Canine morphology: Hunting for genes and tracking mutations

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Why do domestic dogs vary so much in size, shape, coat texture, color and patterning? Study of the dog genome has reached a point where the molecular mechanisms governing such variation across mammalian species are becoming understood. In an essay published in the March 2, 2010 issue of *PLoS Biology*, National Human Genome Research Institute (NHGRI) researchers discuss advances in understanding the genomic mechanisms controlling canine morphology.

There are more than 300 dog breeds in the world, including 170 recognized by the American Kennel Club. All are members of the species Canis familiaris. The authors review unique features of the canine genome that make it particularly good for genetic studies, and they show that breeds can be divided into five major groups derived from groups of ancient forebears. "Study of variation in the dog species, with its breeding structure, helps us hone in on the genomic factors for traits shared across species, including analogs for diseases that occur in the human population," said senior author Elaine Ostrander, Ph.D., chief of NHGRI's Cancer Genetics Branch.

This essay highlights the unique features of dog populations that offer advantages for genetic studies, as well as recent advances in canine genomics that show how genetic mechanisms may control breed-defining traits. For example, the hunt for genes for a prominent trait in more than one breed (such as short legs) is simplified because of the genetic diversity observed between breeds. Also it is easier to identify disease genes in dogs than in the much more diverse human population.

Several features of the dog genome may lead to the large differences between domestic dog breeds, generating a higher rate of new, non-lethal variants in the dog genome, which are then available to be selected upon by breeders. Several discoveries correlating a gene to a particular trait are discussed, from the characteristic short legs of breeds like dachshunds and corgis, to the 30-fold differential in dog skeletal size, to fur texture and color.

"The dog genome is an extraordinary model for genomic study due to the combination of selective breeding practices and perhaps this species' unique capacity to undergo adaptive molecular changes," said co-author Abigail Shearin, a University of Pennsylvania veterinary student pursuing research training in the Ostrander Lab.

More information: Shearin AL, Ostrander EA (2010) Canine Morphology: Hunting for Genes and Tracking Mutations. PLoS Biol 8(3): e1000310. doi:10.1371/journal.pbio.1000310

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