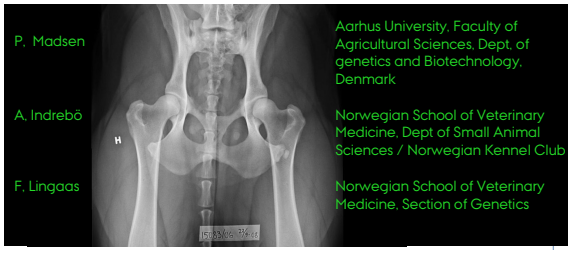
BLUP Animal Model for prediction of breeding values for hip dysplasia in Norwegian dog breeds



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1

Outline

- What is hip dysplasia
- Diagnostics
- Data
- Estimation of variance component
- Prediction of breeding values
- Summing up

2

Canine Hip Dysplasia (HD)

- **HD** is a malformation of the coxofemoral joint – a developmental orthopedic disease in many dog breeds
- Many studies have shown that it is partly genetic controlled, with a polygenic background
- Mild forms seldom affect the functional health of the dog
- In more severe form HD might cause crippling lameness

3

Significance

- The frequency of HD is an important issue in a number of dog breeds and a number of breeders and dog owners are concerned about this trait
- Severe forms may negatively influence the health and life quality for dogs
- Because of the genetic disposition of the disease it has been recommended not to use dogs affected by HD for breeding

4

Classification

- The Hip status or HD is presently classified in 5 classes A (excellent) - E (severe)
- A and B are considered free - while C-E are defined as having different degrees of HD

5

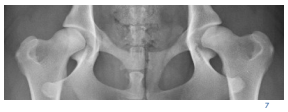
Excellent (A)

Normal (B)

6

Excellent (A)

Mild (C)



7

Excellent (A)

Moderate (D)

8

Excellent (A)

Severe (E)

9

Excellent (A)

Unilateral (B/E)
Official status is always the most sever hip; in this dog E

10

Screening program

- Radiographic screening for HD has been performed in many breeds in Norway for more than 30 years
- Official HD result is obligatory for dogs used for breeding in 70 breeds (for most of the breeds since 20 years)
- For most of breeds 40-60% of the dogs has official HD result
- Selection has until 2008 been based on mass selection

11

Data

HD-scores collected between 1987 and 2008 on 133.821 dogs from 32 breeds was available from the Norwegian Kennel Club (NKC)

No. of records per breeds varied from:

739 for Hamiltonstöver and 786 for Chow Chow

to

14.464 for Golden Retriever and 23.183 for German Shepherd

12

Frequencies of HD-score (extreme breeds)

Breed	# obs,	HD-score (%) A	B	C	D	E
Vorster	2.738	91,2	5,0	2,7	0,9	0,2
Tervuren	2.648	91,1	3,3	3,3	1,6	0,7
Flat Coated Retriever	7.020	89,9	4,1	3,9	1,5	0,6
Chow Chow	822	74,9	5,0	9,6	5,1	5,4
German Shepherd	23.093	67,0	6,9	12,4	8,1	5,6
Newfoundland	2.584	59,9	3,5	13,3	14,1	9,2

13

Estimation of variance component

Variance components were estimated within breeds

Model:

HD = YoB×Sex + litter + animal + e

Where: YoB×Sex (fixed)

litter, animal and e (random)

Relationship between animals were traced as far back as possible in NKC's database

14

Heritabilities (h^2) and litter effect (c^2)

For breeds with >1.000 records:

h^2 varied from:
0,08 for Newfoundland to 0,49 for Saint Bernhard with and average of ~0,30

c^2 varied from:
0,00 for Border Collie to 0,11 for Saint Bernhard with an average of ~0,05

15

Prediction of breeding values

Prediction of breeding values (EBV's) are now conducted 4 times per year,

EBV's are computed within breeds, using BLUP AM with the same model as used for estimations of VC, and with the estimated VC's as "true" parameters

EBV's are standardized in two steps:

1. Standardized to SD = 10 for dogs born 1990 to 2005
2. Standardized to mean = 100 for dogs born within the last 4 years

16

Model validation

Model validation has been conducted by prediction of EBV's based on all data (EBV_{All}) and on a reduced data set, where HD records from dogs born in 2004 and later was deleted (EBV_{Red})

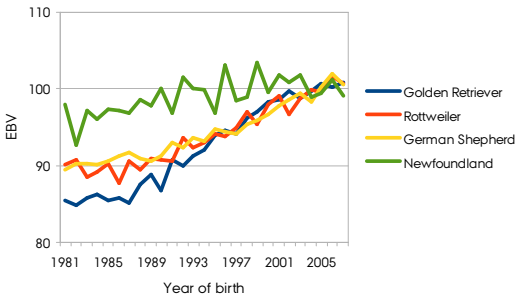
The regression of EBV_{All} on EBV_{Red} has an expectation of 1,0

Dogs with deleted HD record in the reduced data will get EBV_{Red} based on pedigree information, The regression of EBV_{All} on EBV_{Red} for this group of dogs will therefore be at test of bias in pedigree indexes

For 3 breeds (Chow Chow, Irish Setter and Doberman) the regression was substantial below 1,0 (0,79, 0,70 and 0,71)

17

Examples on genetic trends



18

Summing up

- The estimated heritability varies between breeds, but most estimates are between 0,2 and 0,3
- BLUP AM was introduced by NKC in 2008
- EBV's for 32 breeds are computed 4 times per year
- Published on NKC's DogWeb
- Breeding advice: The mean value of the combination should be above breed average (100)

19