

Youth consanguinity in relation to sociodemographic and women-related fertility factors in the Arab society of Israel

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Abstract

Consanguineous marriages (CMs) had been practiced since the old ages, and still common in various communities worldwide, despite the negative effect on future offspring. We aimed to determine the prevalence of CMs in the young population (18-35 years) in relation to various sociodemographic and specific women-related fertility factors in the Arab society of Israel. The study was based on a survey conducted in the year 2021.

The rate of CMs in this young population was high and accounted for 47%. The main type of CMs was the other CMs (OCMs) type (36%), which was higher than that of the first cousin and closer (FCC) marriage type (11%). The highest prevalence rate of CMs was found to be in the youngest age range (18-24 years), and FCC type specifically had also the highest marriage rate in this age range. The South region had the highest rate of CMs (~73%). The highest rates were among Muslims followed by Druze, and the lowest among Christians (~49%, ~42%, and 26.5% respectively). The rates of CMs, were inversely proportional to educational status, income-level, and employment status. The percentage of couples with ≥5 children in the CMs type (8%) was higher than those couples in the non-CMs type (4.6%). The women-related fertility factors were significantly associated with CMs.

It was evident that the young generation is still practicing CMs to a high extent which is affected by various factors. Relevant effective strategies should be adopted to deal with this sensitive and vital issue for the benefit of future generations in our society.

Keywords: Consanguineous marriages; Young generation; Sociodemographic factors; Women-fertility factors; Arab society of Israel

1. Introduction

Consanguineous marriages (CMs) had been practiced since the early existence of human being, which could be defined as marriages between couples who are relatives as second cousins or closer, such marriages were estimated to have nearly one billion (20%) of the global population [1, 2, 3, 4]. A rough estimation indicated that in the Western countries the rate of CMs could be about 1%, on the other hand, the highest prevalence of CMs was observed in North and sub-Saharan Africa, the Middle East, and West, Central, and South Asia [5, 6]. There are many specific communities and

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countries, such as Arab countries, Turkey, Iran, Pakistan, and South India, where CM is a traditional phenomenon and its rate remains high (25–55%) [7, 8, 9].

Consanguinity had been considered as a major factor leading to high rates of genetic disorders, particularly, the autosomal recessive genetic diseases in the offspring of consanguineous parents [10, 11, 12]. A considerable number of studies have shown that consanguinity had adverse outcomes on the progeny of the consanguineous parents, for example they could lead to a diminished fertility, a raise in the incidence of mortality, the evolvement of congenital malformations, asthma, epilepsy, cancer, blood and mental disorders, heart diseases, gastro-intestinal disorders, hypertension, Schizophrenia, common eye diseases and congenital sensorineural hearing loss [13, 14, 15].

Among the major populations studied, the highest rates of CMs have been associated with socio-economic levels, illiteracy, and rural residence [16, 17]. It was established that there are various factors such as demographic, religious, socio-economic status, local traditions including socially accepted norms of endogamy in tribal societies and educational level that affect the rates of CMs [18, 19].

Lots of research work had been carried out about the trend and prevalence of CMs in the Arab society of Israel. There has been a decrease in the pattern of consanguinity within the selected Israeli Arab villages, between two study periods. This change seems to correlate with the sociodemographic status of the villages [20]. A later study revealed that CMs decreased during a specific time (2000-2004) from 33% to 25.9%, then they started increasing rapidly in the successive periods of time till the end of the survey period i.e., 2017 where it reached 41.6%. [21]. Recently, a study revealed that consanguinity among the Arab population in Israel was found to be significantly increasing, and still poses a challenge [22].

To the best of our knowledge, only limited studies did focus on CMs in the young population in terms of their association with various sociodemographic factors, while no previous study had been conducted to test the effect of CMs on women's fertility in the youth in the Arab society of Israel. Therefore, in the current study we aimed to determine the prevalence of consanguineous marriages (CMs) in the young population (18-35 years) in terms of their association with various sociodemographic factors and their interference in some specific women-related fertility factors in the Arab society of Israel.

2. Material and methods

2.1. Study Population and Survey design

The Galilee society, "The Arab national society for health research and services", conducts various comprehensive national surveys in the Arab society of Israel to monitor various changes in socio-demographic and health parameters. The goal of these surveys is to generate essential information and disseminate knowledge concerning the Arab society in Israel. This, in turn, enables a deeper comprehension of their needs, challenges, fears, and potential opportunities for better future planning. Ultimately, this process facilitates the creation of well-informed and objective policies and programs on both local and governmental levels, grounded in scientific evidence.

A national survey was conducted during the year 2021 that focused specifically on young adults in the age range of 18 to 35 years among the Arab society of Israel. In the current study we present the extracted data from this national survey. This was performed to find out the effect of young adults' various socio-demographic factors on the incidence of their consanguineous marriages (CMs) as well as the effect of CMs on specific women-related fertility factors. A multistage design was employed for the sampling process. The sample creation occurred in three distinct stages: first, enumeration areas were selected within one stratification level; second, 24 responsive households were chosen from the selected enumeration area; and finally, one person, either male or female aged between 18 and 35 years, was randomly selected from each household in the second stage using a spreadsheet (Kish method). The study population was segmented into homogeneous strata based on gender and age group variables. Each participant recruited for the study provided informed written consent, having been thoroughly briefed about the study's purpose, following the guidelines outlined in the Declaration of Helsinki. The total sample comprised 1,872 households from the Arab society in Israel.

2.2. Data Collection and Analysis

Data collection involved personal face-to-face interviews with all subjects, utilizing a survey questionnaire designed specifically for this study. The fieldwork team consisted of experienced surveyors who underwent a training course conducted by supervisors and project administrators. The data collection process included the following steps: 1)

Information about the type of relationship between couples as well as their age, education, employment, and income level were directly obtained from the couples themselves through face-to-face interviews. 2) Validating the collected data by cross-referencing with information from the local councils of the region.

The various socio-demographic factors were divided into few parameters. The age ranges of the participants were categorized as: 18-24, 25-29, and 30-35 years, while their marital status factor was categorized as: single, engaged, married, divorced, widowed, and separated. The educational status factor was classified into several categories: those with less than 12 years of education, individuals who completed 12 years of education but did not pass the "Bagrut" exams, individuals who successfully completed the "Bagrut" certification, those with non-academic diplomas, and individuals with academic degrees. It is worth noting that in Israel, the term "Bagrut" refers to the final examinations undertaken by high school students. These exams encompass a variety of subjects and are overseen by the Israeli Ministry of Education. Typically, students take these exams towards the end of their 12th grade, and they hold significant importance in determining eligibility for higher education. The employment factor was categorized into three groups: individuals who were employed, those who were unemployed, and individuals outside of the labor force (that included homemakers and disabled individuals). The income level factor for the household was determined based on the average total income of all family members in Israel, and it was divided into three categories: 1) low, indicating a total income below the average; 2) medium, indicating a total income at the average level; and 3) high, indicating a total income above the average. As the Arab citizens reside in various districts throughout Israel, the residential region factor included four regions, namely: North, Haifa, Centre and South. Regarding religion factor, each participant was divided into Muslim, Christian and Druze. Four specific variables related to women's fertility factors were collected, viz number of children, pregnancy difficulties, medical treatments for pregnancy initiation and spontaneous abortion.

Consanguinity was derived from survey questionnaires by asking the ever-married participant if she/he had a blood relationship to her/his spouse. Relationships were grouped into consanguineous and non-consanguineous marriages (non-CMs). Consanguineous marriages (CMs) were further classified as follows: A) First cousin and closer (FCC), which encompassed double-first cousins (where all grandparents are shared) and first cousins (where the couple is related through patrilineal parallel or cross, or matrilineal parallel or cross). B) Other consanguineous marriages (OCMs), which involved couples who could be related through one of the following relations: first cousins once removed, or second cousins, or double second cousins.

From a genetic perspective, consanguinity is used to describe unions between couples who are known to share genes inherited from one or more common ancestors. Therefore, the coefficient of inbreeding (F) is used to signify the relative homozygosity of the gene loci between the related couples. So, the mean inbreeding coefficients (α) were calculated using the formula $\alpha = \sum P_i F_i$, 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 program. The statistical significance of associations between consanguinity and various determinants were examined using Chi-squared tests. Statistical significance was considered at $p < 0.05$.

3. Results

The results from this survey sample showed that in 2021, the rate of young adults in the Arab society in Israel was 28.4% who are in the age range of 18-35 years, out of whom the ratio of male to female was 51.1% to 48.9%. Their characteristics relating to socio-demographic variables are presented in table 1.

Table 1 Characteristics of the study sample by gender

Factor	Male		Female		Total	
	N	%	N	%	N	%
Age range:						
18-24	363	46.3	409	54.5	772	50.3
25-29	208	26.5	170	22.6	378	24.6
30-35	213	27.2	172	22.9	385	25.1
Marital status						
Single	409	52.2	342	45.5	751	49.0

Engaged	68	8.7	76	10.1	144	9.4
Married	291	37.2	303	40.3	594	38.7
Divorced	15	1.9	17	2.3	32	2.1
Widowed	0	0	8	1.1	8	0.5
Separated	0	0	5	0.7	5	0.3
Region						
North	337	43.0	337	44.9	674	43.9
Haifa	193	24.6	132	17.6	325	21.2
Centre	108	13.8	108	14.4	216	14.1
South	146	18.6	174	23.2	320	20.8
Religion						
Muslim	687	87.6	652	87.1	1339	87.3
Christian	49	6.3	51	6.8	100	6.5
Druze	48	6.1	46	6.1	94	6.1
Educational status						
<12 years	104	13.5	67	9.0	171	11.3
Completed 12 years	182	23.6	169	22.8	351	23.2
Bagrut	286	37.0	269	36.3	555	36.7
Non-academic diploma	93	12.0	89	12.0	182	12.0
Academic degree	107	13.9	147	19.8	254	16.8
Income level						
Low	403	61.7	414	69.5	817	65.4
Medium	126	19.3	102	17.1	228	18.3
High	124	19.0	80	13.4	204	16.3
Employment status						
Employed	551	70.6	302	40.3	853	55.8
Unemployed	51	6.5	80	10.7	131	8.6
Outside the labor force	178	22.8	368	49.1	546	35.7

It was found that most of the young adults lie in the age range category of 18–24 years, constituting about 50.3%, with a considerable difference between males and females (46.3% to 54.5% respectively). While the older age group of 25–29 years had about 24.6%, and the least participants were found in the age group of 30–35 years (25.1%), without significant differences between males and females in both groups. This indicates that the Arab society in Israel is considered to be young. According to their marital status, it was found that 38.7% of the youth in the Arab society of Israel are married, and 9.4% are engaged. On the other hand, majority (49%) of the young adults was found to be single with a considerable difference in between both genders: males (52.2%) and females (45.5%). According to the regional distribution of the young adults, it was found that ~44% of them live in the North region, while in Haifa and the South regions the rate was found to be almost similar (~21%) and minimum rate was in the Centre region (~14%). According to religion, it was found that majority of the young adults were Muslims (87.3%), whereas Christians and Druze had almost similar rates (6.5% and 6.1% respectively). These distributions were also identical for both genders. Regarding the educational status, it was found that majority of the participants (~65%) had Bagrut and/or above academic

education, on the other hand, about 23% of the young adults completed 12 years of education, but without Bagrut certificate, while the rest of the young adults had less than 12 years of education (11%). It was noticeable that the main differences between both genders lie in the academic degree educational status (~20% for females to ~14% for males). Majority of the participants (~65%) have a low-income level, while the rest are distributed almost similarly between the medium and high-income levels. According to the employment status of the young adults, about 56% of them were employed, and, about 9% of them were unemployed, while a considerable rate of them (36%) were outside the labor force, i.e., they could be homemakers or/and disabled. A significant difference was found between both genders whereas 70% of males and 40% of females are employed, while 23% of males and 49% of females are outside the labor force. This indicates that, still majority of the young females are not employed, but are homemakers.

Table 2 shows the frequency of various types of CMs according to several socio-demographic factors.

Table 2 The number and prevalence rates of CMs according to various adult-related socio-demographic factors

Factors	Consa.						Non-consa.		Mean inbreeding coefficient (α)
	First cousin and closer (FCC)		Other consa. (OCM)		Total Consa.		N	%	
	N	%	N	%	N	%			
Age range (y)									
18-24	16	17.6	36	39.6	52	57.1	39	42.9	0.02109
25-29	19	9.1	73	35.1	92	44.2	116	55.8	0.01761
30-35	32	9.8	118	36.2	150	46.0	176	54.0	0.01794
Total	67	10.7	227	36.3	294	47.0	331	53.0	0.01828
Region									
North	26	8.5	103	33.6	129	42.0	178	58.0	0.01808
Haifa	5	6.8	23	31.1	28	37.8	46	62.2	0.01632
Centre	7	6.9	26	25.7	33	32.7	68	67.3	0.01614
South	29	20.3	75	52.4	104	72.7	39	27.3	0.02407
Religion									
Muslim	58	10.9	203	38.0	261	48.9	273	51.1	0.01836
Christian	3	8.8	6	17.6	9	26.5	25	73.5	0.01276
Druze	6	10.5	18	31.6	24	42.1	33	57.9	0.01811
Educational status									
<12 years	12	14.7	32	39.0	44	53.7	38	46.3	0.01886
Completed 12 years	16	9.9	60	37.3	76	47.2	85	52.8	0.01809
Bagrut	13	8.4	67	43.2	80	51.6	75	48.4	0.01811
Non-academic diploma	11	13.8	25	31.2	36	45.0	44	55.0	0.01806
Academic degree	14	10.2	41	29.7	55	39.9	83	60.1	0.01674
Income level									
Low	50	11.5	172	39.7	222	51.3	211	48.7	0.01882
Medium	9	11.3	27	33.8	36	45.0	44	55.0	0.01761

High	7	14.9	11	23.4	18	38.3	29	61.7	0.01743
Employment status									
Employed	45	10.4	150	34.8	195	45.2	236	54.8	0.01788
Unemployed	5	11.9	16	38.1	21	50.0	21	50.0	0.01854
Outside the labor force	17	11.2	61	40.1	78	51.3	74	48.7	0.01866

The total rate of CMs in the young adult's sample of the survey was found to be as high as 47%. The main CM- type was found to be the OCMs type, which constituted about 36%, while the first cousin and closer (FCC) marriage type constituted about 11% of the whole marriages. According to the age range of the participants, the results showed a high prevalence rate of CMs (~57%) in the youngest age range (i.e., 18-24 years). While the other two age ranges (25-29 and 30-35 years) had also high, but almost similar, rates of CMs (~44% and 46% respectively). The differences in the rates of CMs in relation to age range were found to be statistically significant ($p=0.01$). It is noteworthy that the high rate of CMs in the youngest age range is prominent in the FCC marriage type. Consequently, the mean inbreeding coefficient (α) was found to be the highest in the youngest age range (18-24 years), while the other two age ranges (25-29 and 30-35 years) had almost similar values but are still considered to be high.

Furthermore, the data obtained revealed variations in CMs in relation to various geographic regions reaching the highest in the South region about ~73%, followed by the North region (42%), then the Haifa region (~38%), while the Centre region had the lowest prevalence rate of CMs (~33%). This distributional trend is evident in both types of CMs (i.e., the FCC and OCMs types). The differences in the rates of CMs related to region were found to be statistically significant ($p<0.00$). These regional differences were also found in their respective mean inbreeding coefficients (α). It was noticeable that in the South region, the rate of FCC marriage type was considerably high (~20%).

According to religion, the highest prevalence rates of CMs were found to be among Muslims (~49%), followed by Druze (~42%), with the lowest being among Christians (26.5%). These differences were statistically significant ($p=0.043$). The frequency of FCC marriage type was found to be approximately similar in the three religions which is around 10%. The mean inbreeding coefficient (α) was the highest among the Muslims (0.0183), slightly lower among Druze (0.0181) and lowest among Christians (0.0127).

The rates of CMs, were found to be inversely proportional to the family's income-level, as the higher is the income-level, the lower is the rate of CMs. Furthermore, the results indicated that the employed participants had less prevalence rates of CMs as compared to the participants in the unemployed or outside the labor force categories (~45%, 50% and ~51% respectively). In general, it was found that there is an inverse relationship between the educational status and the prevalence rates of CMs; the higher is the educational status, the lower is the rate of CMs, these differences were found to be statistically significant ($p<0.05$). This is specifically evident when comparing the <12 years with the Academic degree categories, where the rates are ~54% and ~40% respectively. These differences in the three factors: income-level, employment and educational status are also clearly reflected in their respective mean inbreeding coefficients (α).

The relationship between specific women-related fertility factors and the prevalence rates of CMs among the participants was demonstrated in table 3.

It was found that the percentage of couples who have ≥ 5 children in the CMs type (8%) was higher than those couples in the non-CMs type (4.6%). Additionally, it was found that the couples with closer CMs type (i.e., FCC) implies that they have a higher number of children than those with other CMs (OCMs), (20.0% and 4.6% respectively). There are minor differences between CMs and non-CMs in relation to presence or absence of pregnancy difficulties (23.7% and 19.8% respectively). These differences were more evident within the two groups of CM types i.e., FCC marriages have more pregnancy difficulties than the OCM group (33.3% and 21.0% respectively). According to medical treatment for pregnancy initiation factor, it was found that couples with CMs have undergone medical treatment for pregnancy initiation more than those with non-CMs (7.3% and 4.4% respectively). Additionally, the occurrence of spontaneous abortion was significantly evident within the couples with CMs versus those with non-CMs (16.7% versus 11.1%). In general, all the women-related fertility factors examined, were found to be significantly associated with CMs.

Table 3 The number and prevalence rates of CMs according to fertility-related factors

Factors	Consa.						Non-Consa.	
	First cousin and closer (FCC)		Other consa. (OCM)		Total Consa.			
	N	%	N	%	N	%	N	%
Number of children								
1-2	22	40.0	132	67.7	154	61.6	184	71.1
3-4	22	40.0	54	27.7	76	30.4	63	24.3
≥5	11	20.0	9	4.6	20	8.0	12	4.6
Pregnancy difficulties								
Yes	19	33.3	44	21.0	63	23.7	55	19.8
No	33	57.9	137	65.5	170	63.9	203	73.3
Decline to answer	5	8.8	28	13.4	33	12.4	19	6.9
Medical treatments for pregnancy initiation								
Yes:	5	7.6	16	7.2	21	7.3	14	4.4
No:	51	77.3	175	78.5	226	78.2	273	85.8
Decline to answer	10	15.1	32	14.3	42	14.5	31	9.7
Spontaneous abortion								
Yes	17	26.1	30	13.9	47	16.7	35	11.1
No	41	63.1	153	70.8	194	69.0	247	78.2
Decline to answer	7	10.8	33	15.3	40	14.2	34	10.8

4. Discussion

Consanguineous marriage (CM) is considered to be a common phenomenon in certain societies (from the Middle East, West Asia and North Africa) who constitute about 20% of the earth's population, and also among emigrants from these communities who settled in North America, Europe and Australia [5, 23]. The results obtained by us indicated that the total rate of CMs in the young population (18-35 years old) of the Arab society in Israel during the year 2021, is high and accounted for 47%. This was found to be within the range of that rate found in many other Islamic societies, for example, the prevalence rates of CMs in Afghanistan 46.2% [24], in Lebanon 35.5% [25], in Jordan 51.2% [26], in Saudi Arabia 51% in 1997 and 40% in 2021 [27, 15], between 20.9 to 32.8% in Egypt, 47 to 60% in Iraq, and 40 to 44.7% in Yemen [1]. Additionally, our previous results from the 2007 and 2017 surveys showed that the total CM prevalence among the general Arab population in Israel increased significantly from 36.3% to 41.6% over the decade [22], while the current results focusing on young adults showed a further increase. This finding is supported by a Saudi study which demonstrated that the prevalence of CMs among the participants' parents was lower (31%) than that among the participants (40%) themselves [15]. There are many explanations for why CMs are still common, widely practiced, and even preferred in many societies around the world. The communities involved in these actions have their own justifications and even consider them traditional and social. These reasons are considered as values which include clan unity, interpersonal compatibility, family property maintenance, parental authority, societal protection for women and reduced matrimonial expenditures [28, 29, 30]. Additionally, it was found that the risk of divorce/separation and polygyny were found to be lower among women with CM [31]. The prevailing opinion is that the social advantages overbalance the health-related disadvantages, which justifies why CMs practice is still favored in certain communities.

Our current findings showed that the main CM type was found to be the other CMs (OCMs) type, which constituted about 36%, while the first cousin and closer (FCC) marriage type constituted about 11% of the whole marriages. This finding is in accordance with a Saudi study which found that the other CMs type (i.e., the second cousin marriages and the distant relative marriages) was slightly higher than the first cousin marriage type [32]. On the contrary to our current results, we previously found that the FCC marriage type among the general population in the Arab society in Israel, had

slightly higher prevalence rate (21%) than OCMs type (20%) during the year 2017 [22]. Moreover, other studies from various communities demonstrated contradicting results to our current study i.e., higher prevalence rates of first cousin marriages than other CM types [26, 1, 15]. This suggests that FC marriage is culturally still deeply rooted in Arab societies. It 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 [33]. Our results showed that the highest rate of CMs was found to be in the youngest age range (18-24 years), and FCC type specifically had also the highest marriage rate in this age range. This may be because of early age at marriage of the couples which is well-known that this variable is associated with CMs [34, 21].

It was well-documented in a considerable number of studies that various socio-economic and demographic factors play vital role in determining the extent and the prevalence of CMs in various societies worldwide [35, 36]. Our findings demonstrated that the south region of the Arab society in Israel had the highest prevalence rate of CMs (~73%) which is inhabited mainly by Bedouins known for this practice, which has been deeply rooted in their culture since ancient times. The results obtained were in concordance with other previously obtained ones from the south region in Israel, but in the years 2009 and 2010, where the prevalence rate of CMs was about 45% [37]. Low rates of CMs were found in the Centre and Haifa regions which could be explained by the common presence of urban residencies in these regions, as it was well-known that urban areas have lower rates of CMs than rural areas [38]. Furthermore, the northern region includes urban, semi-urban and rural localities. Thus, the north's rate of CM is the closest to the average rate of consanguinity in the current survey.

Generally, our data showed that CMs are prevalent in the three religions (Muslims, Druze, and Christians), while there are some variations between them. The high CMs in Muslims could be due to its preferable nature culturally, as it is deeply rooted. Studies from India pointed out that religious affiliation was found to be playing significant role in determining CM [35, 39]. A further study from India [40] found that Muslims show a higher frequency of consanguinity (67.11%) followed by Hindus (27.63%) and Christians (5.26%), which was found to be in conformity with the results of the study conducted in Belgaum [41]. It is noteworthy to mention that the Druze and Christian Arabs are characterized by relatively small communities here in Israel. Moreover, most marriages take place within their own religions. In addition, the populations of these two religions are geographically isolated, which limits opportunities to marry with their counterparts from other Arab countries.

The results show that there is an inverse relationship between the educational status and the prevalence rates of CMs. Most of the studies that examined this relation demonstrated that consanguinity associated with less educated participants in Turkey, India, and Jordan [42, 39, 43] and locally in Israel [44, 45]. On the other hand, some studies found contradicting results for example in Saudi Arabia, where there is still a high prevalence of CMs despite increased educational level, this may be attributed to the fact that this practice is more influenced by attitude towards this type of marriage rather than educational level [19]. A similar result was also obtained in India where more educated women were associated with CM group [46]. Therefore, education may empower women, but there may also be an incompatibility of roles, which prevents them from fulfilling spousal obligations. It is well known that education always gives exposure to newer ideas and wisdom. Furthermore, there is no doubt that education increases community members' awareness and knowledge of the risk factors and drawbacks of CMs. It also broadens and enlightens people's perspective on life and creating a healthy family, and informs them about the genetic disorders and congenital malformations that can result from CM. Therefore, it is important to implement health education programs that spread knowledge about the harmful effects of CMs.

The economic level of the society could be determined by the income-level and the employment. Our results showed an inversely proportional relation between CMs and family's income-level as well as employment. These results were consistent with other studies that revealed similar findings in various communities [47, 48, 43, 17]. The association between the low socioeconomic conditions of families with high prevalence rate of CMs was observed. The economic advantages of CMs, including lower costs, greater simplicity or ease in premarital negotiations and marital arrangements, lower parental and partner expectations, and the financial advantages of dowry, could be considered the causes of this association [49]. However, in other circumstances, CMs may be brought on by economic factors [50].

Our results demonstrated that couples with CMs had a higher number of living children, indicating that their fertility rate is high. Various international studies reported a higher fertility among couples with CMs [51, 52, 53]. Among Arabs, higher fertility rates and higher rates of live births were reported among first cousin couples than non-consanguineous couples in Qatar [16], Kuwait [54], Saudi Arabia [55], and Tunisia [56]. Similarly, in various ethnic groups from Mauritania consanguineous couples had averages of fertility significantly higher than those of non-consanguineous couples [57]. A study from Lebanon found that total pregnancies, live births, and living children were significantly higher among consanguineous couples than among nonconsanguineous ones [58]. Additionally, a recent study from Morocco

revealed that the frequency of late spontaneous pregnancy loss (SPL) was significantly lower in consanguineous couples [59]. Another study from Pakistan revealed that the couples with CMs were found to exhibit greater fertility than non-consanguineous couples, this is in terms of abortions/miscarriages, stillbirths, and deaths in the infants [60, 61]. A recent Pakistani study found that consanguinity was strongly associated with women's reproductive health and fertility behavior particularly for women who gave first birth at a younger age, had multi-gravida pregnancies, multi-parity, pregnancy termination, antenatal care visits, and higher fertility [17].

The presence of higher fertility rates and thus larger families for the couples with CMs may be due to early age at marriages and thus longer reproductive times or better maternal-fetal compatibility due to the presence of a larger number of shared gene loci due to the existence of CMs [62]. Further theory put forward for the increased fertility of the couples with CMs is reproductive compensation to make up for pregnancy losses [63]. Consanguineous couples have been found to use contraception less frequently [64], have babies for a longer period [65], tend to expand childbearing until a later age, and have higher rates of live births and children. On the other hand, some researchers reported lower rates of fertility among women with CMs as evidenced by long inter-birth intervals [66]. Consanguinity was also thought to influence the age at menopause, and it could be linked to autosomal recessive premature ovarian failure [67, 68].

It was found that consanguinity is associated with increased gross fertility [69], but numbers of surviving offspring for both couples with CMs and non-CMs are comparable because of increased morbidity and mortality. Our study revealed that CMs may be associated with high rate of spontaneous abortion. This is in accordance with a study from Algeria that reported a highly significant correlation between inbreeding and the incidence of abortion as well as post and neonatal mortality [70]. Studies from India and Bangladesh demonstrated that women with increasing level of inbreeding have an increased risk of early spontaneous abortion/miscarriage compared to women with non-CM [71, 72]. Pregnancy wastages from periconceptual losses and miscarriages have been reported by some authors to be slightly more common due to genetic problems [62, 73]. However, several studies failed to determine any significant association between consanguineous marriages and increased abortion/miscarriage rate [1].

In relation to pregnancy difficulties and medical treatment for pregnancy initiation, the results we obtained revealed that couples with CMs have more pregnancy difficulties and undergone medical treatment for pregnancy initiation more than those with non-CMs. In the literature it was found that studies on the effect of consanguinity on pregnancy complications are contradictory. It was estimated that about one in six couples in the UAE have difficulties conceiving [74]. A study from a recent genetically isolated population in the Netherlands, found consanguinity to be positively associated with preeclampsia and fetal growth restriction [75] and even suggested a common etiology, caused by a recessive mutation. Conversely, other studies found that there is no effect on the development of maternal and fetal complications of pre-eclampsia [76, 77].

As our data revealed that there is an association between CMs and the couples' fertility-related factors (pregnancy difficulties, medical treatments for pregnancy initiation, and spontaneous abortion), this could be explained due to the presence of some health-related related conditions of the offspring like congenital malformation and/or genetic disorders. Despite this fact it was found that the high fertility rate (in terms of higher number of children) was more commonly observed among couples having CM types. This could seem to be a contradiction, but it may be explained as couples with CMs were more concerned due to consanguinity-related health outcomes among their offspring i.e., congenital malformation and/or genetic disorders, so they go for a higher number of children as a compensation factor. Other explanation may be related to the awareness regarding family planning as it is expected that families who have less education and income-levels tend to be less aware regarding family planning which is the case as shown by our results among couples with CMs.

5. Conclusion

It is evident from the given information in this study that the prevalence rates of CMs among the young generation of the Arab society in Israel are high and affected by various sociocultural, socioeconomic, and demographic factors such as educational status, income-level, and employment status. Furthermore, the women-related fertility factors examined, were found to be significantly associated with CMs. Therefore, we recommend to implement efficient, educational intervention programs and plans to make the people aware of the consequences of consanguinity, then further minimizing the contributing factors that promote consanguineous marriages particularly among the young generations in the Arab society of Israel. Proper collaboration among the religious, public, governmental, and nongovernmental sectors could yield fruitful results. Furthermore, we recommend the insistence on the importance of genetic counseling and its vital effect on future generations in our society particularly for the young people before and after marriage. The health educational programs and genetic counseling should be provided by qualified native Arabic speakers, who understand the religious and cultural backgrounds of the society.

Compliance with ethical standards

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Disclosure of conflict of interest

All the authors of this study declare that they do not have any conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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