7th International Conference on Equine Exercise Physiology

Workshops Session

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WORKSHOPS PROGRAMME

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Tuesday 29 August afternoon

14:00 - 16:00 hours

Workload and conditioning - Chris Rogers, José Luis López Rivero, Eric van Breda, Arno Lindner and Marianne Sloet Van Oldruitenborgh-Oosterbaan

This double workshop has two parts: part I (workload and conditioning) will be held before coffee break and part II (overtraining) after coffee break.

Workload: In relation to cardiovascular response there is the concept of “TRIMPS”
This concept has been applied to compare workload of cyclists on the Spanish tour and the tour de France. Is something similar possible for relating musculoskeletal response to workload?
M/S response relates to distance (number of cycles of load), velocity (magnitude of the load) and frequency (number of workout per time). These can be combined to produce a crude index.
How / where should we provide weightings / zones of response?
Is it as simple as workload less than gallop (14 m/s) and at the gallop (>14 m/s)
We will also discuss the example of bone response to training to indicate this and stimulate discussion.
Conditioning: Scientific approaches to training can be used to select appropriate conditioning programmes (because it is not intensity only but duration and frequency of exercise), and to measure responses. However, conditioning programmes based on scientific data do not seem be widely used in the current practice of training horses. Possible explanations include the substantive controversy and difficult interpretation of published results, the failure of investigators to transfer knowledge to horse trainers and the insufficient knowledge by key players involved in equine training. We will discuss the design of exercise training programmes to promote specific physiological adaptations that could improve performance. We also will discuss whether or not scientific training methods are applied in practice, or are similar to those routinely used in practice.

Muscle energetics in exercising horses - Dominique Votion

An optimally functional musculoskeletal system is crucial for athletic performance and even minor perturbations can limit athletic ability. Muscle histochemistry and biochemistry have allowed characterization of the properties of equine muscle fibres and demonstration of their adaptive plasticity. Cellular energetics has the potential to determine athletic suitability for specific disciplines, muscle adaptations to training, mechanisms of fatigue, and muscle response to diet. Information gained from study of cellular energetics and its potential applications for the assessment of athletic performance will be discussed.
16:30 - 18:30 hours

**Overtraining - Chris Rogers, José Luis López Rivero, Eric van Breda, Arno Lindner and Marianne Sloet Van Oldruitenborgh-Oosterbaan**

Horses in top-training are often balancing on the edge between the right amount of training and too much training. A decrease in performance is often considered to be related to a too low training load. As a consequence, training volume and/or intensity is increased further, resulting in a downward spiral that may eventually end in overtraining. Overtraining is a general term and includes different entities. Based on the pathogenesis and affected organ systems, three types of overtraining can be distinguished: 1) mechanical overtraining, 2) metabolic overtraining or overreaching, and 3) overtraining syndrome or staleness.

Because transition from adequate training to overtraining is gradual, it is difficult to diagnose overtraining in its early stage. Especially parameters that indicate early signs of over-reaching are needed. We will discuss the (patho)physiological adaptation or mal-adaptation due to physical training. We will compare differences and similarities between human and equine adaptive processes and we will try to come to a mutual agreement on terminology regarding overreaching and overtraining.

**New methods of exercise parameters & measurements - Michael Lindinger**

In human and animal clinical practice, multi-frequency bioelectrical impedance analysis (MF-BIA) is increasingly being used as a diagnostic tool to rapidly and non-invasively assess whole body, intracellular and extracellular hydration. The aims of the workshop are to provide a brief summary of research, advantages and disadvantages of BIA methodologies; to discuss and summarize the MF-BIA approach used, including electrode placement and choice of electrical frequencies; and to provide a hands-on demonstration using available horses.

**Rehabilitation and functional biomechanics - Catherine McGowan**

The workshop will involve moderated discussion of rehabilitation and functional biomechanics research in the performance horse. Discussions will include: current focus and methodology from major research groups; outlining planned and on-going projects to avoid un-necessary duplication and development of collaborations; and prioritising a core of projects for completion to move the discipline forward.

13:30 - 18:30 hours

**Visit of laboratories in Genopole Evry: Genomic and molecular biology - Eric Barrey**

Genopole Evry is the largest concentration of laboratories and industries devoted to molecular biology for medical application in France. One of the research topic is the genetic muscular diseases. We propose to visit several laboratories specialised in molecular biology: genome expression, genome sequencing, genotyping, proteomic. During the visit it will be possible to discuss with the specialists about the new methods used in molecular biology.
The quantification of workload in the racehorse

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Musculoskeletal tissue responds to training stimulus. The difficulty has always been how to quantify the training stimulus and this has limited comparison of workload and tissue response between studies. The recent advances in micro technology now permit the rapid quantification of workload with the use of GPS and heart rate monitors. This technology can provide information about instantaneous peak velocities rather than average times and derived velocities over a workout or sections of a workout such as furlong(s).

Comparison between experimental trials and training programmes is difficult because of differences in description of the gait between countries (breeze vs gallop) and in methodology in describing the workload. Multiplication of the distance and velocity worked provides a cumulative workload index (CWI) that permits comparison between horses, studies and training programmes. Five published studies examining training in 2 year old thoroughbreds ranged in duration from 13 to 72 weeks and had CWI's 884,000 - 12,427,000. The mean weekly workload (CWI/week) was 63,000 - 172,000.

Examination of the workload below and above a threshold of 12 m/s identified that for 4 of the studies 25± 5% of the CWI was above 12 m/s. For one of the studies none of the horses exceeded 12 m/s in the workouts. In comparison, data of commercial 2 year racehorses in work indicated that only of 4± 3% of CWI was at velocities above 12 m/s.

The aim of this workshop is to encourage a standardised method to accurately quantify workload and apply this to the future investigation of musculoskeletal response to training.
Conditioning of horses in practice

DL EVANS, A LINDNER**, H MIYATA, JLL RIVERO*, E VAN BREDA
*Laboratory of Muscle Biopathology, Department of Comparative and Pathological Anatomy, Faculty of Veterinary Sciences, Córdoba, Spain; **Arbetisgruppe Pferd, Essen

Scientific approaches to training can be used to select appropriate training intensities, and to measure responses to training. However, conditioning programmes based on scientific data do not seem be widely used in the current practice of training horses. Possible explanations include: 1) the substantive controversy and difficult interpretation of published results, 2) failure of investigators to transfer knowledge to horse trainers and 3) the insufficient knowledge by key players involved in equine training.

We propose this seminar for discussion of the design of exercise training programs to promote specific physiological adaptations that could improve performance. The workshop will also discuss whether or not scientific training methods are applied in practice, or are similar to those routinely used in practice. These objectives will be achieved by comparing well-defined exercise programs used in practice with exercise training programs that have been scientifically evaluated. References to type, intensity, duration, frequency and volume of training exercise would be included. Discussion would be limited to metabolism and muscle adaptations to training because there have been a large number of studies published in these areas that have both the detailed descriptions of the training methods, and the relevant adaptations to training.

Topics and contributors: 1) Overview (JLL Rivero, Spain, moderator), 2) Muscle conditioning of racehorses (H Miyata, Japan), 3) Training racehorses in practice (DL Evans, Australia), 4) Muscle conditioning of endurance and sport horses (JLL Rivero), 5) Training endurance and sport horses in practice (E van Breda, The Netherlands) and 6) Energy metabolism conditioning of racehorses and sport horses (A Lindner, Germany).
Myopathies associated with limitations to performance

VOTION D.M.1, DR ART AND DR VAN ERCK 1, DR VALBERG 2, DR ESSEN-GUSTAVSSON 3, DR HINCHCLIFF 4, DR RIVERO 5, DR SLUSE AND DR NAVET 6
1 Equine Pole, Faculty of Veterinary Medicine, University of Liège, 2 Neuromuscular Diagnostic Laboratory, University of Minnesota, USA, 3 Department of Large Animal Sciences, Swedish University of Agricultural Sciences, Sweden, 4 Department of Veterinary Clinical Sciences, The Ohio State University, 5 Muscle Biology Laboratory, University of Cordoba, Spain, 6 Laboratory of Bioenergetics, University of Liege, Belgium

In sound horses, an optimally functional musculoskeletal system is crucial for athletic performance and even minor perturbations may limit athletic ability. There appear to be numerous causes for muscle dysfunction in horses ranging from sporadic muscle strain to chronic causes of exertional rhabdomyolysis (ER) due to inborn errors of metabolism. There is therefore a growing need for new methodologies to evaluate muscle dysfunction in horses. Conventionally, serum indicators of muscle cell disruption have been used to diagnose myopathies, however, they can not distinguish underlying metabolic abnormalities and/or mechanisms or ER. Interpretation of such blood variables appears more an art than a science for predicting athletic performance. Advanced functional (calcium imaging, muscle contracture tests), metabolic (assessment of metabolic pathways and of energy sources) and morphological (electron microscopy, photometric image analysis) evaluation of skeletal muscle as well as molecular tools (genomics and proteomics) offer new prospects for understanding equine myopathies. Furthermore, these research tools might potentially be used in sports medicine to determine athletic suitability for specific disciplines (e.g. by determining the specific aerobic and anaerobic capacities), muscle adaptations to training, mechanisms of fatigue, and muscle response to dietary interventions. The objectives of this workshop will be to discuss the application of these advanced research tools for the assessment of both pathological (myopathies) and physiological (athletic performance) conditions. From the previous discussion, a brainstorming session will be proposed around the subject of atypical myopathy, a poorly understood pasture myopathy that is currently devastating horses in Europe and in the Midwestern USA.
The overtraining syndrome: 'a bee’s sting'

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Maastricht University, Department Movement Sciences

We propose a workshop on overtraining in sport horses with the objective to exchange scientific and practical knowledge on overtraining from human and equine science.

The primary goal of equine training is to enhance performance. To push performance to its upper limit high amounts of intensive exercise are assumed to be necessary. Consequently, horses are often balancing on the edge between the right amount of training and too much training. A decrease in performance is often considered to be related to a too low training load. As a consequence, training volume and/or intensity is increased further, resulting in a downward spiral that may eventually ends in overtraining. Overtraining is a general term and includes different entities. Based on the pathogenesis and affected organ systems, three types of overtraining can be distinguished: 1) mechanical overtraining, 2) metabolic overtraining or overreaching, and 3) overtraining syndrome or staleness.

Because transition from adequate training to overtraining is gradual, it is difficult to diagnose overtraining in its early stage. Especially parameters that indicate early signs of over-reaching would be preferred.

The treatment of equine overtraining depends on the type of overtraining. Emphasis should be laid on rest, recovery, and diet. Overreaching is reversible within days whereas systemic overtraining requires several month for recovery.

The main outcomes of this workshop are to come to a general scientific and practical agreement on definition, diagnosis and treatment of equine overtraining.

We propose as moderator: M. Sloet van Oldruitenborgh-Oosterbaan, the Netherlands and as invited participants:

1. Scientific status of overtraining, Eric van Breda, the Netherlands
2. Overtraining in sport horses (David L. Evans, Australia)
3. Overtraining in humans (Axel Urhausen, Germany)
4. What can we learn from human overtraining (Eric van Breda, the Netherlands)
The use of multi-frequency bioelectrical impedance analysis to assess hydration status in horses

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In human and animal clinical practice, multi-frequency bioelectrical impedance analysis (MF-BIA) is increasingly being used as a diagnostic tool to rapidly and non-invasively assess whole body, intracellular and extracellular hydration. However, accurate determination of changes in hydration status within individuals over time, using BIA, has remained problematic due to the requirement for complete impedance-frequency relationships at the time points of interest. This major limitation has been the focus of targeted research with horses performing both endurance and high-intensity exercise. This research has resulted in improved predictability to track changes in hydration in horses over time.

The purposes of the workshop are the following: (1) to provide a brief summary of research, advantages and disadvantages of BIA methodologies; (2) to discuss and summarize the MF-BIA approach used, including electrode placement and choice of electrical frequencies; and (3) to provide a hands-on demonstration using available horses. The objectives and proposed outcomes are the following: (1) to provide participants with a basic understanding of how MF-BIA can be used in both research and clinical settings; (2) to provide a forum for open discussion of the advantages and limitations of MF-BIA in research and clinical settings; and (3) to provide the opportunity for participants to try out MF-BIA equipment.

Moderators: Mike Lindinger, Amanda Waller, Sakkie Meeuwsen

Participants: selected workshop attendees.
Functional biomechanics and equine rehabilitation research

MCGOWAN CM, STUBBS NC, GOFF LM, JEFFCOTT LB*

The University of Queensland and *The University of Sydney, Australia

Rehabilitation is a non-specific term to describe both return to normal function or maximising the potential of existing function. Neuromotor and musculoskeletal rehabilitation is an essential component of equine exercise physiology and biomechanics. Rehabilitation research applies functional biomechanics and neuromotor control to better understand the normal and dysfunctional animal and is ideally suited for application to the performance horse. Relatively recently, research collaborations have been developed with researchers in the areas of physiotherapy and manual therapy with equine scientists.

The aim of this workshop is to discuss rehabilitation in the performance horse and to share information amongst research groups regarding the best methodology and models to further rehabilitation research.

Specific aspects of rehabilitation addressed will include:

a) Poor performance, wastage and need for rehabilitation research – LB Jeffcott
b) Physiotherapy techniques in maximising performance focusing on proprioceptive training and core stability exercises – Narelle Stubbs
c) Physiotherapy techniques in maximising performance focusing on the horse-rider unit – Lesley Goff

Methodology and models discussed. Proposed invited participants will include current research groups depending on availability:

a) Alan Wilson – The Royal Veterinary College biomechanics and lameness
b) Catherine McGowan – The University of Queensland Physiotherapy models
c) Hilary Clayton – Michigan State University
d) Theresa Licka University of Vienna Functional biomechanics

The format of the workshop will be a short presentation by each of the contributors in each section followed by a moderated general discussion. Methodology will be chaired by Dr Hilary Clayton and Rehabilitation by Dr Catherine McGowan.

Outcomes of the workshop will include a dissemination of knowledge of current methodology and models for research and application and brainstorming amongst groups with a similar research focus.