population without schizophrenia (17.1%). A study of the morbidity risk of schizophrenia to parents and siblings reported that a total of 16.4% of the schizophrenia probands had at least one first-degree relative with schizophrenia.[18] Another study reported that first-degree biological relatives of individuals with schizophrenia have a tenfold greater risk of developing the disorder themselves than the general population.[11] Mansour *et al*[11] observed significantly and substantially elevated rates of consanguinity among schizophrenia patients in Egypt.

The most striking difference in the incidence of schizophrenia in the study cohort was the gender difference. Schizophrenia was more common among female patients (57.1%) than male patients (42.9%). This finding is consistent with a study by Goldstein *et* al,[19] which found that familial transmission of schizophrenia is significantly greater in female probands than in male ones. A few studies[15,20] have reported that males tended to have a higher incidence of schizophrenia. The question of whether schizophrenia is more common among men than women is controversial. Castle and Murray[20] have suggested that a possible reason for the gender difference in the incidence, symptoms, clinical course and risk factors may be that there are subtypes of schizophrenia to which males and females show differential susceptibility. In the study sample, the incidence of schizophrenia has been found to peak in those who are over 45 years of age, in both males (38.9%) and females (62.5%). It has been reported that schizophrenia can occur at any age, [21] but it tends to first develop or at least become evident between adolescence and young adulthood.

In the study sample, a positive family history of schizophrenia was associated with the development of schizophrenia. The data revealed that siblings of parents who suffered from schizophrenia were at significantly greater risk of developing schizophrenia than siblings of parents who did not have schizophrenia. The study found a significant rate of positive family history of schizophrenia in parents (24.6%; P = 0.04), grandparents (17.5%; P = 0.03) and aunts (21.4%; P = 0.002), compared with individuals without a diagnosis of schizophrenia. This is consistent with family studies[22] which confirmed that relatives of probands with schizophrenia have an increased risk of developing schizophrenia. The risk decreases rapidly from close to more distant relatives. Thus a family history of schizophrenia increases the likelihood of schizophrenia or a similar psychosis developing in the offspring. Family members share a common culture and environment, and therefore familial environmental factors may confound genetic relationships. Furthermore, most of our schizophrenia patients (81.7%) were married; only 18.3% were single. This suggests that schizophrenia and its complications can be diagnosed at an earlier stage based on a positive family history; otherwise it would be diagnosed only later in life when the individual develops recurrent episodes. Based on these findings, schizophrenia has been widely considered to be a familial disorder.

The present study shows that the high prevalence of schizophrenia among the Arab population residing in Qatar is associated with the high rate of parental consanguinity. The rate of parental consanguinity (41.3% vs. 28.7%) and the mean coefficient of inbreeding (0.04356 ± 0.028 vs. 0.0298 ± 0.035) among our schizophrenia patients were significantly higher than those reported in the Arab population without schizophrenia. A similar pattern was observed in male (36.6% and 0.03947) and female (63.5% and 0.04592) schizophrenia patients, compared with their counterparts. Similar to our study findings, a case–control study conducted in Egypt[11] reported a higher rate of parental consanguinity (75%) and mean coefficient of inbreeding (0.044067) among schizophrenia patients than in controls (54% and 0.0219).

Consanguinity contributes to a high incidence of schizophrenia in offspring. This is clearly demonstrated by our data, which showed that schizophrenia was observed more frequently in the offspring (52 children) of consanguineous parents (31 parents) (P = 0.007), whereas the incidence of schizophrenia was significantly lower in the offspring of non-consanguineous parents. This is consistent with the findings of another study, by Dobrusin *et al*,[23] who found a significant increase in the rate of cousin marriages among the parents of schizophrenia parents compared with the parents of infant controls. These study findings revealed that non-consanguineous marriages have a lower rate of schizophrenia in their offspring than consanguineous marriages. This association supports the possibility of recessively inherited genetic risk factors.

Parental consanguinity had an adverse effect on patients' quality of life as shown by the high frequency of severe forms of complications among the reported schizophrenia patients. Empirical studies[24] of the progeny of first cousins indicate that morbidity levels are around 1–4% higher than those for the offspring of unrelated couples. It is evident in the present study that most of the obstetric complications of schizophrenia patients have a higher

prevalence of parental consanguinity and a higher inbreeding coefficient. Parental consanguinity was more frequent in schizophrenia patients with abnormal fetal growth (11.5% vs. 6.8%; 0.029829), rhesus incompatibility (11.5% vs. 9.5%; 0.015625), viral infections (17.3% vs. 16.2%; 0.022321) and pregnancy stress (26.9% vs. 18.9%; 0.025669), with a higher inbreeding coefficient, compared with individuals who had non-consanguineous parents. Geddes *et al*[25] reported that obstetric complications are the best supported environmental risk factors for schizophrenia, but they are probably not themselves sufficient to cause the disorder. In the Danish perinatal cohort,[26] rhesus incompatibility was a risk factor for schizophrenia. It was reported that adverse obstetric events are considered to contribute to the risk of developing schizophrenia.[27]

The present study has confirmed the genetic contribution to schizophrenia. The development of schizophrenia appears to be the result of both genetic and environmental factors, which is consistent with the findings of the study.[28–30] In populations where inbred unions are common, increased levels of morbidity and mortality caused by the action of detrimental recessive genes can be predicted. The study findings suggest that premarital and genetic counselling would be beneficial for the care of patients with schizophrenia and their families. There is also a need for the implementation of strategies to increase public awareness of the health burden of consanguineous marriages.

The limitations of this study are important and should be noted. The study sample is from the Arab population, which includes Qataris and non-Qatari Arabs residing in Qatar. Non-Qatari Arabs include various nationalities, such as Palestinian, Jordanian, Egyptian, Syrian, Lebanese and Sudanese people, and those from other Gulf countries. Thus they can be regarded as a heterogeneous group with slight differences in their rate of consanguineous marriages. Since this is a cross-sectional study, we might not have targeted the appropriate study subjects, which could affect the results. As two psychiatrists were involved in confirming the schizophrenia diagnosis, intra-observer error might have occurred.

Conclusion

The study findings support the notion of familial transmission of schizophrenia. Parental consanguinity is a risk factor for the development of schizophrenia. The inbreeding coefficient was significantly elevated among Arab schizophrenia patients compared with the Arab population without schizophrenia. Schizophrenia was more common among female probands than in male probands. The disorder tends to occur more frequently in the offspring of consanguineous parents than in offspring of non-consanguineous parents. Both parental consanguinity and the inbreeding coefficient were higher where schizophrenia patients had had obstetric complications.

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AB organised the study, collected the data, performed the statistical analysis and wrote the first draft of the article. EED and NS collected the data and contributed to the interpretation of the data and the writing of the manuscript.

CONFLICTS OF INTEREST

None.

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