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Review Article

Consanguinity Status in the Arab Society of Israel: Is it Different?

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Abstract

Consanguinity is a traditional phenomenon that is common in many communities worldwide, particularly, in Arab societies. Its prevalence was still regarded as being high, despite, its decrease in some communities. The purpose of this review is to shed light on the status of consanguineous marriages (CMs) internationally and locally, in the Arab society of Israel. Some of the data were obtained from national surveys over certain periods of time, while the other data were extracted from published articles as, a search was conducted on specific articles published in relation to the prevalence of consanguinity among the Arab society in Israel. It was found 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%. A table of compiled local studies concerning this topic was presented. Some studies showed a continuous decrease in the prevalence of consanguinity, as well as a decrease in various types of CMs, particularly, the first cousin and closer marriage type. We recommend the initiation of comprehensive educational programs for various sectors of the population and the implementation of specific community-based genetic counseling (GC) programs that include genetic testing before and during marriage, particularly for consanguineous couples.

Keywords: Consanguinity, Consanguineous marriage, Trend, Prevalence, Arab society in Israel, First cousin and closer marriage type, Socio-demographic factors, Genetic disorders

Abbreviations: CM: Consanguineous Marriage; CMs: Consanguineous Marriages; AR: Autosomal Recessive; ARD: Autosomal Recessive Disorders; GC: Genetic Counseling; ROH: Runs of Homozygosity; PTC: Papillary Thyroid Cancer; UAE: United Arab Emirates; CHD: Congenital Heart disease; ALL: Acute lymphoblastic leukemia

Introduction

Consanguinity Worldwide

Definition and background: Consanguinity (or consanguineous marriage - CM) is described as a marriage between a couple who are relatives as second cousins or closer [1]. The inbreeding coefficient (abbreviated as F) is a measurement of how closely a couple is related. Thus, F measures the possibility that two genes at any locus in an individual are identical by descent from the common ancestor(s) of two parents. Therefore, an F value that is ≥ 0.0156 is a CM [1,2]. Using the inbreeding coefficient (F) between

individuals can be utilized in various fields such as quantitative genetics, conservation genetics, forensics, evolution, and ecology [3].

When couples share at least one common ancestor, they are said to be inbred or consanguineous, therefore, these two terms i.e., "inbreeding" and "consanguinity" are used interchangeably. Inbreeding in population genetic terms refers to a departure from nonrandom "mating" in which individuals' "mate" with those more similar (genetically) to them than if they "mated at random" in the population. Children whose parents were consanguineous may be more vulnerable to genetic disorders because autosomal recessive gene mutations are inherited from one common ancestor. Biologically, the closer the parents are to each other, the greater the likelihood that their children will inherit identical copies of one or more undesirable recessive genes. For instance, the genetic makeup of first cousins, is predicted to share 12.5% (1/8). As a result, their progeny will be homozygous (1/16) at 6.25% of gene loci (i.e., they will receive identical copies of all gene copies from both parents) on average [4]. Since the dawn of modern humans, CMs have been practiced. The practice of consanguinity has been widespread amongst several communities across the globe, with rates varying according to religion, culture, and geography [5].

The prevalence of consanguineous marriages worldwide: Western countries were found to have very low rates of CMs (~1%) as compared to Arab nations [1]. In comparison to Western countries, the Middle East and North Africa have high levels of CMs [6]. In Western society (Netherlands), a study was conducted seeking to gain information about: (A) attitudes of people belonging to ethnic groups (Dutch Moroccans and Turkish), in terms of consanguinity, and their perception of risks associated with offspring; and (B) the attitudes of the people from these groups toward reproductive information targeted at consanguineous couples. It was found that over 50% of the respondents believe that information should be provided before marriage, while only 10% believe that it should never be disclosed [7]. Consanguineous marriages have been practiced since the early existence of modern humans. Currently, ~20% of the world's population lives in communities that prefer to marry close relatives [8]. In Pakistan, an epidemiological study on CMs was undertaken to determine the various types of marriages and the distribution of inbreeding rates. The study revealed that CMs accounted for 62 percent of the whole marriages, from which first-cousin marriage type was the most common one, accounting for 50.13 percent of all CMs [9]. A further study from Pakistan demonstrated that the proportion of CMs varied from about 60 percent to over 80 percent, with first cousin unions accounting for 40 percent to 50 percent of the whole CMs which is the most predominant one [10]. First cousin marriage type was the most common type of all CM types in a study from Afghanistan, as it accounted for 21.7% of all CM types. It was followed by second cousin type, first cousins once removed type, beyond second cousin type, and double first cousin type accounting for 16.0%, 14.0%, 6.9%, and 1.6% respectively, of all CM types [11]. A study conducted in 2016 to evaluate the prevalence of CMs among Iranians from the south-west Iran, found that cousin marriages accounted for 51.8 percent of all CMs [12]. Between two national-level surveys in India, research was undertaken to examine the change in prevalence of CMs. The general prevalence of CMs has decreased from 9.4% to 7.9% [13].

It is known that marriage practices have direct consequences for human genetic variation. One of the extensively debated and regulated practices, is consanguinity. Couples who are second cousins or closer and their offspring constitute an overall estimation of 10.4% of the world's population. Additionally, it has been observed that north and sub-Saharan Africa, the Middle East, and West, Central, and South Asia have the highest rates of CMs [14]. Pakistan and India were found to have some of the highest prevalence rates of CMs, with over 73 percent in Pakistan [15] and 5 percent to 60 percent in India [16].

Consanguinity and genetic disorders: CMs indicate an increased risk of autosomal recessive and multifactorial genetic disorders for offspring since autosomal recessive gene mutations are inherited from a common ancestor [17]. As a result, children born to consanguineous couples are 13 times more likely than children born to the general population to have genetic diseases, and one out of every ten infants born to first-cousin marriages in Birmingham, UK, dies in infancy or develops a major impairment [18,19]. Consanguineous marriages were associated with the incidence of several single-gene and multifactorial diseases, and congenital malformations, including bronchial asthma, hearing defect, heart diseases, sickle cell anemia [20]. In India, one of the recent studies was carried out to evaluate the adverse pregnancy outcome in connection to consanguinity and mother age. The study revealed that 15.6% of negative pregnancy outcome was recorded in inbreeding population while, 9.3% were recorded in out breeding population [21]. The progeny of couples with consanguineous unions were found to have longer runs of homozygosity (ROH) in their genomes, as compared to those from the non- consanguineous unions [22]. Such children are known to carry a greater recessive disease burden [23] equivalent to an increase in child mortality or severe disease of approximately 3-4% [24,25]. A study in Bangladesh found that CMs have negative effects on reproductive behavior and the occurrence of inherited disorders as bronchial asthma, hearing loss, heart disease, and sickle cell anemia [20]. Recent research linked paternal consanguinity, which is thought to be a risk factor for papillary thyroid cancer (PTC), to the occurrence of PTC. This condition should be included during familial risk assessment and GC, according to the study [26], especially in

communities with high incidence of CMs. A study that incorporated published genetic data and information about marriage traditions from 396 worldwide communities was done to evaluate the larger effect of consanguinity on patterns of genetic variation on a global scale. Marriage behaviors only account for a small percentage of the variation in the distribution of runs of homozygosity (ROH), hence the ability to forecast marriage practices from population genetic samples is limited [27].

Consanguinity in the Arab world

Although CM is customary and recognized in most African and Asian countries, it is more popular, particularly, in Arab countries [28,1]. Many assume that the rate of CMs declines with modernization, change of lifestyle, and increased literacy, however, empirical evidence contradicts this [29,30]. Due to the many societal advantages of CMs, about 20% of the world's population prefers them. The rates of CMs do differ between and among groups of various communities, this could be because of a variety of factors such as culture, location, ethnicity, and religion [5]. According to various ethnic-related factors, the rates of CMs in different groups of people vary greatly. It is worth noting that in many Arab countries, the rate of marriage between close relatives is the highest in the world, accounting for about 20-50% of all weddings. It was found that first cousin marriages were the most common accounting for roughly 20 to 30 percent of all marriages [5]. CMs rates and geographic endogamy were more common in the more rural areas of Tunisia. The percentage of CMs varies between 20.1 and 39.33 percent [31,32]. In Tunisia, all couples who have a family history of genetic disorders and/or CMs must undergo premarital GC [33]. A six-fold increase in the incidence of autosomal recessive disorders (ARD) was previously documented due to the high rates of CMs [34]. Consanguinity was found in 69.4 percent of cases in a recent retrospective analysis of 425 patients from Tunisia having ARD, the prevalence of first cousin unions was 48.94 percent. In some southern locations, consanguinity accounted for 65.26 percent. Most of the mutations were found to be homozygous. Geographic endogamy was also found in 93.92 percent of the subjects investigated. The authors calculated a sevenfold rise in ARD related with CMs; it was further noticed that in certain cases, the risk was as high as 24-fold [35].

Double first cousins, first cousins, first cousins once removed, second cousins, and beyond second cousins were the various categories used to categorize CMs according to the degree of relationship between the husband and wife. Due to the rising frequency of CMs, many uncommon genetic illnesses and new genetic abnormalities have been discovered [2]. The prevalence of CMs is common among the uneducated and low educated, especially in rural areas [36]. CMs have been observed to become less common in various Arab societies throughout time, as there has been a decrease in their frequencies [37,38]. However, it is still believed that the relative frequency of CMs in Arab communities is high ranging between 20% to 50% [39]. The rate of CMs has been found to be affected by various factors such as demographics, religion, socioeconomic status, and local traditions [40,41]. An estimated 35% of Jordanian marriages were consanguineous in 2012. Consanguinity has been on the decline in the country, with the rate falling from 57 percent in 1990 to 35 percent in the study time (2018). In 2012, first cousin marriages accounted for 23 percent of all marriages, and they comprised the majority of all CMs accounting for 66 percent of them [42]. According to a study carried out in Palestine, it was revealed that CMs are frequently used in the Palestinian Territories, accounting for 45 percent of all marriages in 2004. However, CMs were found to be declining over time [43].

CMs accounted for 27.4 percent of youth marriages in Egypt (with ages 13 to 35). However, the frequency varies by geography, with rural Upper Egypt (43.6 percent) having the highest frequency and urban Lower Egypt having the lowest (13.2 percent). In addition, it is higher in rural (29.3%) than urban (23.9%) areas [44]. According to a study from Saudi Arabia, it was found that 29.7% of parents were consanguineous (first and second cousins) [45]. In Saudi Arabia, a cross-sectional study was carried out to investigate the effect of CMs in genetic diseases. The study revealed that CMs among parents play a substantial role in congenital heart disease (CHD). As CM has a variable effect on genetic disorders, therefore, it should be considered during GC [46].

According to a research work conducted in Bahrain, it revealed that the prevalence of first-cousin marriages decreased from 24% to approximately 7% over a period of ten-years [47]. Furthermore, 35.5 percent of marriages in Lebanon were consanguineous; 31.6 percent were between first cousins, 3.9 percent were between second cousins, and 2.3 percent were between farther relatives [48]. Moreover, several research works found disparities in maternal and paternal first-cousin marriages, with first-cousin marriages accounting for 73.3 percent in the United Arab Emirates (UAE) [49]. According to a study conducted in Qatar, it was revealed that the current generation has a high percentage of consanguinity (54.0 percent). First cousin marriages type was the most common CM (34.8 percent). When compared to other communities, double first cousin marriages were common (3.1 percent). In one generation, the rate of CMs in Qatar was found to be rising from 41.8 percent to 54.5 percent [50]. A recent study in Qatar looked at the impact of CMs in a group of people with genetic illnesses. It was discovered that CMs were recorded in 397 of 599 (66.2%) Qatari families, with first cousins accounting for 65 percent of the population. According to the findings, paternal consanguinity plays a substantial influence in raising the occurrence of genetic illnesses, particularly ARD.

These findings aid policymakers in developing social, educational, and public health programs with the aim of minimizing the negative effects and drawbacks of hereditary diseases in the population of Qatar [51]. A recent review was conducted in Qatar summarized the potential causes of infertility there. It found that the high rate of consanguinity leading to genetic abnormalities, could be one of the causes that affect infertility in this population [52]. CMs have high frequency in many of the developing nations, this raises the likelihood of homozygosity for several genes, which probably could impact acute lymphoblastic leukemia (ALL), a common childhood cancer, and its prognosis. Thus, a study was carried out in Syria to investigate the influence of CMs and the number of siblings on ALL, as there is a lack of studies dealing with this effect. Some factors and prognostic aspects of childhood ALL were discovered to be altered by CMs and the number of siblings [53].

CMs are thought to be a major source of genetic abnormalities that result in disabled offspring, with 90% of such cases occurring in developing nations [54,55]. CMs have been linked to various genetic abnormalities, including immunodeficiency disorders, beta-thalassemia, children's hypertension, protein C and protein-S deficiency, phenylketonuria, and low birth weight, according to a study conducted in Qatar [56]. In Morocco, a study was conducted to determine the impact of CMs on the occurrence of hemoglobinopathies. It was discovered that 50.25 percent of infants with hemoglobinopathies had consanguineous parents with first cousin marriages accounting for 68.69 percent of this CMs [57]. It had been estimated that billions of dollars are spent every year to treat and control the congenital diseases resulting from CMs. In Arab countries, the treatment of 4 hereditary diseases including thalassemia, sickle-cell anemia, cystic fibrosis, and hemophilia costs more than 13 billion dollars annually [58].

Consanguinity in Arab society of Israel

Characteristics and sociodemographic determinants of the Arab society in Israel: The Israeli state was founded in 1948 when most of the Palestinians living in the same region were expelled from their homeland by force to the West Bank of the Jordan river or Gaza Strip or even the neighboring Arab countries, who live in exile to date [59]. In 2019, the Israeli population included 9,140,500 citizens of whom 6,773,200 were Jews. Muslim Arabs (1,635,800), Christian Arabs (177,300), and Druze (145,310) were among the other communities living on the same land. For generations, each Arab community has been somewhat isolated, owing to the religious group's penchant for CMs. The Muslims that comprise more than 80% of the Arab population in Israel are mostly living in localities or neighbourhoods where they are the majority [60]. The Arabs tends to marry close relatives frequently, thus, having high rates of CMs, furthermore, the towns and villages where they live were founded by relatively few individuals [61].

Regardless of the mechanism used, the link between socioeconomic status and mortality may be adjusted by resources such as money, knowledge, prestige, and power that boost health regardless of how they are used [62]. Despite the overall increase in the educational and economic status of the citizens of Israel, still, the Arabs' average educational and income levels remain below that of the Jews. Moreover, the contribution of Arab women in the labor market is around 25%, which is much lower than that (70%) of the Jewish women [63]. The Arab society of Israel has unique socio-demographic and cultural features that could lead to common and rare gene-mutations that give rise to genetic disorders [63,61]. It was established by various studies that the Israeli Arabs have a lower life span than Jews, the reason for this could be due to the contribution of chronic diseases in the Arab community, particularly, ischemic heart disease and diabetes [64].

Consanguineous marriages among Arab society of Israel: The Arab society of Israel, like other Arab nations, is noted for having an increased rate of CMs, particularly, favoring the first-cousin union [65,66]. The prevalence rate of CMs declined from 35.8% among those married before the year 2000 to 28.2% among those married between 2000 and 2004, and 24.0 percent among those married between 2005 and 2009 [67]. Sharkia and colleagues evaluated the occurrence and trends of two generations of first-cousin marriages in 2015. The proportion of first-cousin marriage type decreased over two generations, but it remained the most prevalent among the other types of CMs [68]. A local study was carried out that provided estimates of the relative contributions of the women's school enrollment and educational achievement to the decrease in the prevalence rates of CMs over two time periods, 1975-1979 and 2005-2010. The study revealed that CMs decreased by almost 60%. A third of this decrease could be attributed to the increase in the age at which the women leave school. This reduction was unrelated to the women's educational attainment [69]. Even though the prevalence rate of CMs and infant mortality among Bedouins in the Negev (south of Israel) has decreased, nevertheless, such values remain alarmingly high. The number of Bedouins affected by genetic disorders has decreased in tandem with the fall in consanguinity [70]. The Jewish population had a comparatively low prevalence rate of CMs (2.3 percent), from which just a rate of 0.8 percent corresponds to first cousin marriage type [71].

Drawbacks of consanguinity: Many studies have shown that CMs 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, mental retardation, asthma, and epilepsy [72-74]. Long runs of homozygosity (ROHs), which are indicative of recent

consanguinity, have been associated to recessive inheritance of complex phenotypes [75]. Consanguineous couples' offspring are more likely to develop rare recessive syndromes [76], fetal, newborn, and child mortality [77-79], birth abnormalities [80-82], and later disabilities such deafness [83,84]. Consanguinity may also play a role in longer-term outcomes, such as malignancies in children and young people, breast cancer [85,86], and complicated disorders later in life [87,88].

Despite the presence of many negative effects of CMs, but their prevalence was high about 44% according to the study conducted in 1994 [89]. This prevalence is still high according to our current study accounting for about 42% as per the data from the 2017 survey.

A study investigated the reading difficulties in the children of parents with CMs in the Arab society of Israel. Reading difficulty was found to be more common in children with highly consanguineous parents than in children with less consanguineous and unrelated parents [90]. Regardless of the harmful consequences of CMs on the present as well as and future generations' health, but the Western lifestyle followed by many of the Arab citizens in Israel was unable to significantly decrease the phenomenon of CMs [73].

Advantages of CMs: Many communities (including, Arab countries, India, and small isolated communities,), in addition to the Israeli Bedouin community, who prefer CMs, have their own reasons that justify such action and even consider it to be traditional and social. Such reasons are considered as values. Clan unity, interpersonal compatibility, family property maintenance, parental authority, and societal protection for women were the key reasons offered in this context [91].

The prevailing opinion is that the advantages overbalance the disadvantages. This explains why the custom is still extremely prevalent in such communities [92].

Methodology

Definitions

The couples in consanguineous marriages (CMs) have varied degrees of relationship. Double first cousins, first cousins, first cousins once removed, second cousins, and double second cousins were the various types of CMs (pedigrees of these types of CMs are illustrated in Figure1). The following are the two primary categories of such marriages:

a. Marriages between first cousins and closer. Double-first cousins (in which all grandparents are shared) and first cousins are examples of this marriage type (in which the couple is patrilateral parallel or cross, or matrilateral parallel, or cross).

b. Marriages between distant relatives, in which the couples could be related to each other through one of the following relations: first cousins once removed, second cousins and double second cousins.

c. Non-consanguineous marriage. This type of marriage includes the couples who are not related and/or who are born in different villages.

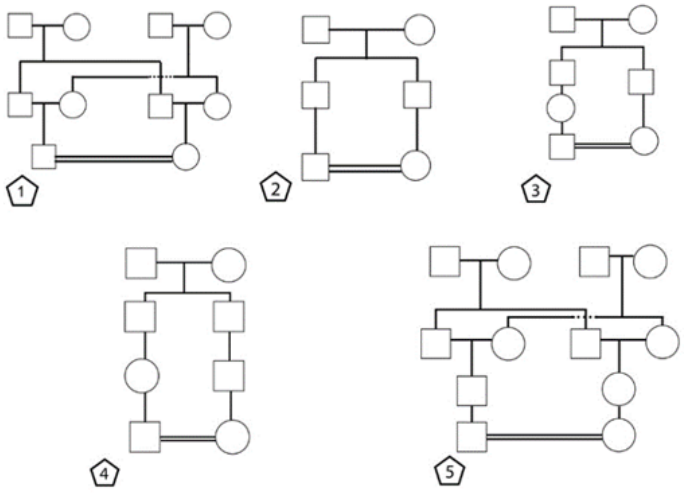

Figure 1: Pedigrees of the various types of consanguineous marriages (CMs), along with their inbreeding coefficients (F):
1. Double first cousins (F=0.125),
2. First cousins (F=0.0625),
3. First cousins once removed (F=0.0313),
4. Second cousins (F=0.0156),
5. Double second cousins (F=0.0313).

Study Population and Survey Design

These surveys aim to produce the required information and spread knowledge about the Arab society in Israel, thus, consequently understanding the needs, challenges, fears, and the possible opportunities for a better future planning. This leads to the establishment of appropriate policies and programs by the decision makers, based on scientific and objective data. The sample was created at three levels: one stratification level of enumeration regions was chosen, 30 responsive families in the chosen enumeration area was picked, and two people, a male and a female, were chosen. This selection was made from each household in the second stage using the spread sheet (Kish) for random selection. The study population was divided into homogeneous strata, considering gender and age group variables. The samples were representative of the Arab community in Israel.

Data Collection

Data were obtained using various surveys conducted during different periods of time from 1980 to 2017. The couples included in these studies are from various parts of the Arab society in Israel.

A. Data for the first two periods (i.e., 1980-1985 and 2000-2004) were collected as follows:

i. The various information concerning the couples who got married during the two periods of time, were collected from the Shar'i Courts in the northern region. All Muslim marriages are registered in this court, in accordance with the law of the Israeli Ministry of the Interior.

ii. Data completion and validation were confirmed by the local councils of the region.

iii. The type of relationship between the couples was further confirmed by the couples themselves, through oral interviews.

iv. The data were further confirmed using telephone interviews with 300 randomly selected couples. Furthermore, the data were cross-checked by contacting local village representatives, who are familiar with all families in their respective villages.

B. The data for the periods of time (i.e., 2007-2017) were performed by "The Galilee Society: The Arab National Society for Health Research and Services" which conducts comprehensive national surveys in the Arab population of Israel tri-annually, to examine changes in various socioeconomic and health status variables, including health-related aspects of CMs.

Results and Discussion

The results in Table 1, showed that the total CMs decreased in the first two periods surveyed (i.e. 1980-1985 and 2000-2004) from 33.1% to 25.9%, thereafter, they started increasing to the last survey in 2017 reaching 41.6% (Table 1). On the other hand, FC and closer marriage type was found to decrease from the first period of the survey (1980-1985) to the second one (2000-2004) from 23.9% to 13.6%, then they started increasing gradually till the period of 2010 reaching 22.3%, consequently, reaching to an almost stable rate of about 21% by the latest survey in 2017. This fluctuation in the prevalence rate of FC and closer marriage type was accompanied by a nearly constant increase in the prevalence rate of other CMs type from 9.1% in the first period of the survey to 20.4% in the last period of the survey (i.e., 2017).

Table 1: The prevalence rates of consanguineous marriages (CMs) in the Arab society of Israel during various periods studied.

Period (Years)	CMs			Non-CMs
	FC and Closer	Other CMs	Total CMs	
	%	%	%	%
1980-1985	23.9	9.1	33	67
2000-2004	13.6	12.3	25.9	74.1
2007	18.1	18.2	36.3	63.7
2010	22.3	17.2	39.5	60.5
2014	20.8	20.3	41.1	58.9
2017	21.2	20.4	41.6	58.4

The phenomenon of CM is traditional and appreciated in many countries of Africa, and Asia. It is more common specially in Arab countries [28]. It had a global frequency of roughly 10% at the start of this decade, with a high predominance in the Arab and Middle East Muslim countries and a low incidence in Western Europe, North America, Australia, and Russia [5,14].

The present results showed an almost increase in the frequency of CMs during the various periods of times investigated, though a nearly stable ratio could be reached in the last two periods surveyed. These findings were supported by a study on Saudi population [45] that found that CMs were significantly higher among the daughters than the parents. The relative occurrence of CMs is still regarded as

being high [39] in Arab communities ranging between 20 to 50%. A study from India [13], showed that in North Indian region there had been a significant increase in CMs.

In contrast to the current results, previous results [65] from a geographically limited area showed that the trend in CMs was decreasing. A further comprehensive study from the year 1948 to 2007 [61] also indicated that CMs were generally decreasing significantly from 42% to 30%. Furthermore, consanguinity rates have been demonstrated to decline with time in many Arab societies [38,42&43].

As CMs are still widely practiced in many communities, particularly, Arab and some Asian societies, this could be justified [93] by their common belief in the social, cultural, political, and economic advantages of CMs. Very recently, a researcher from Jordan has established that CMs have certain social benefits, since they serve protective roles against divorce or separation, polygyny, and marriage survival [94], this emphasizes the wellbeing of the family specifically and generally for the society. Other studies [95,96] revealed certain advantages of consanguinity, as in comparison to the non-CMs group, women with CMs had considerably higher fertility and mean live births.

On the other hand, non-CMs are a better technique for delaying the onset of sickness for some generations until science develops a viable remedy [93]. There are many epidemiological studies that showed a significant excess of congenital anomalies in the offspring of the consanguineous couples. Such marriages resulted in significantly increased incidences of abortion and stillbirth. Further, reproductive losses (i.e., neonatal, post-neonatal, infant, less than 5 years, and pre-reproductive mortalities) have been observed to be [14] remarkably higher in the consanguineous communities compared to the non-consanguineous counterparts.

Therefore, it is established [5,68&93] that CMs are still high, and practiced, as they have a considerable degree of social beneficial reasons. Such marriages impose a challenge, as the societies in which they are highly practiced, do believe in their positive role of maintaining the stable family structure, security to the woman, and retaining the wealth and land within the expanded family.

The current results showed that first-cousin (FC) and closer marriages were found to be the preferred type of CMs, as they slightly increased with time. Such trend was also documented by various studies [59,61,67&68] among the Arab society in Israel. Many other studies [5,1] from the Arab countries also documented that the most common type of CMs is the first-cousin one. It constituted as high as 30% - 50% or even more of all marriages occurring among relatives in each population. For instance, a Qatari study [50], found that the most common type of CMs was between first cousins with a rate of 34.8% of total CMs. A further study from Jordan [42], found that most CMs in 2012 were first cousin marriages, constituting 23% of all marriages and 66% of all CMs. This trend of the favoured first-cousin marriages was also established in other societies, such as in Brazil [97], as well as in Pakistani immigrants [10] living in the UK. This shows that first cousin marriage type is culturally deeply rooted, particularly in the Arab communities. Therefore, it is established [5,68&93] that CMs are still high, and practiced, as they have a considerable degree of social beneficial reasons.

A study from the southern of Israel, examined the current prevalence of consanguineous marriages and their determinants among Israeli Bedouins, revealed that the rate of consanguineous marriages is still very high [98], making this population at risk for congenital malformations and genetic diseases.

It is known that many factors (cultural, religious, political, socio-demographic, geographical, and economic) play an important role in determining the prevalence of CMs in many societies worldwide. Such factors are related to the status of women particularly, their age at marriage, their educational level, and occupation, as well as economic status [42]. The results demonstrated that the wives' early age at marriage (≤22 years) as well as their low educational attainment (≤6 years) are associated with high prevalence of consanguinity. In concordance with the current results many studies indicated that there is a significant correlation between women's age at marriage and their educational level [28,39&99].

It was important to compile various local and recent studies conducted on the Arab society of Israel and compare their results, therefore, a table was constructed for this purpose (Table 2).

Table 2: The prevalence rates of consanguineous marriages (CMs) in the Arab society of Israel during various periods studied.

Number	Reference/ Year	Aim /Population Sample	Main Findings	
			Prevalence of CMs/	Prevalence of FC
1	Sharkia, et al., 2008 [65]	Data on consanguinity among 1,321couples from four selected villages of the Arab society in Israel were recorded during two periods (1980-1985 and 2000-2004).	Decreased from 33.1% to 25.9%	Decreased from 23.9% to 13.6%.
2	Na'amnih, et al. 2014 [98]	Data on consanguineous marriages among Bedouins (a subgroup within the Muslim Arab population) in Israel were collected. A total of 1,290 Bedouin women who delivered in the maternity wards of the only hospital serving the Bedouin population were interviewed between November 2009 and January 2010.	44.80%	65.7 % of all consanguineous marriages
3	Vardi-Saliternik, et al. 2002 [100]	A national survey was performed on consanguineous marriages in Israeli Arabs and Druze. During 1990-1992, women were interviewed after delivery in maternity wards all over Israel. Data on consanguinity between the couples, their parents, and other demographic information were received from 1,303 Muslim Arabs including 278 Bedouins, from 107 Christian Arabs and 115 Druze.	Muslim Arabs (42%) Christian Arabs (22%) Druze (47%).	Rates of first cousin and closer matings in Muslim Arabs and Druze were stable over time
5	Schellekens, et al. 2017 [69]	A survey on the Palestinians in Israel was used to assess the effects of education on the probability of a consanguineous marriages.	Between 1975–1979 and 2005–2010, CMs declined by almost 60%.	Not applicable
6	Sharkia, et al., 2015 [68]	The study was carried out in order to determine the prevalence and trends of first-cousin marriage types in the Arab society of Israel over a period of two generations. The study sample represented this community.	Generation-1 (1948-1979): 43.1% Generation-2 (1980-2009): 33.7%	Generation-1 (1948-1979): 20% Generation-2 (1980-2009): 14.6%
7	Sharkia, et al., 2016 [61]	The study was conducted to determine the prevalence and trends of various types of consanguineous marriage among the Arab community in Israel over a long time period (1948-2007). The study sample included 3173 Arab couples living in Israel in 2007 and 2008.	Decreased from 42.5% to 30.9%	Decreased from 23% to 12.7%.
8	Jaber, et al., 1994 [89]	A study was conducted to determine the frequency of consanguineous marriages and the inbreeding coefficient in the Arab society in Israel. A total of 9,300 Israeli Arab students in the second grade were sent questionnaires to be filled out by their fathers, with 8521 completed questionnaires returned	44.30%	Occurred more often than marriages between other relatives.
9	Jaber, et al., 1997B [101]	In a previous nationwide study, the rate of consanguineous matings were examined in the Israeli Arab community.	The average inbreeding coefficient was 0.0192 in 1956-7.	Not applicable
9	Zlotogora, 2002 [59]	The study aimed to determine the marriage patterns in a single Muslim village in Israel during four successive periods of time, since the year 1920 and thereafter.	53.90%	20%
10	Jaber, et al., 2000 [102]	The study was conducted in the last 40-year period, to assess the trends in the frequency of consanguineous marriages in four locations of the Israeli Arab population.	CMs in the period 1961-1965 were (50.6%). But by the period 1981-1985 they decreased to 40.6%. In different locations they significant decreased from 52.9% in the period 1961-1970 to 32.8% in the period 1991-1998.	Not applicable

Conclusion

Consanguineous marriages (CMs) are high in the Arab society of Israel, as documented by the surveys carried out in this as well as other local studies. Therefore, it is almost clear that CMs impose a challenge, as the societies in which they are highly practiced, do believe in their positive role, despite their serious drawbacks, particularly, on the current and future generations. Thus, we recommend the initiation of comprehensive educational programs for various sectors of the population and the implementation of specific community-based GC programs.

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Conflict of Interests

The authors declare that there is no conflict of interests whatsoever.

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