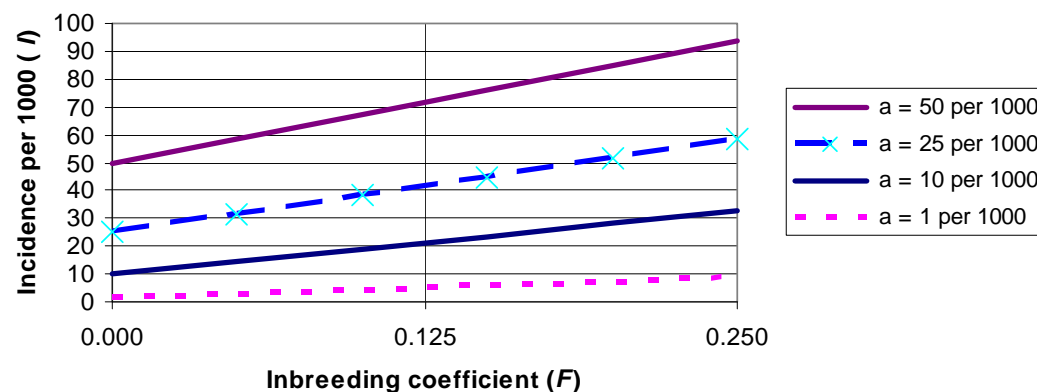


THE DIFFERENCE BETWEEN MATING FIRST-DEGREE AND SECOND-DEGREE RELATIVES

- One way to show this effect is to look at the incidence of inherited disorders due to a recessive gene in offspring of certain matings; the rest of this document deals only with this type of inherited disorder.
- If parents are related, there is an increased risk that their offspring will have an inherited disorder.
- The more closely related the parents, the greater is the increased risk that their offspring will have an inherited disorder.
- The graph below shows this effect for a range of inbreeding (F) levels¹. The vertical line for $F = 0.125$ is the minimum F for offspring of second-degree relatives², and the vertical line for $F = 0.250$ is the minimum F for offspring of first-degree relatives². It is obvious that the greater the level of inbreeding, the higher the incidence of an inherited disorder.

Effect of inbreeding on incidence of autosomal recessive disorders



- The actual increase is greater with more common diseases and the relative increase is greater for rarer ones. Specific examples are explained below.
- For rare disorders (e.g., 1 per 1000 in non-inbred animals), the incidence increases to around 5 per 1000 for offspring of second-degree relatives (an increase of 383%), and to around 9 per 1000 for offspring of first-degree relatives (an increase of 766%).
- For more common disorders (e.g., 50 per 1000 in non-inbred animals), the incidence increases to around 72 per 1000 (an increase of 52%), and to 93 per 1000 for offspring of first-degree relatives (an increase of 87%).
- The cases for other incidences are shown by other lines in the graph.

¹ The incidence has been calculated using the formula $I = (1-F)a + F\sqrt{a}$, where I is incidence, F is the inbreeding coefficient, and a is the frequency of affected non-inbred animals (Falconer, D.S and Mackay, T.F.C., 1996. *Introduction to Quantitative Genetics* (4th edn) Longman, Harlow; p. 62).

² Some offspring of the mating of second-degree and first-degree relatives will have inbreeding coefficients greater than the minimum values quoted here, because further back in their pedigrees, they have additional ancestors in common.

- Another point of reference for deciding whether matings between second-degree relatives are acceptable is the law relating to human matings. The table below summarises the present marriage law for Australia, and the present incest laws in Australia, UK and USA.

Jurisdiction	Act	Section	PROHIBITIONS							
			Ancestor-descendant	Grandparent-grandchild	Parent-offspring	Sibs (unspecified)	Full-sibs	Half-sibs	Uncle/aunt-niece/nephew	First cousins
AUSTRALIA				NM	NM	NM			NM	NM
Australia	Marriage Act 1961	23/23B	☐	NM	NM	NM	☐	☐	NM	NM
NSW	Crimes Act 1900	78A (Incest)	NM*	☐	☐	NM	☐	☐	NM	NM
ACT	Crimes Act 1900	62 (Incest)	☐	NM	NM	NM	☐	☐	NM	NM
QLD	Criminal Code 1899	222 (Incest)	☐	NM	☐	☐	NM	NM	☐	NM
VIC	Crimes Act 1958	44 (Incest)	☐	NM	☐	NM	☐	☐	NM	NM
SA	Criminal Law Consolidation Act 1935	72 (Incest)	NM	☐	☐	NM	☐	☐	NM	NM
TAS	Criminal Code Act 1924 - Schedule 1	133 (Incest)	☐	NM	NM	☐	NM	NM	NM	NM
WA	Criminal Code Compilation Act 1913	329	☐	NM	NM	NM	☐	☐	NM	NM
NT	Criminal Code	134 (Incest)		NM	☐	NM	☐	☐	NM	NM
OTHER COUNTRIES										
UK	Sexual Offences Act 2003		NM			NM				
USA	State by state		NM			NM				(in some states)

* NM = not mentioned

CONCLUSIONS

- There is a universal prohibition on the mating of first-degree relatives
- All jurisdictions ban the mating of at least some forms of second-degree relatives
- The mating of third-degree relatives (first cousins; minimum inbreeding coefficient of offspring = 0.0625) is generally regarded as acceptable

Frank Nicholas (with advice/input from John James, Claire Wade, Peter Thomson, Bethany Wilson and Mohammad Shariflou), 25 October 2010
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