SNPs associated with osteochondrosis in horses on different stage of training


NCBiR
NCN
Aim

- Looking for the genetic background of osteochondrosis
- Looking for the best scale and moment for OCD evaluation
Definition of osteochondrosis

• Polish definition
• other definitions

OC lesions, disturbances, flattening
OC - Dissecans
Material and methods

All stallions (87) and mares (114) tested during two successive years on performance test stations were examined for OC(D) before and after performance tests.

Horses were x-rayed using digital equipment in fetlocks (1 image), stifles (2 images) and hocks (1 image) from right and left side.
Material and methods

- Scale used:
  - **OCD** (+) 3 1
  - no signs of **OC(D)** (-) 0 0
  - some marks of **OC(D)** (+/-) 1-2 0

All joints were taken into account, one single note was given for every horse.
Material and methods

Genotyping

Genomic DNA was isolated from the blood samples by the MasterPure Genomic Purification Kit (Epicentre).

DNA was then used to genotype each horse using the Illumina Neogen Equine Community Array, which consists of 65 157 SNP markers evenly distributed across 31 autosomes in average spacing of 43.2 kb.

Total call rate achieved the value of 99.75%.

The quality of SNP clusters was analyzed by using GenomeStudio (Illumina).

63 946 SNPs were used for statistical analysis.
Material and methods

Statistical analysis - SNP

Statistical analysis including Cochran-Armitage test and logistic regression assuming an additive model of inheritance (except SNP effect, also training centre, sex, age, breeder and pedigree information) were used.

Testing SNP effects:
- Cochran-Armitage test

\[ T = (N_{AB\text{sick}}N_{\text{healthy}} - N_{AB\text{healthy}}N_{\text{sick}}) + 2(N_{BB\text{sick}}N_{\text{healthy}} - N_{BB\text{healthy}}N_{\text{sick}}) \]

- Logistic regression

\[
\logit(p_{\text{sick}}) = \beta_1 X_{\text{SNP}} + \beta_2 X_{\text{training centre}} + \beta_3 X_{\text{sex}} + \beta_4 X_{\text{breed}} + \beta_5 X_{\text{age}} + \beta_6 X_{\text{breeder}} + \beta_7 X_{\text{sire}} + \beta_8 X_{\text{dam}}
\]
Material and methods

Statistical analysis - \( h^2 \)

Additionally heritability was calculated at two different stages of training. The animal model with sick/healthy as dependent variable was used with the fixed effect – training centre, breed, sex, breeder, age was fitted as a fixed effects and animal as random effect. The pedigree file was used. The Monte Carlo Markov Chain (MCMC) method was applied. Heritability was counted as the following ratio:

\[
\frac{\text{VAR}(A)}{\text{VAR}(A) + \text{VAR}(R) + \pi^2/3}
\]

Heritability estimated on the observed scale 0-1 were transformed to continuous scale using the equation:

\[
h^2 = h^2_{0,1}\left[\frac{(1 - p)}{i^2 p}\right]
\]
Results

OCD evaluation

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>♂</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>♀</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

♂: OCD free
♀: OCD

0% - 80%
The collection of significant SNP was not the same in the both investigations.
Results

SNP evaluation

<table>
<thead>
<tr>
<th>SNP ID</th>
<th>P-value</th>
<th>Adjusted P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIEC2_1061013</td>
<td>0.000191701</td>
<td>0.000115934</td>
</tr>
<tr>
<td>BIEC2_55129</td>
<td>0.000158218</td>
<td>0.000255875</td>
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<tr>
<td>BIEC2_66407</td>
<td>0.000225441</td>
<td>0.000291625</td>
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<tr>
<td>BIEC2_755946</td>
<td>0.000607778</td>
<td>0.000482501</td>
</tr>
</tbody>
</table>

Only four SNP (out of 20 observed as important for each term) were involved in OCD for both stage of training. Multiple testing lowered the significance of SNP effects.
Results

h² evaluation

I - 0.303
II - 0.265

Heritability estimations are not exactly the same on both stages of the training, however standard errors are not known.
Conclusions

1. Not the same SNPs are associated with the OCD status of horse on different stages of training. 4 SNP are significant for both stages of training.

2. Heritability estimation for the horse OCD status does not reach the same level on different stages of training.

That might bias different evaluation of the horse OCD health status between times and places by using BVE and genotyping. Comparison of different research need exactly information on the training status of evaluated horses. It seems useful to evaluate the horse before any kind of the training or conditioning.
Thank you for your attention!