

# The importance of the *DMRT3* mutation on riding traits and gaits in Standardbred and Nordic trotters



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- Standardbred & Nordic trotters
- *DMRT3*
- Aims
- Materials and Methods
- Results
- Summary
- Implications
- Acknowledgements



# TROTTERS AS RIDING HORSES

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- Standardbreds can compete in harness racing until 10 or 12 years of age
- Nordic trotters can compete until 15 years of age
- Breeding and riding after their career
- Trotters are known for having difficulties with canter



- Normally three different gaits; walk, trot and canter
- About 70 breeds with alternative gaits
- Major discovery 2012 - *DMRT3*
- Favorable impact on alternative gaits and performance in horses competing in harness races

# DISTRIBUTION OF MUTATION ACROSS BREEDS

| <u>BREED</u>                   | <u>CC</u> | <u>CA</u> | <u>AA</u> |
|--------------------------------|-----------|-----------|-----------|
| <u>Gaited</u>                  |           |           |           |
| Icelandic Horse                | 3         | 105       | 149       |
| Rocky Mountain Horse           | 0         | 0         | 17        |
| Kentucky Mountain Saddle Horse | 0         | 2         | 20        |
| Missouri Fox Trotters          | 0         | 0         | 40        |
| Peruvian Paso                  | 0         | 0         | 19        |
| Paso Fino                      | 0         | 0         | 45        |
| Standardbred Pacers            | 0         | 0         | 37        |
| Tennessee Walkers              | 0         | 1         | 32        |
| <u>Non-Gaited</u>              |           |           |           |
| Gotland Pony                   | 28        | 0         | 0         |
| Swedish Ardenne                | 22        | 0         | 0         |
| Swedish Warmblood              | 35        | 0         | 0         |
| Arabian                        | 29        | 0         | 0         |
| Thoroughbred                   | 35        | 0         | 0         |
| Shetland Pony                  | 20        | 0         | 0         |
| North Swedish Draft            | 31        | 0         | 0         |



To investigate whether the *DMRT3* mutation negatively influence canter ability and riding performance in Standardbred and Nordic trotters



- 115 Standardbreds and 55 Nordic trotters used for riding
- Questionnaire study
- The owners had to score the gaits on a scale from 1-6
- Focus on rhythm, balance and transitions
- Pace and tölt association
- Wald test, t-test and Fisher exact test
- Hair sample for DNA isolation

## Riding traits

### Questionnaire to horse owners

|   |            |   |   |           |   |   |                    |
|---|------------|---|---|-----------|---|---|--------------------|
| 1. <u>How many years</u> has the horse <u>been used</u> for <u>riding</u> ?                       |            |   |   |           |   |   | Do not <u>know</u> |
|   |            |   |   |           |   |   |                    |
| 2. Did the horse <u>compete</u> in <u>trotting</u> before <u>trained</u> in <u>riding</u> ?       |            |   |   |           |   |   | Do not <u>know</u> |
|   | <u>Yes</u> |   |   | <u>No</u> |   |   |                    |
| 3a. <u>How well</u> does your horse <u>perform</u> <u>collected canter</u> (1= poor, 6= perfect)? |            |   |   |           |   |   |                    |
| <u>Rhythm</u>   | 1          | 2 | 3 | 4         | 5 | 6 |                    |
| <u>Balance</u>  | 1          | 2 | 3 | 4         | 5 | 6 |                    |
| <u>Transitions</u>  | 1          | 2 | 3 | 4         | 5 | 6 |                    |

# GENOTYPE FREQUENCIES

|                        | AA (n)     | CA (n)    | CC (n)    | Total | Freq A | Freq C |
|------------------------|------------|-----------|-----------|-------|--------|--------|
| <b>Standardbreds</b>   | 0.90 (104) | 0.10 (13) | 0 (0)     | 115   | 0.95   | 0.05   |
| <b>Nordic trotters</b> | 0.18 (10)  | 0.40 (22) | 0.42 (23) | 55    | 0.38   | 0.62   |

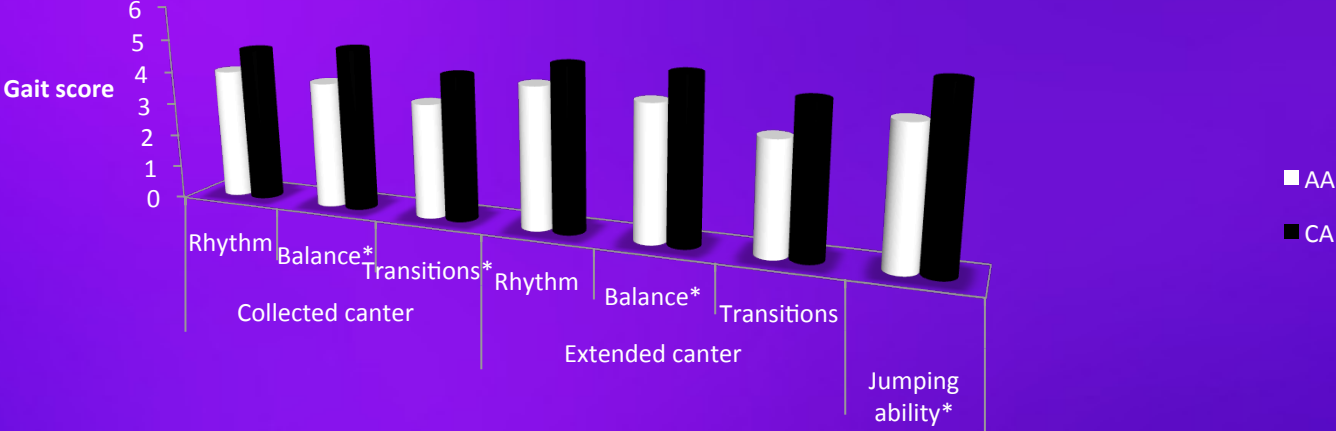




# EFFECT OF *DMRT3* ON CANTER ABILITY - STANDARDBREDS



## Canter and jumping Ability



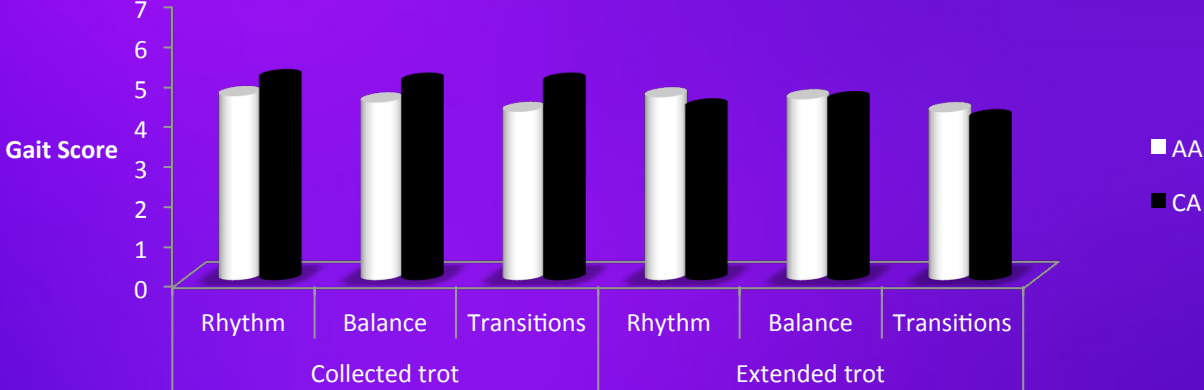
Scale from 1 (poor) to 6 (perfect)

\*P<0.05

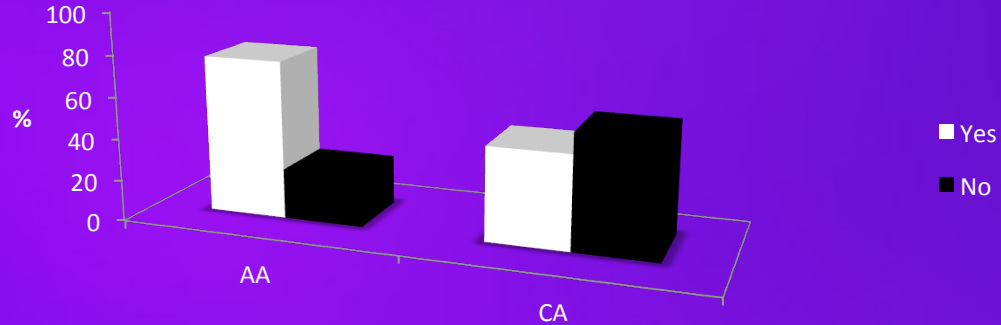
# EFFECT OF *DMRT3* ON TROTTING ABILITY - STANDARDBREDS



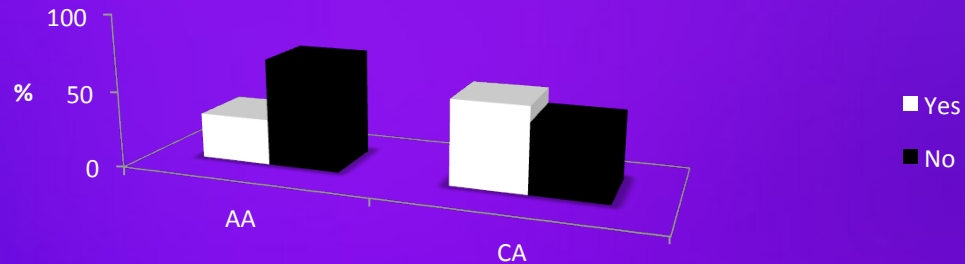
### Average Trot scores Standardbreds



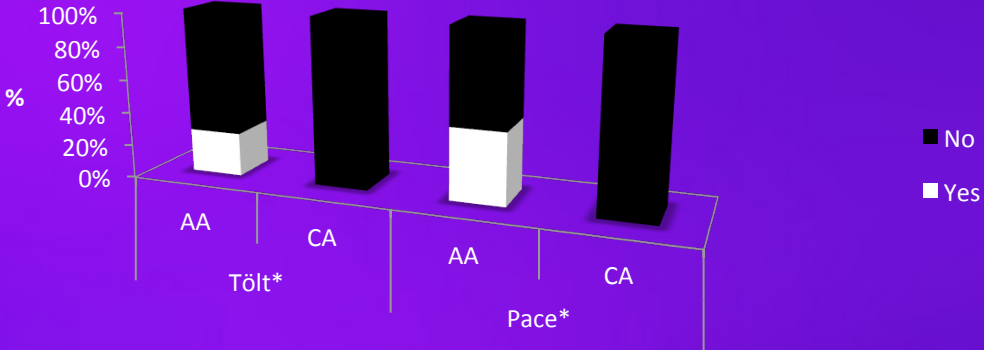
## Competed in harness racing



## Competed in dressage

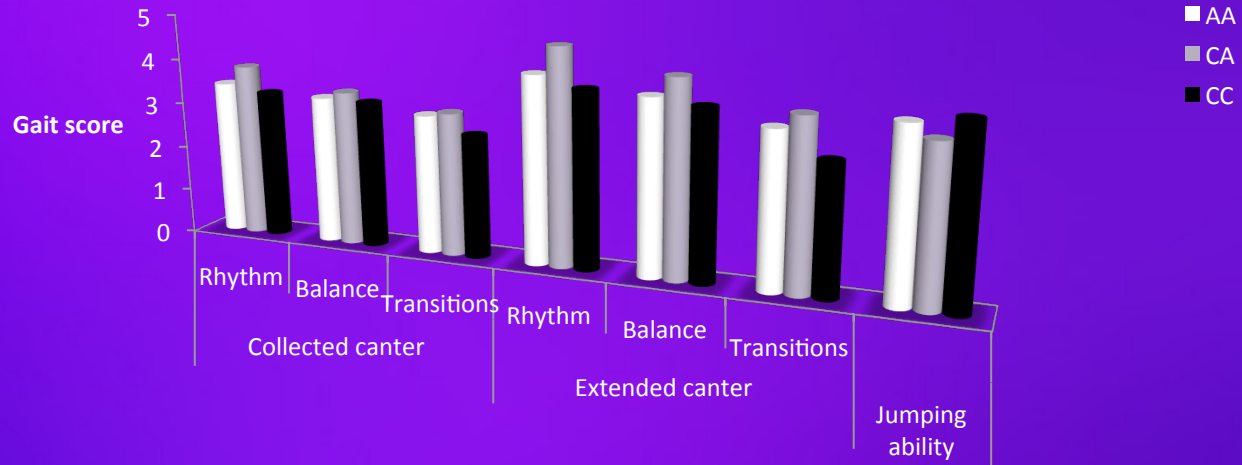


## Tölt and pace

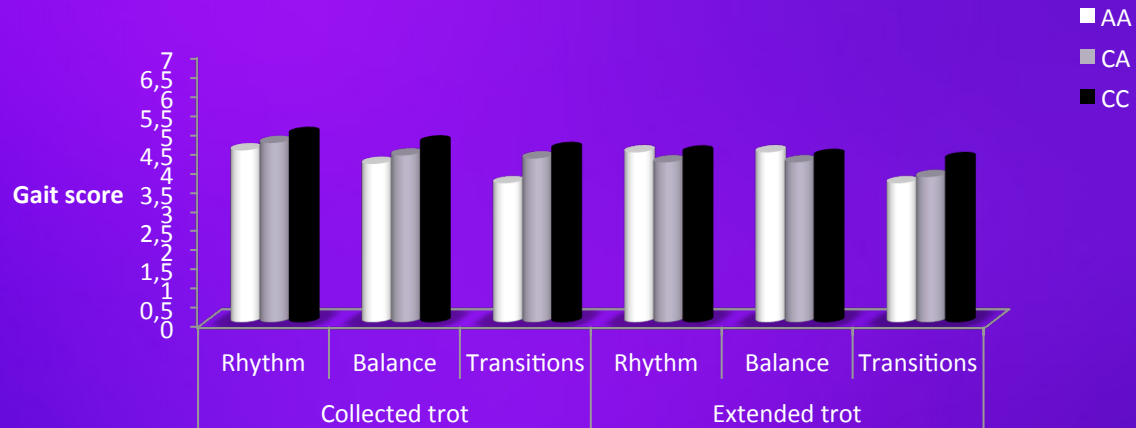


\*P<0.05

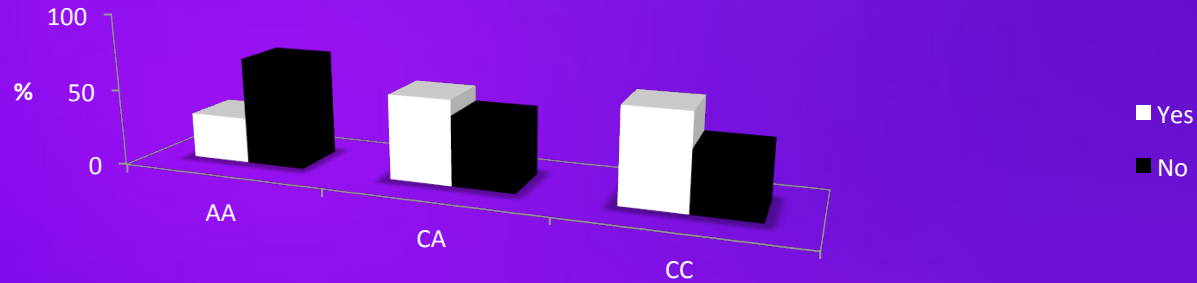
## Canter and Jumping ability



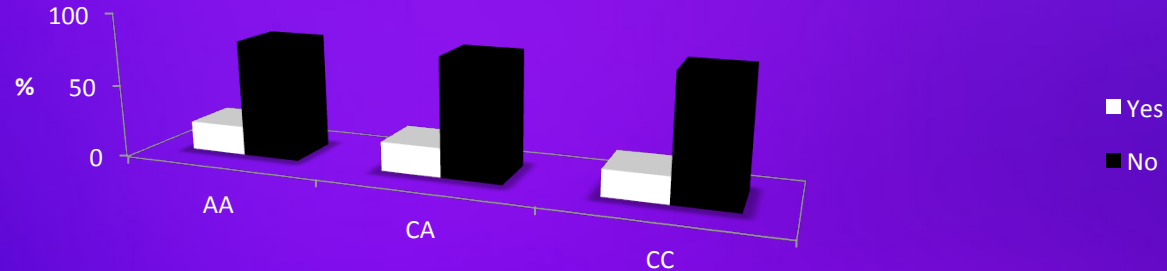
## Average trot scores Nordic trotters



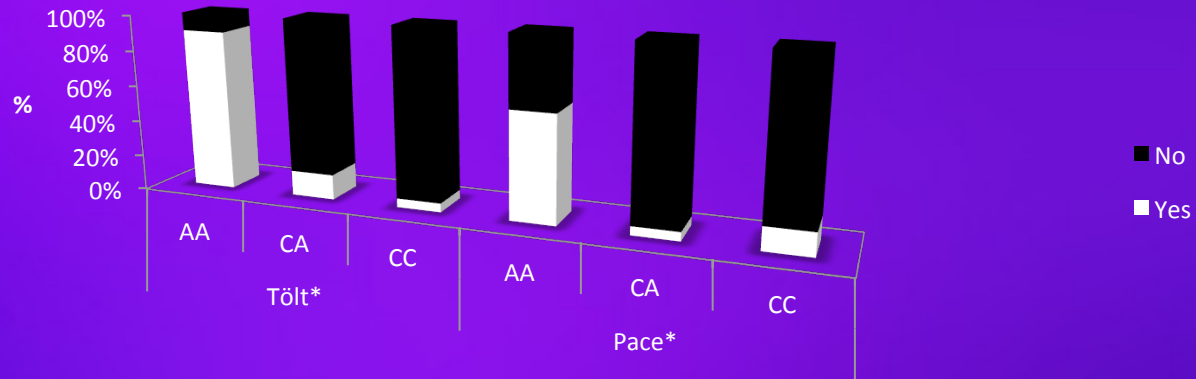
## Competed in harness racing



## Competed in dressage



## Tölt and pace



\*P<0.05



# COMPARISON WITH OTHER BREEDS

- Standardbreds similar to Finnhorses
- AA genotype negative for canter and trot in Finnhorses
- Icelandic horses CA got higher evaluation scores for canter and trot than AA horses



# DISCUSSION

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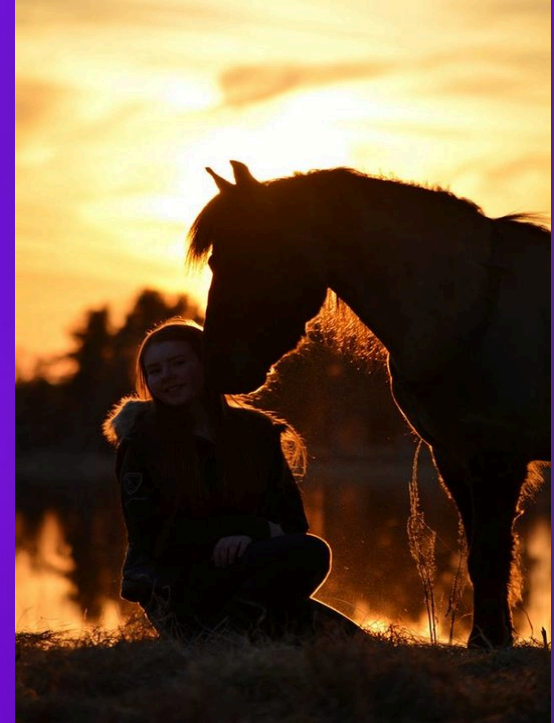
- Questionnaire data vs competition data
- Possible to teach the trotters to canter, but takes time
- Nordic trotters are different from other breeds
- Higher frequency of wild-type allele among riding horses
- Investigate more breeds, compare CA and CC horses



# IMPLICATIONS

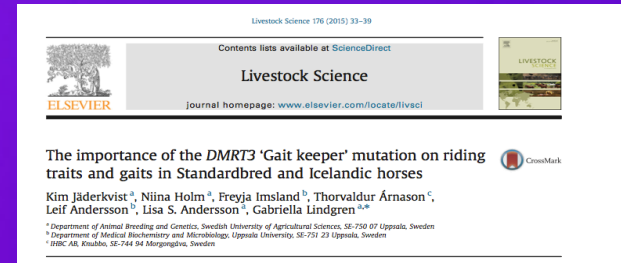
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- Different genotypes are optimal for different disciplines
- Genetic test for the SNP
- Aid in breeding schemes and training programs
- Useful test when you are planning to buy a young horse
- Use horses that does not work for harness racing for riding



# ACKNOWLEDGEMENTS

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- All horse owners that contributed with samples
- The Swedish Research Council Formas, The Swedish Research Council (VR) and KSLA (Stiftelsen Edvard Nonnens stipendiefond)



Göra om.... Dela upp tävling o gångarter på två slides... Bilder

| Question                       |     | AA (n)  | CA (n)   | P     |
|--------------------------------|-----|---------|----------|-------|
| Competed in harness racing (%) | Yes | 76 (79) | 45 (5)   | 0.07  |
|                                | No  | 24 (25) | 55 (6)   |       |
| Competed in dressage (%)       | Yes | 30 (30) | 55 (6)   | 0.17  |
|                                | No  | 70 (71) | 45 (5)   |       |
| Ever shown tölt (%)            | Yes | 26 (27) | 0 (0)    | 0.06  |
|                                | No  | 74 (75) | 100 (11) |       |
| Ever shown pace (%)            | Yes | 43 (43) | 0 (0)    | 0.006 |
|                                | No  | 57 (56) | 100 (11) |       |

*\*P < 0.05 = statistical significant difference between the groups*

# FINNHORSES RIDING TRAITS



| TRAIT           |              | AA (n= 14) | CA (n= 23) | CC (n= 22) | P*<br>(AA vs CA)     | P*<br>(AA vs CC) |
|-----------------|--------------|------------|------------|------------|----------------------|------------------|
| Coll. canter    | -Rhythm      | 2.50       | 4.57       | 4.23       | 2.5x10 <sup>-6</sup> | 0.0002           |
|                 | -Balance     | 2.71       | 4.30       | 4.14       | 0.0008               | 0.003            |
|                 | -Transitions | 2.57       | 4.04       | 3.82       | 0.002                | 0.006            |
| Ext. canter     | -Rhythm      | 2.71       | 4.52       | 3.82       | 2.7x10 <sup>-5</sup> | 0.01             |
|                 | -Balance     | 2.79       | 4.09       | 3.91       | 0.007                | 0.02             |
|                 | -Transitions | 2.64       | 3.87       | 3.64       | 0.007                | 0.02             |
| Jumping ability |              | 3.54       | 4.13       | 4.32       | 0.22                 | 0.08             |

Scale from 1 (poor) to 6 (perfect)

*\*P < 0.05 = statistical significant difference between the groups*

# RESULTS FINNHORSES – RIDING TRAITS

- The AA horses got significantly lower scores for canter and trot than CA and CC horses
- CA horses also had a better walk than AA horses
- No significant difference between CA and CC horses, except for rhythm in extended canter (P=0.05)



# FINNHORSES RIDING TRAITS



| TRAIT      |              | AA (n= 13) | CA (n= 22) | CC (n= 22) | P<br>(AA vs CA)      | P<br>(AA vs CC)      |
|------------|--------------|------------|------------|------------|----------------------|----------------------|
| Coll. trot | -Rhythm      | 2.38       | 4.34       | 4.41       | 1.2x10 <sup>-5</sup> | 2.6x10 <sup>-6</sup> |
|            | -Balance     | 2.38       | 4.43       | 4.55       | 9.2x10 <sup>-7</sup> | 2.8x10 <sup>-7</sup> |
|            | -Transitions | 2.38       | 4.30       | 4.45       | 2.4x10 <sup>-6</sup> | 1.7x10 <sup>-7</sup> |
| Ext. trot  | -Rhythm      | 2.85       | 4.09       | 3.68       | 0.003                | 0.05                 |
|            | -Balance     | 2.85       | 3.95       | 3.73       | 0.02                 | 0.05                 |
|            | -Transitions | 2.77       | 3.95       | 3.64       | 0.01                 | 0.06                 |
| Walk       | -Rhythm      | 4.00       | 4.91       | 4.50       | 0.02                 | 0.14                 |
|            | -Balance     | 4.08       | 4.95       | 4.68       | 0.01                 | 0.12                 |
|            | -Transitions | 3.85       | 4.77       | 4.55       | 0.01                 | 0.08                 |

Scale from 1 (poor) to 6 (perfect)

*\*P < 0.05 = statistical significant difference between the groups*



# FINNHORSES RIDING TRAITS

| Question                       |     | AA (n)  | CA (n)  | CC (n)  | P      |
|--------------------------------|-----|---------|---------|---------|--------|
| Competed in harness racing (%) | Yes | 21 (3)  | 41 (9)  | 23 (5)  | 0.39   |
|                                | No  | 79 (11) | 59 (13) | 77 (17) |        |
| Competed in dressage (%)       | Yes | 31 (4)  | 78 (18) | 24 (5)  | 0.0006 |
|                                | No  | 69 (9)  | 22 (5)  | 76 (16) |        |
| Ever shown tölt (%)            | Yes | 38 (5)  | 4 (1)   | 5 (1)   | 0.006  |
|                                | No  | 62 (8)  | 96 (22) | 95 (21) |        |
| Ever shown pace (%)            | Yes | 46 (6)  | 22 (5)  | 18 (4)  | 0.21   |
|                                | No  | 54 (7)  | 78 (18) | 82 (18) |        |



*\*P < 0.05 = statistical significant difference between the groups*

# STANDARDBREDS RIDING TRAITS

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| Question                       |     | AA (n)  | CA (n)   | P     |
|--------------------------------|-----|---------|----------|-------|
| Competed in harness racing (%) | Yes | 76 (79) | 45 (5)   | 0.07  |
|                                | No  | 24 (25) | 55 (6)   |       |
| Competed in dressage (%)       | Yes | 30 (30) | 55 (6)   | 0.17  |
|                                | No  | 70 (71) | 45 (5)   |       |
| Ever shown tölt (%)            | Yes | 26 (27) | 0 (0)    | 0.06  |
|                                | No  | 74 (75) | 100 (11) |       |
| Ever shown pace (%)            | Yes | 43 (43) | 0 (0)    | 0.006 |
|                                | No  | 57 (56) | 100 (11) |       |

*\*P < 0.05 = statistical significant difference between the groups*

# COLDBLOOD TROTTERS RIDING TRAITS

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- No differences in gait scores between genotypes in Coldbloods used for riding
- The ability to perform tölt and pace was strongly associated with genotype in *DMRT3*
- No difference for the questions about competitions



# EFFECT OF *DMRT3* ON RIDING TRAITS - STANDARD BREDS

| TRAIT          |              | AA (n=96-104) | CA (n=11) | P    |
|----------------|--------------|---------------|-----------|------|
| Collected trot | -Rhythm      | 4.58          | 5.00      | 0.24 |
|                | -Balance     | 4.42          | 4.91      | 0.16 |
|                | -Transitions | 4.19          | 4.91      | 0.06 |
| Extended trot  | -Rhythm      | 4.55          | 4.27      | 0.47 |
|                | -Balance     | 4.50          | 4.45      | 0.90 |
|                | -Transitions | 4.18          | 4.00      | 0.65 |
| Walk           | -Rhythm      | 5.10          | 5.00      | 0.85 |
|                | -Balance     | 5.00          | 5.27      | 0.45 |
|                | -Transitions | 4.88          | 5.10      | 0.40 |

Scale from 1 (poor) to 6 (perfect)

*\*P < 0.05 = statistical significant difference between the groups*