Journal of Academic Research Vol 29, Issu 2, 2025 "31-43"

The prevalence and health consequences of consanguineous marriage in Misurata city-Libya

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Article information

Key words

Consanguineous, marriage, congenital, coefficient of inbreeding, Misurata, offspring .

Received **25 11 2025**, Accepted **03 12 2025**, Available online **03 12 2025**

Abstract

background: consanguinity is defined as a union between second cousins or closer with an inbreeding coefficient greater than or equal to 0.0156. Consanguinity is practiced by up to 10% of the global population, with rates ranging from 80.6% in certain middle eastern provinces to less than 1% in western societies**.**

Methods: a cross-sectional study was conducted in Misurata city – Libya between January 2024 and January 2025 to determine the impact of consanguineous marriages on offspring health. Filling prepared questionnaire (copy attached) with direct interviewing of random sample of parents attending Misurata medical Centre for any reasons.

Results: the prevalence of consanguineous marriage among 112 couples in Misurata city was 36.6% (95% ci: 28.3%–45.0%) while the prevalence of congenital disease among 41 consanguineous couples in Misurata was 61% (95% ci: 45.8%–74.4%), Women marriage before age 23 was significantly higher than that of their late marrying counterparts. On the other hand, men have a significantly higher likelihood (1.99 times) of contracting consanguineous unions between the ages of 23 and 29. focusing on physical disabilities (7.4% of cases) and the 3.75-fold higher risk in consanguineous offspring, specifically noting congenital heart disease, insulin-dependent diabetes mellitus, global developmental delay, and chronic kidney disease.

Conclusion: emphasizing the necessity of public health initiatives and genetic counseling to address higher rates of congenital disabilities and cardiovascular conditions caused by persistent socio-cultural traditions of consanguineous marriage, while also recognizing the widespread issue of genetic homogeneity caused by long-term endogamy.

Limitations: including the strong influence of population endogamy, which results in accumulated homozygosity ("random consanguinity") across generations, potentially masking or underestimating the true health effects of immediate consanguinity. Furthermore, the substantial role of environmental factors in complex and late-onset diseases must be considered.

I. Introduction:

A certain pattern of marital behavior known as consanguinity occurs when two closely related people get married. A union between second cousins or closer with an inbreeding coefficient of 0.0156 or higher is considered consanguineous from the standpoint of medical genetics.[1] Up to 10% of people worldwide are consanguineous,

with prevalences varying from less than 1% in western countries to 80.6% in some middle eastern regions [2]. Social class, education level, religious affiliation, area size and location, rural-urban environment, and parental consanguinity are some of the sociodemographic characteristics that fundamentally influence the occurrence of consanguineous partnerships, which varies by region.[5–3] .

Since the 20th century, urbanization, better communications, and growing industrialization have all contributed to a general decline in consanguinity [6]. In several middle eastern and north African nations, consanguinity accounted for 20–52% of all marriages, indicating the opposite tendency [7]. Consanguinity is a long-term practice that homogenizes the gene pool of the population. This leads to the accumulation of homologous chromosomes in individuals, which increases homozygosity and, in turn, the expression of some recessive genes [8]. Furthermore, consanguinity raises the chance of mortality as well as congenital, chronic, and infectious disorders because many recessive alleles in populations are detrimental to health [9].

Numerous epidemiological studies that demonstrate the substantial impact of consanguinity on children's health, particularly in highly consanguineous societies, lend credence to these findings [5]. As a result, links between consanguinity and numerous illnesses and ailments have been identified. Congenital abnormalities [11], infectious disease susceptibility [13], non-communicable diseases [12], intellectual disability [10], and primary immunodeficiencies [14] are notable examples. Furthermore, numerous studies have documented the effect of consanguinity on survival, emphasizing its correlation with higher rates of spontaneous abortions [16] and progeny mortality [15].

II. Methods:

Study design:

A cross-sectional study was conducted in Misurata city – Libya between January 2024 and January 2025 to determine the impact of consanguineous marriages on offspring health. Statistics done by using MS Excell 2021. Filling prepared questionnaire (copy attached) with direct interviewing of random sample of parents attending Misurata medical Centre for any reasons Ethical considerations: formed consent from one of the parents and consent from the ethical committee at Misurata medical Centre.

(see appendix a for the full questionnaire).

III. LITERATURE REVIEW

1 .BACKGROUND AND DEFINITION OF CONSANGUINITY:

Consanguinity is defined as a specific pattern of matrimonial behavior where the union occurs between two closely related individuals. From a medical genetics standpoint, a consanguineous union is typically defined as a marriage between second cousins or closer relatives, resulting in an inbreeding coefficient (F) $\geq$ 0.0156. The coefficient of inbreeding (F) is a genetic measure that estimates the probability that an individual inherits two identical copies of a gene from both parents. For the most common form of close kin union—first cousin marriage—the inbreeding coefficient (F) is 0.0625 (6.25%), meaning their offspring are expected to be homozygous at 1/16 of all loci. First cousins are related by the 3rd degree and share about 12.5% of their genes.

Unions such as uncle–niece or aunt–nephew marriages have a higher inbreeding coefficient (F = 0.125 or 12.5%). The long-term and successive practice of consanguinity within a population leads to homogenization of the gene pool, increasing homozygosity and enhancing the expression of certain recessive genes. Since many recessive

alleles are harmful to health, consanguinity increases the risk of congenital, chronic, and infectious diseases, as well as mortality.

Table 1 shows consanguineous marriage relationships and their corresponding coefficients of inbreeding.

2 .GLOBAL PREVALENCE AND SOCIO-DEMOGRAPHIC CONTEXT:

Consanguineous marriage is practiced by up to 10% of the global population. Rates vary widely, from less than 1% in Western societies to as high as 80.6% in certain Middle Eastern regions. It is estimated that around one billion people live in countries where 20% to over 50% of marriages are consanguineous. These unions are primarily concentrated in North and Sub-Saharan Africa, the Middle East, and West, Central, and South Asia.

in some Middle Eastern and North African countries, consanguinity still accounts for 20–52% of all marriages. While countries like Jordan and Turkey have shown a decline, others such as the Palestinian territories and Pakistan have remained stable, and increases have been reported in Qatar, the United Arab Emirates, and Yemen. The prevalence of consanguineous unions is strongly influenced by socio-demographic factors, including education level, religion, social status, and whether individuals live in rural or urban areas.

Table 2 shows the global prevalence of consanguineous marriage.

Table 1. Consanguineous marriage relationships.

Biological relationship	Genetic relationship	Coefficient of inbreeding
Uncle–niece / double first cousin	Second degree	0.125
First cousin	Third degree	0.0625
First cousin once removed / double second cousin	Fourth degree	0.0313
Second cousin	Fifth degree	0.0156
Second cousin once removed / double third cousin	Sixth degree	0.0078
Third cousin	Seventh degree	0.0039

Table 2. Global prevalence of consanguineous marriage.

Consanguinity, %	Numbers in millions
<1	1,027 (15.5)
1–9	2,906 (43.9)
10–19	32 (0.5)

20–29	432 (6.5)
30–39	136 (2.1)
40–49	215 (3.2)
50+	216 (3.3)
Unknown	1,662 (25.1)

IV. RESULTS:

1. .SOCIODEMOGRAPHIC DETERMINANTS OF CONSANGUINEOUS MARRIAGES IN MISURATA:

The Misurata study analyzed several sociodemographic factors associated with consanguineous unions.

Consanguinity and age at first marriage:

The data showed a significant relationship between early age at marriage and consanguinity. The proportion of women who married before age 23 was significantly higher in consanguineous unions compared to those who married later. The average age at marriage was 22 ± 4 years for mothers and 29 ± 5 years for fathers. Men were found to be 1.99 times more likely to enter consanguineous unions between the ages of 23 and 29.

Consanguinity and birth environment (rural/urban):

In the Misurata study, no statistically significant difference was found in the frequency of consanguineous marriages between individuals born in urban versus rural areas. This finding contrasts with earlier research that reported higher rates of consanguinity among rural-origin couples.

Table 3 shows the age of marriage among consanguineous couples.

Table 3 age of marriage in consanguinity couple.

AGE OF MARRIAGE	FATHER (N)	MOTHER (N)
<18	0	24
19-24	21	59
25-29	41	22
30-34	29	7
>35	21	0
TOTAL	112	112

	Mother (y)	Father(y)
Average of age ±SD	22±4	29±5

2. CONSANGUINITY AND COUPLE'S OCCUPATION STATUS:

The Misurata study found that men working in commerce and lower-level government jobs had a higher probability of being involved in consanguineous unions. The majority of wives (64%) were identified as housewives, even among those with higher education levels.

Table 4 shows the occupations of couples in consanguineous marriages.

3. CONSANGUINITY AND EDUCATION LEVEL:

Education level is recognized as an important determinant of consanguinity in North African and Muslim communities. Survey data showed variations in education levels: among wives, 25% had elementary education, 18% had completed high school, and 30% held a bachelor's degree. Among husbands, 33% had elementary education, 34% had a diploma or technical qualification, and 20% held a bachelor's degree. These findings suggest a greater emphasis on skilled education among males.

Table 5 shows the education levels of couples in consanguineous marriages.

Table 4 couples' occupation in consanguinity marriage.

Wife occupation	No
House wife	72
Nurse	5
Governmental	3
Teacher	18
Dentist	2
University prof	1
Medical tech	1
Student	7
Physiotherapy	1
Post grad students	1
Pharmacist	1

Husband occupation	No
Private business	46
Retired	1
Governmental	56
Engineer	6
University prof	1
Legal consultant	2

Table 5 couples education level.

Wife education level	
Elementary	28
Diploma	12
High school	20
Non	5
Bachelor	34
Some university	9
Student	2
Master	2
Husband education level	
Elementary	37
High school	14
Diploma	39
Bachelor	20
Master	2
Some university	1

4. PARENTAL CONSANGUINITY:

The study found that parental consanguinity was associated with a higher likelihood of consanguineous unions among their offspring. This supports the concept of intergenerational transmission of consanguinity, where parents who are satisfied with their own consanguineous marriages may encourage their children to do the same, reinforcing cultural and familial traditions. Among the total couples surveyed, 41 were identified as consanguineous: 28 couples were second-degree relatives, 10 were third-degree, 1 was fourth-degree, and 2 were fifth-degree.

Table 6 shows the degrees of consanguinity among the couples.

Table 6 degree of consanguinity.

Degree of consanguinity	No. Of couples
2nd degree	28
3rd degree	10
4th degree	1
5th degree	2
Total	41

5. BIOLOGICAL EFFECTS ON OFFSPRING HEALTH:

The Misurata study found a statistically significant association between consanguinity and congenital disabilities, including physical disabilities, mental retardation, and deafness. Physical disabilities were the most common birth defects among consanguineous offspring, accounting for 7.4% of cases and presenting a 3.75-fold higher risk compared to non-consanguineous counterparts. A significant increase in mental retardation was also observed among consanguineous offspring, consistent with findings from other regional studies. The overall impact of consanguinity on children's health is well supported by extensive epidemiological evidence, especially in highly consanguineous populations. Among the surveyed families, the most frequent congenital anomalies were congenital heart disease (8 cases), insulin-dependent diabetes mellitus (5 cases), global developmental delay (4 cases), and chronic kidney disease (4 cases).

Table 7 shows the average number of siblings in the families.
Table 8 shows significant genetic and familial history associated with consanguinity.

Table 7 average siblings no. In the families.

Average of siblings ±sd	5±2

Table 8 significant genetics/familial history & association of consanguinity.

	No. Of couples
Significant genetics/familial history	37
Significant genetics/familial history + consanguinity	25

V. CONCLUSIONS:

The Misurata study found a statistically significant association between consanguinity and congenital disabilities, including physical disabilities, mental retardation, and deafness. Physical disabilities were the most common birth defects observed among consanguineous offspring, accounting for 7.4% of cases and presenting a 3.75-fold higher risk compared to non-consanguineous counterparts. A significant increase in the risk of mental retardation was also reported, consistent with findings from other regional studies.

The overall impact of consanguinity on children's health is well supported by extensive epidemiological evidence, particularly in highly consanguineous populations. Among the surveyed families, various congenital anomalies were reported, with the highest counts for congenital heart disease (8 cases), insulin-dependent diabetes mellitus (5 cases), global developmental delay (4 cases), and chronic kidney disease (4 cases).

Table 7 shows the average number of siblings in the families.
Table 8 shows significant genetic and familial history associated with consanguinity.

Education and occupation:

Although education is recognized as an important determinant of consanguinity in North African communities, the persistence of consanguineous unions even among highly educated couples highlights the strong influence of familial and cultural pressures that can override individual awareness. The occupational analysis differed from some international patterns, showing a higher likelihood of consanguineous unions among men working in commerce and lower-level government positions.

Rural/urban context:

Contrary to many previous studies, the Misurata research found no statistically significant difference in the frequency of consanguineous marriages between individuals from urban and rural backgrounds.

Key biological and health findings:

The study reinforced the genetic consequences of consanguinity, which increases homozygosity and the expression of harmful recessive alleles.

- **Congenital disabilities:** A significant difference in congenital disabilities was observed among consanguineous offspring, particularly physical disabilities, mental retardation, and deafness. Physical disabilities were the most common, accounting for 7.4% of cases and presenting a 3.75-fold higher risk compared to non-consanguineous offspring. Common congenital anomalies included congenital heart disease (8 cases), insulin-dependent diabetes mellitus (5 cases), global developmental delay (4 cases), and chronic kidney disease (4 cases).
- **Complex diseases:** Consanguinity was identified as a significant predictor only for cardiovascular conditions, with no significant association found for cancer, diabetes, bronchial asthma, epilepsy, or psychiatric disorders.

The prevalence of consanguineous marriage among 112 couples in Misurata City was 36.6% (95% CI: 28.3%–45.0%), while the prevalence of congenital disease among 41 consanguineous couples was 61% (95% CI: 45.8%–74.4%) based on the Wilson score interval.

Discussion of limitations (endogamy effect):

The reduced observed impact of consanguinity on the full range of complex disorders, compared with findings from international studies, was attributed to two main factors:

1. The substantial role of environmental factors in the development of complex and late-onset diseases.

2. The strong influence of population endogamy (limited genetic mixing) within Misurata. In such highly endogamous populations, increased homozygosity—known as random consanguinity—accumulates across generations, regardless of the couple's immediate consanguinity status. This underlying genetic uniformity can mask the actual health effects of consanguinity, potentially leading to an underestimation of related morbidity and mortality.

In conclusion, the study emphasizes that while socio-cultural traditions continue to promote consanguineous marriage in Misurata—contributing to higher rates of congenital disabilities and cardiovascular conditions among offspring—public health initiatives and genetic counseling programs must also address the widespread genetic homogeneity caused by long-term endogamy in the region.

Table 9 shows congenital anomalies identified in families during the survey.

Table 9 congenital anomalies located in families during the survey.

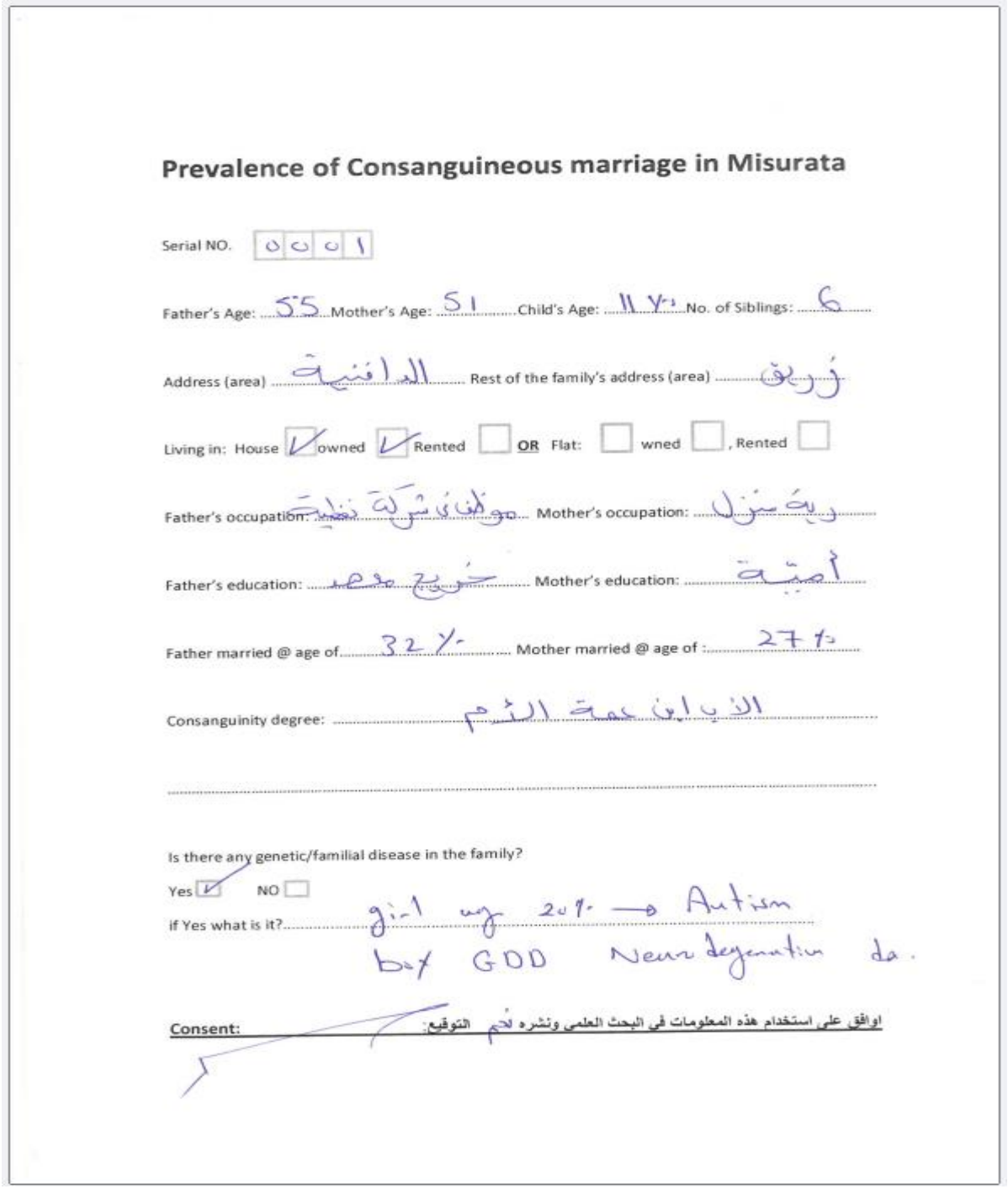
Congenital anomalies	No
Organic acidemia	1

Neurodegenerative disease	2
Cleft lip and palate	1
Cong. Hydrocephalus	2
Congenital heart disease	8
Developmental dysplasia of Hip	1
Limb deformity	1
Autism	2
Global developmental delay	4
Spina bifida	1
Brain tumor	1
Epilepsy	2
Down syndrome	2
Chronic kidney disease	4
Renal tubular acidosis	1
Type 1 Diabetes mellitus	5
Atopy	3
Cong. Adrenal hyperplasia	1
Hypopituitarism	1
Inflammatory bowels diseases	1
Autoimmune hemolytic anemia	1

VI. APPENDIXES:

Appendix a:

the full questionnaire



Prevalence of Consanguineous marriage in Misurata

Serial NO. ٠٠٠١

Father's Age: 55 Mother's Age: 51 Child's Age: ١١ Y٠ No. of Siblings: 6

Address (area) الدافنية Rest of the family's address (area) زوارة

Living in: House ☑ owned ☑ Rented ☐ OR Flat: ☐ wned ☐ , Rented ☐

Father's occupation: موظف في شركة نفط Mother's occupation: ربة منزل

Father's education: خريج معهد Mother's education: أمية

Father married @ age of 32 Y٠ Mother married @ age of : 27 Y٠

Consanguinity degree: الأب ابن عمة الأم

Is there any genetic/familial disease in the family?

Yes ☑ NO ☐

if Yes what is it? girl age 20 Y٠ → Autism by GOD Neurdegenration da.

Consent: اوافق على استخدام هذه المعلومات في البحث العلمي ونشره ثم التوقيع:

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