Heritability and genetic correlations for health and survival in Norwegian Red calves

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EAAP 2015
Introduction

• Calf survival and health
  – indicator of animal welfare
  – important economically
  – No calf, no cow

• Increased recordings on calfhood diseases in recent years in Norway
  – increased direct recording by veterinarians
Aim

• Estimate heritabilities and genetic correlations for calf survival and the three most common calfhood diseases in Norwegian Red
Traits

4 binary traits:

• Survival to 6 months of age
• Respiratory disorders
• Gastritis/enteritis
• Arthritis/joint disorders

Veterinary treatments
Data

• 606,447 Norwegian Red calves
• Males and females born from 2004 to 2013
• Records until 180 days old, death or sold from the herd

• Binary traits
  – Diseases: 1 = treated, 0 = not treated
  – Survival: 1 = alive, 0 = dead before 180 d
    • Calves sold from herd: survival = missing
Mean Frequency

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of records</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory disease</td>
<td>606 447</td>
<td>3.32</td>
</tr>
<tr>
<td>Gastritis/enteritis</td>
<td>606 447</td>
<td>2.31</td>
</tr>
<tr>
<td>Arthritis/joint disorder</td>
<td>606 447</td>
<td>1.32</td>
</tr>
<tr>
<td>Survival</td>
<td>497 109</td>
<td>95.57</td>
</tr>
</tbody>
</table>

Disease frequency among those that died:
- 11.57 % respiratory disease
- 7.94 % gastritis/enteritis
- 4.82 % arthritis/joint disorder
Disease frequency by birthyear

Norwegian University of Life Sciences

Calfhood diseases

Respiratory disorder
Gastritis/enteritis
Arthritis
Calf survival by birthyear
Age at time of treatment

Age in months: 1 mo, 2 mo, 3 mo, 4 mo, 5 mo, 6 mo

Number of treatments:
- Respiratory
- Gastritis/enteritis
- Arthritis

Calfhood diseases
Norwegian University of Life Sciences
Age at time of death

Number of calves

Age in months

Calfhood diseases

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Model

• Multivariate threshold sire model
  – Gibbs sampling, RJMC in DMU (Madsen and Jensen, 2010)

• Fixed effects (no classes):
  – Sex (2) - size of calf (3)
  – Singleton/twin (2) - group size (11)
  – Calving difficulties (3) - month-year of birth (120)

• Random effects:
  – Herd-year
  – Sire
Random effects

• 1,320 Norwegian Red AI-sires
  – Minimum 50 calves/sire (mean=460)
  – 12,942 animals in pedigree file
  • Sires and dams traced as far back as possible

• 23,997 herd-year
  – Minimum 1 health recording on calves 180 d or younger
  • Including dehorning
### Variance components and heritability - posterior mean (SD)

<table>
<thead>
<tr>
<th>Disease</th>
<th>$\sigma^2_{sire}$</th>
<th>$\sigma^2_{hy}$</th>
<th>$h^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory disease</td>
<td>0.022 (0.002)</td>
<td>0.40 (0.01)</td>
<td>0.09 (0.01)</td>
</tr>
<tr>
<td>Gastritis/enteritis</td>
<td>0.012 (0.002)</td>
<td>0.46 (0.01)</td>
<td>0.05 (0.01)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>0.019 (0.003)</td>
<td>0.23 (0.01)</td>
<td>0.07 (0.01)</td>
</tr>
<tr>
<td>Survival</td>
<td>0.011 (0.001)</td>
<td>0.18 (0.01)</td>
<td>0.04 (0.01)</td>
</tr>
</tbody>
</table>

\[ h^2 = 4 \times \frac{\sigma^2_{sire}}{\sigma^2_{sire}} + \sigma^2_{hy} + 1 \]
### Genetic correlations - posterior mean (SD)

<table>
<thead>
<tr>
<th></th>
<th>Respiratory disease</th>
<th>Gastritis/enteritis</th>
<th>Arthritis/Joint disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastritis/enteritis</td>
<td>0.30 (0.09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthritis/joint disorder</td>
<td>0.23 (0.08)</td>
<td>0.31 (0.10)</td>
<td></td>
</tr>
<tr>
<td>Survival</td>
<td>-0.67 (0.07)</td>
<td>-0.64 (0.07)</td>
<td>-0.59 (0.07)</td>
</tr>
</tbody>
</table>
Herd correlations
- posterior mean (SD)

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</tr>
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<tbody>
<tr>
<td>Arthritis/Joint disorder</td>
<td>-0.25 (0.02)</td>
<td>-0.17 (0.02)</td>
</tr>
<tr>
<td>Survival</td>
<td>-0.22 (0.02)</td>
<td></td>
</tr>
</tbody>
</table>

Remaning herd correlations was close to zero
Summary

• Heritabilities 0.04 – 0.09, similar to other health traits

• Genetic correlations are favourable, moderate to strong

• Information early, from both sexes - advantage
  – Large progeny groups, high accuracy of sire EBV

• New traits to be included in the total merit index for Norwegian Red
Thank you