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A Review of Consanguinity in the Iraqi Population: A Call to Action to Prevent a Future Health Catastrophe

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Abstract

Although not uncommon worldwide, consanguinity has been a part of Arab culture and tradition as a means to strengthen tribal blood relations. However, this type of union has been linked to inherited diseases, particularly those of a recessive nature (e.g., hemoglobinopathies). Furthermore, several recent studies have documented highly significant associations between consanguineous parentage and common multifactorial diseases, including but not limited to hypertension, mental disorders, and several cardiovascular diseases. In Iraq, the prevalence of consanguinity is very high and still on the rise. This has resulted in an increased prevalence of inherited diseases and has significant negative impacts on Iraq's limited economy. To address this issue, epidemiological studies are urgently required to generate a comprehensive database comprising the distribution of genetically inherited diseases that will be fundamental to establishing an effective future healthcare system. An educational public awareness campaign should accompany these efforts to inform the population about the profound consequences of consanguinity on offspring health. Finally, legislation needs to be put in place to ensure highly vetted genetic testing is conducted prior to any blood-related marriage in order to prevent further genetic complications for future generations of Iraq.

Keywords: Consanguinity, inherited diseases, genetic testing, legislative measures.

1. Introduction

Consanguineous marriage describes the unification of blood relatives with an inbreeding coefficient (*F*; the probability that two genes at any given genomic locus are identical by descent) of ≥ 0.0156 in the resulting progeny [1]. Such unions represent 10.4% of marriages worldwide [2], but are particularly prevalent within Arab populations [3]. This can be attributed, in part, to the traditional role of intrafamilial relations in reinforcing tribal alliances and preserving family wealth. The incidence of cognate relationships among the Arab community ranges between 10.9 and 80.4% [4]. However, it has been reported at markedly higher rates among certain ethnic groups, particularly in Egypt and Syria. Further, first cousin marriages are the most preferred type of blood-related union, accounting for as much as 85% of such marriages

in Yemen [4]. Although less frequent in non-Arab Muslim countries, consanguinity remains high, particularly in Pakistan, where up to 50.3–78.5% of marriages are between cousins [5-7].
Intrafamily coupling is associated with a substantial increase in the rate of monogenic and autosomal recessive inherited diseases among offspring. Children born of consanguineous unions possess elevated genome homozygosity, the consequence of which is known to increase the expression of potentially deleterious recessive phenotypes. Up to 6% of the genome of offspring resulting from first-cousin marriages is predicted to be homozygous. However, this has been reported in excess of 11% among such children with a recessive health condition [8]. It is therefore unsurprising that communities that socially favor inbreeding experience an increased burden of diseases. For example, the recessively inherited blood disorder β-Thalassemia is highly prevalent in tribal populations that favor consanguinity [9]. Additionally, cognate marriages have also been reported to increase the risk of common multifactorial diseases, likely due to a reduction in the overall genetic fitness of the population. In Qatar, for example, inbreeding has been associated with higher odds of common diseases including cancer, hypertension, hearing deficits, mental disorders, heart diseases, gastrointestinal disorders, and diabetes mellitus [10–12]. The aim of the current article is to review the distribution of consanguinity prevalence in Iraq and highlight the gaps of knowledge that urgently need to be filled. Further, the article will also provide an expert opinion to minimize the negative impact of blood-related diseases on the future health of the population.

2. Methods

Evidence for the current article was compiled using a selective PubMed database search inclusive of publications available up to January 2023. The search terms employed included (“consanguinity” OR “blood-related marriage” OR “cousin marriage”), in combination with (Iraq), (“blood diseases” OR “hemoglobinopathies” OR “disease” OR “health” OR “inherited disease”). Only publications describing the prevalence of relevant health conditions (i.e., of public concern) with well-described data collection and statistical analyses were used for the current article.

3. Consanguineous Marriages in Iraq

The literature concerning the prevalence of intrafamilial marriage and its implications on population health in Iraq is sparse and largely outdated see **Table 1**. Overall, available studies have reported a nation-wide consanguinity rate ranging between 24 and 71%, with notable province-to-province variation. In the semi-autonomous Kurdish region of Northern Iraq, estimates of the prevalence of intrafamilial unions have been consistently calculated between 24.3 and 36.9% [13–15], with a single study reporting that above 70% of marriages in the region involve individuals with a degree of relatedness [13]. However, this upper estimate was calculated by surveying a small number of families (n = 21), bringing its accuracy and broader generalisability into question. An elevated rate of cognate unions is observed in the predominantly Arab Central and Southern regions of the country, between 44.0 and 53.4% [16–18], and in the Anbar province in the West of Iraq, estimated at 64.6% [19]. The most extensive study examining the prevalence of consanguinity in the country was published in 2000 [20]. With the support of the United Nations International Children's Emergency Fund (UNICEF), the authors concluded that up to 61.0% of marriages within South and Central Iraq were among

blood relatives. It is important to note, however, that the degree of relatedness was not specified for all unions; hence, it may include relationships between extended family members with a clinically non-significant *inbreeding coefficient in the* resulting progeny.

Table 1. Prevalence of Consanguineous Marriage in Iraq

Provence/ region	Sample size	Information Source	Consanguinity (%)	First Cousin (%)	Reference
Kirkuk	21 families	Population survey	71.4	57.1	Barth (1954)
South Kurdistan	46 families	Population survey	36.9	17.4	Barth (1954)
Dohuk	591 couples	Healthcare centres	27.2	ND	Al-Allawi & Al-Dousky (2010)
Sulaimani	736 couples	Healthcare centres	24.3	ND	Jalal *et al*. (2008)
Baghdad	4491 families	Hospital: in- and outpatients	46.4	29.2	Hamamy *et al*. (1986)
Baghdad	382 families	Hospital and research centre staff	53.4	35.9	Hamamy & Al-Hakkak (1989)
Baghdad	302 families	Population based sample	44.0	56.4	Lafta (2010)
Anbar	150 families	Outpatient clinic of hospital	64.6	36.6	Yahyaa *et al.* (2019)
South/central Iraq	13897 women*	Household survey	61.0	ND	Ali & Shah (2000)

***Household survey of women conducted with financial and technical support from UNICEF. The 61% includes marriages of cousins and other relatives. Consanguineous and other relatives' marriages in the semi-autonomous Kurdish region were found in less than 50% of the 11099 interviewed women. ND= not defined.**

4. The Gap of Knowledge in Iraq

The profound impact of inbreeding on population health outcomes necessitates the development of a better understanding of consanguinity in Iraq. To address the consequences of consanguinity for the Iraqi populace, researchers need to establish three key areas of knowledge:

1. Despite their widespread prevalence and continued increase [21], there has been no recent comprehensive study to estimate the prevalence of cousin marriages in Iraq. Further, existing estimates have not included unregistered marriages, which are widely practiced in the country's rural areas.

2. There is a notable lack of epidemiological data comparing the prevalence of health diseases in people borne of blood-related marriages versus background population risk. This is necessary on two counts: (1) it is essential to establish which common multifactorial diseases are increased by consanguinity, allowing for early screening and intervention implementation in at-risk groups; and (2) although inbreeding is highly associated with the inheritance of rare recessive genetic disorders, grossly insufficient population data are available on these conditions. As such, the generation of epidemiological records will support efforts to determine the impact of inbreeding on family health and the broader health of society.

3. The economic burden of treatment and symptom management of health disorders associated with consanguinity within the fast-growing Iraqi population is enormous. For example, the Federal Board of Supreme Audit in Iraq estimates the monthly cost of β-thalassemia per patient at USD$17,136 to $54,420 [22, 23]. This culminates in an annual sum of $191,323 to $507,114 million for 11,165 registered patients in 16 of 19 thalassemia centers. However, researchers have

not conducted systematic studies to estimate the economic cost of inherited diseases on a fast-growing population that heavily relies on revenue from selling oil.

5. Recommendation

5.1.Public Awareness Campaign

At present, there are few public awareness initiatives focussed at educating the population of the devastating consequences of consanguineous marriage on the transmission of recessive and common diseases. Continual prompts from the research community for increased premarital genetic screening and enforceable legislative measures to decrease the incidence of these in the community [23] have not led to consistent action to challenge traditional tribal rules favouring blood-related marriages. For example, in the first five years of the premarital mandatory screening programme for haemoglobin diseases in the Kurdish region of Iraq (commenced in 2008), 93.1% of the couples identified at risk for having children with hemoglobinopathies proceeded with their marriage [24]. In this context, a public health awareness campaign focused on the health risks associated with intrafamilial marriages are urgently needed in Iraq, particularly in the rural, less educated population [19] where the prevalence of consanguineous marriages is high and still on the rise [21].

Historically, Cyprus had one of the highest frequencies of the β-Thalassemia globally, estimated at ~18% [25-26]. In an effort to eradicate the condition, a well-organized awareness campaign was instituted by Cyprus government. Commencing in high school, students were introduced to the fundamentals of genetics with a focus on the transmission of β-Thalassemia and its impacts on individuals' health [27]. This was delivered in conjunction with increased practitioner education, as well as a wide-spread media campaign targeting the broader population, and played a critical role in encouraging voluntary pre-natal screenings [27]. Weaving education of β-Thalassemia in public life has resulted in a statistically significant decrease of 1.89% in the disease frequency of the Greek Cypriot population in 24 years [28] demonstrating the efficacy of this approach in improving public health literacy and outcomes.

5.2. Availability of Database

While surveying the published literature, we observed a notable lack of relevant statistical data regarding the health of Iraq's population. The absence of quantitative data makes it difficult to assess the impact of blood-related marriages on community wellbeing as well as the financial implications for the country's economy. We have entered the modern era of information, where primary data must be available to experts to adequately plan for the future. Urgent action must be taken to fill the void of Iraq's medical database shortcomings. For example, the Dunedin Multidisciplinary Study of Health and Development in New Zealand tracked the health and well-being of 1037 individuals from birth. Detailed qualitative and quantitative data was recorded regarding the participants' physical, mental, social, and emotional status [29], garnering a detailed understanding of New Zealand's public health. This permitted researchers to conduct relevant studies into the medical pitfalls and needs of the population. If replicated in Iraq, this level of understanding would undoubtedly produce data to interpret the medical needs of the country, including those concerning the social and economic burdens conferred by consanguineous unions.

Such a database would benefit from the collection of accompanying biological samples (e.g.,

salivary DNA) and physical/mental measures, as in the UK prospective Biobank study [30–31], an ongoing research effort aiming to assess the genetic, environmental, and lifestyle determinants of a wide range of diseases in over 500,000 individuals aged 40–69 years. The combined analysis of survey data with genetic and other physiological factors allows researchers to investigate the role of genes and the environment on health outcomes. The benefits of such studies are innumerous for a country with elevated rates of recessive and monogenic diseases and to determine what is needed to manage the health sector of a fast-growing population.

5.3. Legislative Measures

As an overwhelmingly Muslim country, the influence of religious views greatly impacts Iraqi and other Arab societies. As such, the involvement of Islamic Religious Institutions (including but not limited to Al-Azhar of Egypt and Jaafari Jurisprudence in Najaf, Iraq) could prove instrumental in challenging the societal structures and deeply religious traditions that favor intrafamilial marriages. It is critical that religious and law-making authorities jointly legislate the prohibition of marriage without prior genetic testing authenticated by a reputable laboratory testing center, with sustainable measures to prevent the distribution of disingenuous premarital certificates based on inaccurate laboratory results. Such measures have proven successful in Cyprus, with the Cyprus Thalassemia Center being the only organization able to distribute authentic certificates recognized by the Holy Church of Cyprus. To this end, a public health genetic testing laboratory should be commissioned within Iraq and linked to the highest religious authorities, liaising with the legal establishment responsible for issuing marriage certificates. The authorities responsible for issuing marriage certificates should not recognize genetic testing results from private laboratories to authorize marriage. This level of vetting will assist in the prevention of the birth of children to cognate parents, minimizing the transmission of inherited diseases such as hemoglobinopathies.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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