Introduction

- Warmbloods used extensively
  - Sport & pleasure riding
  - Strong need for good conformation & healthy constitution
- Warmblood population large & genetically diverse
  - Low risks of inbreeding if matings well planned
- Exchange of genetic material increasing within Europe

Introduction cont...

- Little known about how European countries manage inherited disorders in breeding plans
- Such information would allow spread of knowledge
  - Improve health & welfare of horses
  - Strengthen trading ties between countries

Aims

1. Review 11 skeletal disorders with known/suspected heritabilities
2. Determine strategies employed by European countries/breeding associations to manage inherited disorders in warmblood sport horse breeds

Review - Genetic Disorders

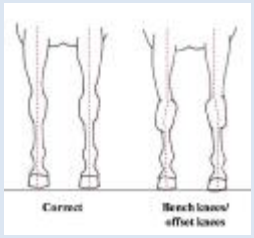
- Genetic disorders
  - Defects in structure/function caused by negative mutation (Trommershausen-Smith, 1980)
  - Can be purely genetic (single/many genes) or combination of genes & environment
    - Congenital or developmental
- Horse breeding
  - Advantages: well-kept studbooks, many progeny & new molecular techniques
  - Disadvantages: long gestation, single births, changes in ownership & delayed/no symptoms

Review - Skeletal Disorders

- Abnormal bone & cartilage growths
  - Musculoskeletal problems localised in lower limb
    - culling of Swedish warmbloods (Wallin *et al.*, 2000)
    - loss of training in Hanoverians (Stock & Distl, 2005)
  - Great variation in how disorders are defined, diagnosed & graded
    - standardisation desired
- Many skeletal/conformational deviations not lethal but predispose to injuries
  - Varies between breeds & sport types
  - Treatment/correction

Review – Bench knees

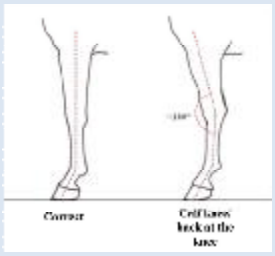
- Genetic implications
  - ↑ weight on medial splint bone & interosseous ligaments
  - Associated with racing injuries in TB horses
  - Every 10% ↑ in offset ratio = ↑ risk of swelling & problems in front fetlock (McIlwraith *et al.*, 2003; Anderson *et al.*, 2004)
  - Prevalence of 60% in SW horses (Holmström *et al.*, 1990)
  - h^2 not yet estimated



Axial deviation of carpal bones laterally

Review – Calf knees

- Genetic implications
  - Conformation of young TB changes as they mature from back at the knee to slightly over at the knee
  - Strains carpal bone ligaments & ↑ compression on dorsal surface of carpus
  - Highly undesirable in racing & associated with ↑risk in carpal chip fractures & carpitis (Marks, 2000; Stashak, 2002; Dolvik & Klemetsdal, 1994)
  - High h^2 estimated in Norwegian cold-blooded trotters (0.42) (Dolvik & Klemetsdal, 1999)



Backward deviation of the carpal bones

Review – Weak pasterns

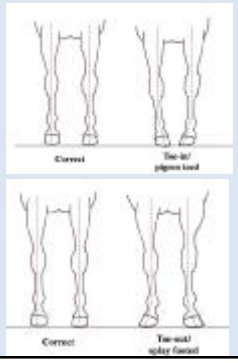
- Genetic implications
  - Predispose to injuries of suspensory ligaments, sesamoid bones & superficial flexor tendons
  - Potential causes of carpal chip fractures
  - Long pasterns ↑odds of forelimb fractures (McIlwraith *et al.*, 2003)
  - Prevalence of sloping pasterns 35.2% in Norwegian cold-blooded trotters & low h^2 of 0.09 (Dlovik & Klemetsdal, 1999)

Correct

Long sloping pastern

Review – Toe-in/Toe-out

- Genetic implications
  - Neonatal foals usually toed out but as mature, inward rotation
  - Predispose to ringbone & sidebone
  - Toe out horses "wing" (swing hooves in arc) inwards
  - Mild-moderate toe in found in 50% elite SW horses (Holmström *et al.*, 1990)
  - Toe out: more prevalent in Norwegian cold-blooded trotters (44% fore & 68% hind) & h^2 between 0.04 – 0.11 (Dolvik & Klemetsdal, 1999)



Materials & Methods

November 2008 – online survey sent to 37 breeding organisations in 29 European countries

- Collection & recording of disorders in stallions, young horses, mares & foals
  - When & where?
  - By whom?
  - Summarizing & evaluating records
  - Monitoring of fertility in stallions
- Management of 29 disorders in breeding stallions
  - Disorder screened for?
  - Consideration in breeding?
    1. Not considered at all
    2. Only when severe
    3. Can be compensated with good performance
    4. Stallion excluded from breeding

Results & Discussion

Country	Association
Belgium	Belgian Warmblood
Denmark	Danish Warmblood
Finland	Finnish Warmblood
France	Les Haras Nationaux
Ireland	Irish Sport Horse
Norway	Norwegian Warmblood
Poland	Polish Horse Breeders
Scotland	Scottish Sports Horse
Slovenia	University of Ljubljana, Veterinary Faculty
Sweden	Swedish Warmblood
Switzerland	Swiss Sporthorse Breeding

- Replies from 11 countries
  - 38% reply rate
- Breeding associations play major roles (stallions & young horses)
  - formulating restrictions
  - record keeping
  - summary & evaluation of records

Stallions & young horses

Country	Stallions Recorded	Young horses Recorded
BLG	Y	N
DK	Y	Y (V)
FIN	Y	Y
FR	Y (V)	N (V)
IRE	Y	N
NOR	Y	N
POL	N	N
SCOT	Y (V)	Y (V)
SLO	N	N
SE	Y (V)	Y (V)
SWI	Y	Y

- Stallions
  - Recordings usually occur at compulsory stallion events
- Young horses
  - Recordings usually occur at young horse events or prior to sale
- Few countries record disorders during private veterinary visits

Foals & mares

Country	Foals Recorded	Mares Restrictions
BLG	N	Y*
DK	Y	N
FIN	N	N
FR	N	N
IRE	N	N
NOR	N	N
POL	N	Y
SCOT	Y	Y
SLO	Y	Y
SE	Y	N
SWI	N	Y

- Owner/breeder usually responsible for reporting disorders of foals
- Missing information from foals not attending YH events
  - Involve vets in collecting records
- Recording of disorders in mares more difficult
  - Higher numbers & dispersed
  - Selection on mares & stallions may be required for disorders with high h^2

Stallion fertility

Country	Stallion fertility Monitored
BLG	N
DK	Y
FIN	Y
FR	N
IRE	N
NOR	Y
POL	N
SCOT	Y
SLO	Y
SE	Y
SWI	N

- Denmark & Norway: semen test
  - Motile & healthy sperm
- Finland, Norway, Sweden: statistics
  - Foaling & pregnancy rate
  - Rates <40-50% considered low
- Important which method used
  - Statistics alone do not represent true fertility of stallion (Amman, 2004)
- Although good fertility economically important, may not be clearly represented in all breeding plans (Koenen *et al.*, 2004)

Record evaluation

- 5 countries evaluated records
  - BA & Veterinary Faculty (VF) of University
- 4 of the countries published information
  - Not specified what format information was published in
- Collection & evaluation of records
  - Use available information on disorders to assist BAs and breeders in selecting stallions
  - Option to create central database of disorders at national level

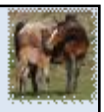
Breeding stallions

- Screening of breeding stallions
  - skeletal & joint the most (e.g. OC/OCD, bone spavin, over-/underbite & conformational deviations)
    - May reflect lameness as major problem in warmblood sport horse
  - muscular the least (e.g. Rhabdomyolysis)
    - May be group of emerging disorders
    - Polysaccharide Storage Myopathy (PSSM) correlated with cases of exertional rhabdomyolysis
    - PSSM found in 50% of muscle biopsies from warmblood horses with neuromuscular symptoms (McCue *et al.*, 2006)
    - h^2 of exertional rhabdomyolysis estimated at 0.4 (Oki *et al.*, 2005) in TB horses with an autosomal dominant inheritance suggested (Dranchak *et al.*, 2005)

Breeding stallions

- Consideration in breeding stallions
  - Great variation between countries to what level disorders were considered
  - Degenerative joint, reproductive & respiratory disorders mostly resulted in exclusion
  - Conformational deviations = all considered to the same level within countries
    - race horse studies show some deviations are more detrimental than others
    - research which conformations mostly likely lead to injury, depending on use

Summary



- Many conformational deviations not lethal but do predispose to injuries
  - Varies between breeds and sport types
  - Treatment/correction possible but ultimately should they breed?
  - Variation in how disorders are defined, diagnosed & graded
- Breeding associations play major roles in selection, management & recording
  - Vets & researchers smaller roles
- Recording of disorders
  - mostly at young horse/stallion events thus not representative of whole population

Summary cont…

- Screening in breeding stallions
  - Skeletal & joint the most
  - muscular the least
- Consideration in breeding stallions
  - Great variation between countries
  - Degenerative joint, reproductive & respiratory = exclusion
  - Conformational deviations = consensus within countries
- Fertility of stallions
  - Does not seem to be of high priority in most breeding plans

Conclusions

- Consensus desired within & between countries
  - Diagnose & grade disorders in standardised way
  - Research into relationship between conformation & performance of riding horses
- Inclusion of all interested parties in recording, collection & evaluation of disorder data
  - Obtain frequencies & heritabilities
- Information collected
  - Evaluated within breeding associations for stallion approval
  - Published, allowing breeders to more efficiently match stallions to mares

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