

Extent of inbreeding in pedigree dogs revealed in new study

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German shepherd dogs are prone to an abnormal development of the hip joints.

The extent of inbreeding in purebred dogs and how this reduces their genetic variation is revealed in a new study by Imperial College London researchers. Inbreeding puts dogs at risk of birth defects and genetically inherited health problems.

These issues and the researchers' findings are highlighted in an upcoming TV programme entitled "Pedigree dogs exposed," which will air on BBC One on Tuesday 19 August 2008 at 21.00 BST.

Particular dog breeds are believed to be prone to particular health problems and birth defects. For example, Dalmation dogs are predisposed to deafness, many Boxer dogs have problems with heart disease, and disproportionate numbers of German Shepherd dogs have an abnormal development of the hip joints known as hip dysplasia.

Inbreeding in pedigree dogs arises because certain dogs, prized for exhibiting the characteristics desirable for that breed, are used to father many litters of puppies. When dogs from

these litters come to be mated, some will be paired with dogs having the same father from other litters. Over generations, more and more dogs across a particular pedigree are related to one another and the chances of relatives mating increase.

Recessive genetic variants only have adverse health effects such as deafness when an individual carries two defective copies of the gene. If a popular sire carries just one defective copy, he will not show the problem himself and nor will his puppies. However, the defect may become common in later generations if his grandpuppies and great grandpuppies are mated with each other, rather than introducing new genetic traits by breeding outside their relatives.

Although the problems associated with inbreeding have been known for many years, prior to the new study it had not been systematically measured. For this study, researchers from Imperial used mathematical modelling to analyse how dogs were related to one another within ten different dog breeds including the Boxer and Rough Collie.

They looked at the parentage of eight generations of dogs, using records collected from 1970 to the present day by the UK Kennel Club.

The researchers' analysis showed that, for example, Boxer dogs were so closely related to one another and had such little genetic variation between them that genetically, 20,000 dogs looked like a population of about 70. In the Rough Collie breed, 12,000 dogs looked in genetic terms like a population of about 50.

Such small effective population sizes mean that the chances of a dog breeding with a close relative, resulting in birth defects and genetically inherited health problems, are high. The researchers argue that those involved in breeding dogs should encourage breeding from a larger pool of potential mates in order to create greater genetic variation

and lessen dogs' chances of inheriting genetic disorders. They suggest measures such as limiting how many times a popular dog can father litters; encouraging mating across national and continental boundaries; and relaxing breed rules to permit breeding outside the pedigree.

Professor David Balding, the corresponding author of the research from the Division of Epidemiology, Public Health and Primary Care at Imperial College London, said: "The idea that inbreeding causes health problems in particular dog breeds is not a new one, but we believe ours is the first scientific study to explore this issue and analyse the extent of inbreeding in a systematic way, across many breeds. We hope that following our work, dog breeders will make it a high priority to increase the genetic diversity within different breeds. Otherwise, we will see growing numbers of dogs born with serious genetically inherited health problems."

The researchers carried out their analysis as part of an effort to explore how understanding disease in dogs can help inform research into human disease. The research was funded by the Biotechnology and Biological Sciences Research Council.

Further information about the research is provided in the study, which is published in the journal *Genetics*: "Population structure and inbreeding from pedigree analysis of purebred dogs," *Genetics*, 179(1): 593–601, 2008.
doi:10.1534/genetics.107.084954 Calboli FC ,
Sampson J, Fretwell N, Balding DJ

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