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SHORT REPORT

The prevailing trend of consanguinity in the Arab society of Israel: is it still a challenge?

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Abstract
The aim of this study was to determine the trend of consanguineous marriage among the Arab population in Israel. Socio-demographic data for the Arab population were extracted from national health surveys conducted in Israel in 2007 and 2017. The prevalence of consanguineous marriage among the Arab population in Israel increased significantly from 36.3% to 41.6% in the decade from 2007 to 2017. First-cousin and closer marriages constituted about 50% of total consanguineous marriages in the two periods surveyed. Consanguinity was found to be significantly related to religion and place of residence. Thus, the prevalence of consanguineous marriage remains high among the Arab population in Israel, similar to other Arab societies. These findings affect the health of future generations and impose a challenge for health care professionals.

Keywords: Consanguinity; Marriage and mate selection

In clinical genetics, consanguineous marriage (CM) refers to marriage of biologically related individuals who are second cousins or closer (Modell & Darr, 2002). It is a major factor leading to high rates of genetic disorders and congenital malformation in addition to infant mortality (Subalakshmi & Mohan, 2021). In several global communities, e.g. Arab countries, Turkey, Iran, Pakistan and South India, CM is a traditional phenomenon and its rate remains high (25–55%) (Bittles & Black, 2015; Sharkia *et al.*, 2016; Ben-Omran *et al.,* 2020). The Arab population in Israel is currently 1.9 million, and includes 85.1% Muslims, 7.6% Druze and 7.3% Christians (Central Bureau of Statistics, 2018a, b). The Arab population in Israel has unique socio-demographic and cultural features that resemble those in other Arab societies, e.g. a high proportion of CM. Furthermore, Arab villages in Israel are relatively small, which leads to common and rare gene mutations that give rise to genetic disorders (Sharkia *et al.,* 2016).

The rate of CM among Arabs in Israel has decreased from 35.8% among those married before 2000, to 28.2% among those married in 2000–2004 and to 24.0% among those married in 2005–2009 (Na'amnih *et al.,* 2015). In 2015, Sharkia and colleagues investigated the prevalence of first-cousin marriages in two generations and found the rate to be decreasing, although it was still the most predominant type of CM (Sharkia *et al.* 2015).

The aim of this study was to determine the rates of CM and its subtypes in 2007 and 2017 among the Arabs in Israel using a nation-wide survey. The effects of various socio-demographic factors on CM were also investigated. The Galilee Society: The Arab National Society for Health

Table 1. Prevalence rates of consanguineous marriage (CM) and mean of inbreeding coefficients (α) in the Arab society of Israel, 2007 and 2017

	CM										
	FC and closer		Other CM		Total CM		Non-CM		Total sample		Mean inbreeding coefficient (α)
Survey period	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	
2007	574	18.1	577	18.2	1151	36.3	2022	63.7	3173	100	0.01560
2017	400	21.2	386	20.4	786	41.6	1104	58.4	1890	100	0.01850

Research and Services conducts comprehensive national surveys in the Arab population of Israel tri-annually, in order to examine changes in various socioeconomic and health status variables, including health-related aspects of CM. The present study compared data from national health surveys conducted in 2007 and 2017 to detect the change and trend of the incidence of CM among the Arab population in Israel.

Arab citizens reside in various districts throughout Israel. In this study, 'residential region' was divided into four regions, namely: North, Haifa, Centre and South. Locality of residence was divided into urban (>15,000 population), semi-urban (between 5000 and 15,000 population) and rural (<5000 population). Regarding religion, the sample was divided into Muslim, Christian and Druze couples. The dependent variable was consanguinity, derived from survey questionnaires that asked ever-married women if they had a blood relationship to their husbands. Relationships were grouped into consanguineous and non-consanguineous marriages. Consanguineous marriages were classed as either 'first cousin (FC) and closer' or 'Other'.

From a genetic point of view, mean inbreeding coefficients (α) were calculated using the formula $\alpha = \Sigma P_i F_i$, where P_i is the percentage of each marriage type and F_i is the inbreeding coefficient of that respective marriage type. Data management and statistical analyses were conducted using SPSS. The statistical significance of associations between consanguinity and various determinants were examined using Chi-squared tests. The Kruskal-Wallis test was used to evaluate the significance of the differences observed between the two periods of time surveyed. Statistical significance was considered at $p<0.05$.

The results of the 2007 and 2017 surveys showed that the total CM prevalence among the Arab population increased significantly from 36.3% to 41.6% over the decade (Table 1). This trend is clearly reflected in an increase in the mean inbreeding coefficient (α) over time from 0.0156 to 0.0185. First-cousin and closer marriage types were found to be the most common (50% of total CMs). Furthermore, all CM types increased slightly with time.

Table 2 shows the rates of the different types of marriage by the prevailing religions in the Arab population of Israel. Among Muslims, the rate of CM increased slightly, from 39.8% to 42.1%, from 2007 to 2017. Among Druze and Christians, the rate increased significantly, from 29.3% to 42.7% and from 19% to 27.6%, respectively, over the decade. The differences in consanguinity related to religion in the two periods surveyed were found to be significant ($p<0.05$). It was noteworthy that the prevalence rate among the Druze was highest in 2017. In FC and closer marriage types, the differences in prevalence rates between the two periods were small for all religions. In contrast, among other CM types, there was a significant increase among Christians (from 5.8% to 16.4%) and Druze (from 9% to 21.1%), while among Muslims there was a slight decrease (from 21.2% to 20.5%) from 2007 to 2017. Furthermore, the mean inbreeding coefficient (α) was found to be the highest among Druze, but slightly lower among Muslims, while the lowest was among Christians. Additionally, the mean inbreeding coefficient (α) significantly increased among Druze, while among Muslims it increased slightly, and among Christians it was near stable over the decade 2007–2017.

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Table 2. Prevalence rates of consanguineous marriage (CM) and mean inbreeding coefficients (α) by religion, 2007 and 2017

Religion		CM						Non-CM		Total sample		Mean inbreeding coefficient (α)
		FC and closer		Other CM		Total CM						
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Muslim	2007	459	18.6	524	21.2	983	39.8	1489	60.2	2472	100	0.0159
	2017	349	21.6	332	20.5	681	42.1	937	57.9	1618	100	0.0176
Christian	2007	48	13.2	21	5.8	69	19.0	294	81.0	363	100	0.0112
	2017	8	11.0	12	16.4	20	27.4	53	72.6	73	100	0.0116
Druze	2007	69	20.4	30	9.0	99	29.3	239	70.7	338	100	0.0178
	2017	43	21.6	42	21.1	85	42.7	114	57.3	199	100	0.0204
Total	2007	574	18.1	577	18.2	1151	36.3	2022	63.7	3173	100	0.0156
	2017	400	21.2	386	20.4	786	41.6	1104	58.4	1890	100	0.0185

Table 3. Prevalence rates of consanguineous marriage (CM) and mean of inbreeding coefficients (α) by place of residence, 2007 and 2017

Place of residence		CM		Non-CM		Total sample	Mean inbreeding coefficient (α)
		n	%	*n*	%		
Urban	2007	442	30.4	1010	69.6	1452	0.0144
	2017	400	35.4	694	64.6	1074	0.0148
Semi-urban	2007	399	35.4	728	64.6	1127	0.0154
	2017	275	46.0	323	54.0	598	0.0159
Rural	2007	310	52.2	284	47.8	594	0.0201
	2017	131	60	87	40.0	218	0.0220
Total	2007	1151	36.3	2022	63.7	3173	0.0156
	2017	786	41.6	1104	58.4	1890	0.0185

The highest rate of CM was in rural areas, followed by semi-urban areas, with the lowest prevalence in urban areas (Table 3). These differences were also observed in their mean inbreeding coefficients (α). The differences in CM increased in the three types of places in both surveys. The relationship between consanguinity and region is presented in Table 4. The South region had the highest rate of CM (66.4%), followed by the Centre region (46.6%). In the North region, the rate was 38.2%, with the lowest rate in the Haifa region (31.9%). These regional differences were also found in the mean inbreeding coefficient (α).

This study indicates that there was an increase in the prevalence of CM among the Arab population of Israel over the period 2007–2017. Similar findings have been revealed in various societies where CM is common (Hamamy & Alwan, 2016; Kalam *et al.,* 2021). However, a trend of decreasing CM has been noted in various communities (Assaf & Khawaja, 2009; Islam *et al.,* 2018). Despite declines in CM, its prevalence remains high in certain societies, owing to the common belief in the social, cultural, political and economic advantages of CM (Bhinder *et al.,* 2019; Islam, 2021; Nawaz *et al.,* 2021). The present study demonstrated that first-cousin marriages were the preferred type of CM in the Arab population of Israel. This preference prevails

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Table 4. Prevalence rates of consanguineous marriage (CM) and mean inbreeding coefficients (α) by region in most recent survey, 2017

Region	CM		Non-CM		Total sample	Mean inbreeding coefficient (α)
	n	%	*n*	%		
North	400	38.2	648	61.8	1048	0.0159
Haifa	115	31.9	245	68.1	360	0.0151
Centre	115	46.6	132	53.4	247	0.0186
South	156	66.4	79	33.6	235	0.0280
Total	786	41.6	1104	58.4	1890	0.0185

in most societies where CM is practised (Sharkia *et al.,* 2015, 2016; Bittles & Black 2015), suggesting that FC marriage is culturally deeply rooted in Arab societies. This could be explained by the belief of FC marriage's positive role in maintaining the stable family structure, security for woman and retaining wealth and land within the extended family. The well-known biological drawbacks of CM include increased homozygosity, health-related complications such as genetic diseases, infant mortality and congenital malformations (Sharkia *et al.,* 2010; Subalakshmi & Mohan, 2021). These negative effects of CM, along with its continuous high prevalence rate in a large number of societies, pose a serious challenge for health care systems.

These results document an increase in CM among Druze and Christian Arabs in Israel. The prevalence of CM among Muslims has remained high (Sharkia *et al.*, 2016). Druze and Christian Arabs are characterized by relatively small communities. Furthermore, the vast majority of marriages occur within the religion itself. Additionally, the populations of these two religions are geographically isolated, thus limiting the availability of potential spouses.

This study found that the highest rate of CM was in rural areas, and the lowest in urban areas, which is in concordance with studies from Tunisia (Ben Arab *et al.,* 2004), Pakistan (Riaz *et al.,* 2016) and India (Sharma *et al.,* 2021). The highest increase of CM was in the semi-urban areas. This could be attributed to the transfer of residence from rural to a semi-urban setting (due to natural population growth), while the socio-cultural life of these semi-urban areas has remained rural in nature.

The southern region of Israel, inhabited by Bedouins, has the highest rates (44.8%) of CM (Na'amnih *et al.,* 2014), followed by the central region, with a Muslim majority of Arab inhabitants, and a considerable shift of the Bedouin population from the southern to the central region. The lowest rate of CM was in the urban Haifa region. Christian Arabs, characterized by a low rate of CM, constitute about 40% of the Arab population in the city of Haifa (Central Bureau of Statistics, 2020). On the other hand, the northern region includes Muslims, Druze and Christians in urban, semi-urban and rural settings. Thus, the north's rate of CM is the closest to the average rate of consanguinity among the surveyed Arab population.

In conclusion, CM remains high in the Arab society of Israel, as in many Arab countries. This study revealed that religion, geographic region and socio-demographic variables are significant factors in determining the rate of CM. Attitudes towards the practice of CM, which are deeply rooted in culture and mentality, are difficult to change. Thus, it is recommended that community-based genetic counselling programmes that include genetic testing before and during marriage are implemented in the Arab population of Israel, particularly for consanguineous couples.

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Ethical Approval. This study was approved by the ethical board of The Galilee Society: The Arab National Society for Health Research and Services and by the ethics committee of the Triangle Research and Development Center, Israel. Participants provided written informed consent for participation in the surveys after received detailed explanations of the survey procedures.

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