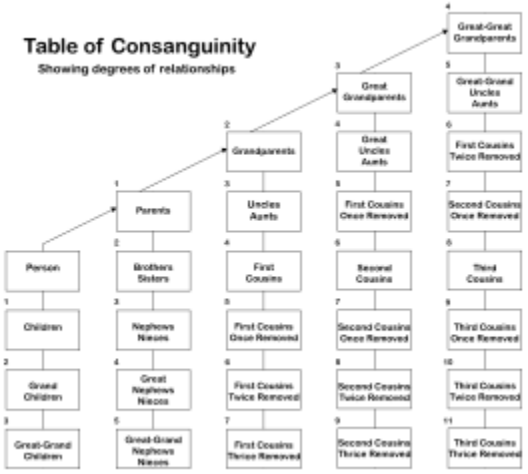
Consanguinity

Consanguinity ("blood relation", from Latin *consanguinitas*) is the property of being from the same kinship as another person. In that aspect, consanguinity is the quality of being descended from the same ancestor as another person.

The laws of many jurisdictions set out the degree of consanguinity in relation to prohibited sexual relations and marriage parties. Such rules are also used to determine heirs of an estate according to statutes that govern intestate succession, which vary from jurisdiction to jurisdiction. In some places and times, cousin marriage is approved and expected; in others, it is taboo as incest.

The degree of relative consanguinity can be illustrated with a *consanguinity table* in which each level of lineal consanguinity (*generation* or *meiosis*) appears as a row, and individuals with a collaterally consanguineous relationship share the same row.[1] The Knot System is a numerical notation that describes consanguinity using the Ahnentafel numbers of shared ancestors.[2]



The number next to each box in the Table of Consanguinity indicates the degree of relationship relative to the given person.

Contents

Legal definitions

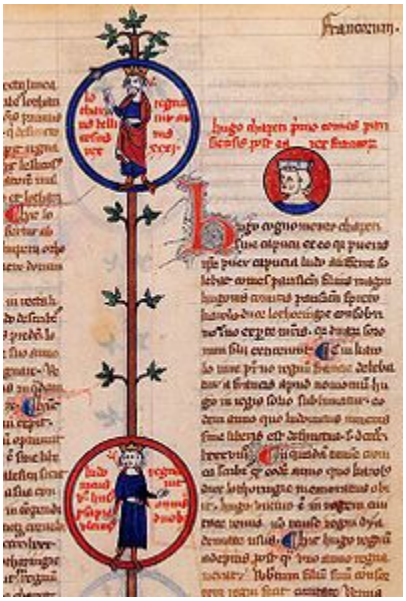
Modern secular law

The degree of kinship between two people may give rise to several legal issues. Some laws prohibit sexual relations between closely-related people, referred to as incestuous. Laws may also bar marriage between closely-related people, which are almost universally prohibited to the second degree of consanguinity. Some jurisdictions forbid marriage between first cousins, while others do not. Marriage with aunts and uncles (avunculate marriage) is legal in several countries.

Consanguinity is also relevant to inheritance, particularly with regard to intestate succession. In general, laws tend to favor inheritance by persons closely related to the deceased.

Some jurisdictions ban citizens from service on a jury on the basis of consanguinity as well as affinity with persons involved in the case.[3]

In many countries, laws prohibiting nepotism ban employment of, or certain kinds of contracts with, the near relations of public officers or employees.



Consanguinity of the kings of France as shown in *Arbor genealogiae regum Francorum* (Bernard Gui, early 14th century).

Religious and traditional law

Christianity

Under Roman civil law, which early canon law of the Catholic Church followed, couples were forbidden to marry if they were within four degrees of consanguinity.[4] In the ninth century the church raised the number of prohibited degrees to seven and changed the method by which they were calculated.[4] This meant that the nobility struggled to find partners to marry, as the pool of non-related prospective spouses became smaller. They had to either defy the church's position or look elsewhere for eligible marriage candidates.[4] In 1215 the Fourth Lateran Council made what they believed was a necessary change to canon law reducing the number of prohibited degrees of consanguinity from seven back to four.[5][6] The method of calculating prohibited degrees was changed also: Instead of the former practice of counting up to the common ancestor then down to the proposed spouse, the new law computed consanguinity by counting back to the common ancestor.[4] In the Roman Catholic Church, unknowingly marrying a closely consanguineous blood relative was grounds for a declaration of nullity, but during the eleventh and twelfth centuries dispensations were granted with increasing frequency due to the thousands of persons encompassed in the prohibition at seven degrees and the hardships this posed for finding potential spouses.[7]

Ban on marriage to minor degrees of relationship imposed by the Roman Catholic Church was met with heavy criticism in the Croatian society in the 11th century, which led to a schism in the Croatian church.[8]

After 1215, the general rule was that while fourth cousins could marry without dispensation, generally the need for dispensations was greatly reduced.[7] In fourteenth century England, for example, papal dispensations for annulments due to consanguinity (and affinity) were relatively few.[9]

The connotations of degree of consanguinity varies by context, though most cultures define a degree of consanguinity within which sexual interrelationships are regarded as incestuous or the "prohibited degree of kinship".

Among the Christian *Habesha* highlanders of Ethiopia and Eritrea (the predominantly orthodox Christian Amhara and Tigray-Tigrinya), it is a tradition to be able to recount one's paternal ancestors at least seven generations away starting from early childhood, because "those with a common patrilineal ancestor less than seven generations away are considered 'brother and sister' and may not marry." The rule is less strict on the mother's side, where the limit is about four generations back, but still determined patrilinearly. This rule does not apply to Muslims or other ethnic groups.[10]

Islam

The Quran at 4:22–24 states. "Forbidden to you in marriage are: your mothers, your daughters, your sisters, your father's sisters, your mother's sisters, your brother's daughters, your sister's daughters."[11] Therefore, the list of forbidden marriage partners, as read in the Qur'an, Surah 4:23, does not include first cousins.[12] Muhammad himself married his first cousin Zaynab bint Jahsh.[13]

Financial incentives to discourage consanguineous marriages exist in some countries: mandatory premarital screening for inherited blood disorders has existed in the UAE since 2004 and in Qatar since 2009, whereby couples with positive results will not receive their marriage grant.[14]

Hinduism

In the *Manusmriti*, blood relation marriage (on the mother's side) is prohibited for 7 generations.

Ayurveda states that marriage within the Gotra (father's side) is a consanguineous marriage which can lead to many gestational and genetic problems in the fetus. Therefore, it has become a common practice in Hindu households during pre-marriage discussions to ask the couples' Gotra. Couples of the same Gotra are advised not to marry. The advisers of this system say that this practice helps to reduce gestational problems and ensures a healthy progeny.

Genetic definitions

Genetically, consanguinity derives from the reduction in variation due to meiosis that occurs because of the smaller number of near ancestors. Since all humans share between 99.6% and 99.9% of their genome,[16] consanguinity only affects a very small part of the sequence. If two siblings have a child, the child only has two rather than four grandparents. In these circumstances the probability that the child inherits two copies of a harmful recessive gene (allele) rather than one which would not have immediate effects is much increased.

Genetic consanguinity is expressed as defined 1922 by Wright[17] with the coefficient of relationship r, where r is defined as the fraction of homozygous due to the consanguinity under discussion. Thus, a parent and child pair has a value of r=0.5 (sharing 50% of genes), siblings have a value of r=0.5, a parent's sibling has r=0.25 (25% of genes), and first cousins have r=0.125 (12.5% of genes). These are often expressed in terms of a percentage of shared DNA.

As a working definition, unions contracted between persons biologically related as second cousins or closer ($r \geq 0.03125$) are categorized as consanguineous. This arbitrary limit has been chosen because the genetic influence in marriages between couples related to a lesser degree would usually be expected to differ only slightly from that observed in the general population. Globally it is estimated that at least 8.5% of children have consanguineous parents.[18]

In clinical genetics, consanguinity is defined as a union between two individuals who are related as second cousins or closer, with the inbreeding coefficient (F) equal or higher than 0.0156.where (F) represents the proportion of genetic loci at which the child of a consanguineous couple might inherit identical gene copies from both parents.[19]

It is common to distinguish first-degree cousins, second-degree cousins, and often also third-degree cousins. Since comparatively few people can trace their full family tree for more than four generations, the identity of fourth-degree cousins often cannot be established. Also, at a genetic level, half-fourth cousins typically do not exhibit greater genetic similarity with one another than with any other individual from the same population.[20]

Epidemiology, rates of occurrence

Cultural factors in favor

Average DNA shared between relatives[15]

Relationship	Average DNA shared %
identical twin	100%
fraternal twin	50%
individual-self	100%
parent / child	50%
half-sibling	25%
sibling	50%
grandparent / grandchild	25%
half-aunt / half-uncle / half-niece / half-nephew	12.5%
aunt / uncle / niece / nephew	25%
half-first-cousin	6.25%
first-cousin	12.5%
sesqui-first-cousin	18.75%
double-first-cousin	25%
great-grandparent / great-grandchild	12.5%
half-grandaunt / half-granduncle / half-grandniece / half-grandnephew	6.25%
grandaunt / granduncle / grandniece / grandnephew	12.5%
half-first-cousin-once-removed	3.125%
first-cousin-once-removed	6.25%
sesqui-first-cousin-once-removed	9.375%
double-first-cousin-once-removed	12.5%
half-second-cousin	1.5625%
second-cousin	3.125%
sesqui-second-cousin	4.6875%
double-second-cousin	6.25%
sester-second-cousin	7.8125%
triple-second-cousin	9.38%
sesqua-second-cousin	10.9375%
quadruple-second-cousin	12.5%
great-great-grandparent / great-great-grandchild	6.25%
half-great-grandaunt / half-great-granduncle / half-great-grandniece / half-great-grandnephew	3.125%
great-grandaunt / great-granduncle / great-grandniece / great-grandnephew	6.25%
half-first-cousin-twice-removed	1.5625%
first-cousin-twice-removed	3.125%
sesqui-first-cousin-twice-removed	4.6875%
double-first-cousin-twice-removed	6.25%
half-second-cousin-once-removed	0.78125%

second-cousin-once-removed	1.5625%
sesqui-second-cousin-once-removed	2.34375%
double-second-cousin-once-removed	3.125%
sester-second-cousin-once-removed	3.90625%
triple-second-cousin-once-removed	4.6875%
sesqua-second-cousin-once-removed	5.46875%
quadruple-second-cousin-once-removed	6.25%
half-third-cousin	0.390625%
third-cousin	0.78125%
sesqui-third-cousin	1.171875%
double-third-cousin	1.5625%
sester-third-cousin	1.953125%
triple-third-cousin	2.34375%
sesqua-third-cousin	2.734375%
quadruple-third-cousin	3.125%
4.5-tuple-third-cousin	3.515625%
quintuple-third-cousin	3.90625%
5.5-tuple-third-cousin	4.296875%
sextuple-third-cousin	4.6875%
6.5-tuple-third-cousin	5.078125%
septuple-third-cousin	5.46875%
7.5-tuple-third-cousin	5.859375%
octuple-third-cousin	6.25%

A simplistic depiction of genetic relatedness after *n* generations as a 2^{-n} progression.

Reasons favoring consanguinous marriage have been listed as higher compatibility between husband and wife sharing same social relationships, couples stability, enforcing family solidarity, easier financial negotiations and others.[19]:187 Consanguinity is a deeply rooted phenomenon in 20% of the world population, mostly in the Middle East, West Asia and North Africa.[19] Globally, the most common form of consanguineous union is between first cousins, in which the spouses share $\frac{1}{8}$ of their genes inherited from a common ancestor, and so their progeny are homozygous (or more correctly autozygous) at $\frac{1}{16}$ of all loci (r = 0.0625).[21] Due to variation in geographical and ethnic background and the loci chosen to genotype there is some 2.4% variation expected.[22]

Europe

Historically, some European nobles cited a close degree of consanguinity when they required convenient grounds for divorce, especially in contexts where religious doctrine forbade the voluntary dissolution of an unhappy or childless marriage.[23]

Muslim countries

In the Arab world today the practice of marrying relatives is common. According to the Centre for Arabic Genomic Research, between 40% and 54% of UAE nationals' marriages are between family members, up from 39% in the previous generation. Between 21% and 28% of marriages of UAE nationals were between first cousins.[14][24] Consanguineous marriage is much less prevalent in Christian Arabs as they do not practice arranged marriages.[25][26][27][28] Additionally, an indult dispensation is required to marriages contracted between first cousins or closer in Arab Christian denominations in communion with the Roman Catholic Church, and the Greek Orthodox Church; there are no similar regulations that apply to first-cousin marriages in the Coptic Orthodox Church.[28]

Diagram of common family relationships, where the area of each colored circle is scaled according to the coefficient of relatedness. All relatives of the same relatedness are included together in one of the gray ellipses. Legal degrees of relationship can be found by counting the number of solid-line connections between the self and a relative.

In Egypt, around 40% of the population marry a cousin. A 1992 survey in Jordan found that 32% were married to a first cousin; a further 17.3% were married to more distant relatives.[29] 67% of marriages in Saudi Arabia are between close relatives as are 54% of all marriages in Kuwait, whereas 18% of all Lebanese were between blood relatives. The incidence of consanguinity was 54.3% among Kuwaiti natives and higher among Bedouins.[30]

It has been estimated that 55% of marriages between Pakistani Muslim immigrants in the United Kingdom are between first cousins,[31] where preferential patrilateral parallel cousin marriage, i.e. a boy marrying the daughter of his father's brother is favored.

Double first cousins are descended from two pairs of siblings, and have the same genetic similarity as half-siblings. In unions between double first cousins the highest inbreeding coefficients are reached, with an (F) of 0.125, for example in among Arabs and uncle-niece marriages in South India.[19]

Genetic disorders

The phenomenon of inbreeding increases the level of homozygotes for autosomal genetic disorders and generally leads to a decreased biological fitness of a population known as inbreeding depression, a major objective in clinical studies.[32] While the risks of inbreeding are well-known, informing minority group families with a tradition of endogamy and changing their behavior is a challenging task for genetic counseling in the health care system.[33] The offspring of consanguineous relationships are at greater risk of certain genetic disorders. Autosomal recessive disorders occur in individuals who are homozygous for a particular recessive gene mutation.[34] This means that they carry two copies (alleles) of the same gene.[34] Except in certain rare circumstances (new mutations or uniparental disomy) both parents of an individual with such a disorder will be carriers of the gene.[34] Such carriers are not affected and will not display any signs that they are carriers, and so may be unaware that they carry the mutated gene. As relatives share a proportion of their genes, it is much more likely that related parents will be carriers of an autosomal recessive gene, and therefore their children are at a higher risk of an autosomal recessive disorder.[35] The extent to which the risk increases depends on the degree of genetic relationship between the parents; so the risk is greater in mating relationships where the parents are close relatives, but for relationships between more distant relatives, such as second cousins, the risk is lower (although still greater than the general population).[36]

Consanguinity in a population increases its susceptibility to infectious pathogens such as tuberculosis and hepatitis.[37]

See also

- Affinity (Catholic canon law)
- Coefficient of relationship
- Cognatic kinship
- Cousin marriage in the Middle East
- Endogamy
- Exogamy
- Genetic distance
- Genetic diversity
- Genealogy
- Inbreeding
- Inbreeding avoidance
- Inbreeding depression
- Incest
- Incest taboo
- Legality of incest
- List of coupled cousins
- Mahram
- Mendelian inheritance
- Milk kinship
- Prohibited degree of kinship
- Proximity of blood

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